CONCEIVE DESIGN IMPLEMENT OPERATE (CDIO)

CURRICULUM AND DETAILED SYLLABI

FOR

B.E DEGREE (Computer Science and Engineering) PROGRAMME

FOR THE STUDENTS ADMITTED FROM THE

ACADEMIC YEAR 2018 - 2019

THIAGARAJAR COLLEGE OF ENGINEERING

(A Government Aided ISO 9001-2008 certified

Autonomous Institution affiliated to Anna University)

MADURAI – 625 015, TAMILNADU

Phone: 0452 – 2482240, 41

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Department of Computer Science and Engineering

Vision

Excellence in Computer Science and Engineering education and research.

Mission

1. Strive for academic excellence in Computer Science and Engineering through a creative teaching learning process.

2. Transform students into technically competent, socially responsible and ethical Computer Science professionals.

3. Create Centres of Excellence in leading areas of Computer Science and Engineering.

4. Incubate, apply and spread innovative ideas by collaborating with relevant industries and R&D labs through focused research groups.

5. Attain these through continuous team work by a group of committed faculty, transforming the Computer Science and Engineering department as a leader in imparting Computer Science and Engineering education and research.

Program Educational Objectives (PEOs) for B.E. (CSE) Programme

PEO1: Graduates will be able to perform in technical/managerial roles ranging from design, development, problem solving to production support in software industries and R&D sectors.

PEO2: Graduates will be able to successfully pursue higher education in reputed institutions.

PEO3: Graduates will have the ability to adapt, contribute and innovate new technologies and systems in the key domains of Computer Science and Engineering.

PEO4: Graduates will be ethically and socially responsible solution providers and entrepreneurs in Computer Science and other engineering disciplines.

Program Outcomes (POs) for B.E. (CSE) Programme

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a

member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs) for B.E.(CSE) Programme

PSO1: (Cognitive Outcome)

Ability to solve complex Knowledge Engineering problems by building systems across domains including Systems Engineering, Software Development & Engineering, Networks & Security, Data Mining and Artificial Intelligence.

PSO2: (Skill Outcome)

Ability to apply technical and research based skills learnt through professional society events, certification programs, projects and lab exercises to provide sustainable solutions to Computer Science and Engineering problems related to the society and environment.

PSO3: (Attitudinal and Behavioral Outcome)

Ability to practice as an ethical Software Engineer and/or Researcher in the evolving disciplines of Computer Science and Engineering and its allied application domains by employing soft and project management skills learnt through internships, project work and/or collaborative projects with industry.

Specialization of B.E Computer Science and Engineering Programme:

1. Theoretical Computer Science
2. Systems Engineering
3. Software Development and Engineering
4. Networks and Security
5. Data Mining
6. Artificial Intelligence

Thiagarajar College of Engineering, Madurai - 625015
Credit Distribution for B.E (CSE) Programme – 2018 – 2019 Batch

S.No	Category of Courses	Credits
A	**Foundation Courses**	**52 - 57**
	Humanities and Social Sciences (HSS)	09 -11
	Basic Sciences (BS)	21
	Engineering Sciences (ES)	22 - 25
B	**Professional Core Courses**	**55**
C	**Elective Courses**	**24 - 48**
	Program Specific Electives	12 – 24
	Program Specific Electives for Expanded Scope	6 - 12
	General Elective	3 - 6
	Foundation Elective	3 - 6
D	**Project work, Seminar, Internship** in Industry or at Higher Learning Institutions	**15**
E	Mandatory Courses – Environment Science, Induction Programme, Indian Constitution, Essence of Indian Tradition knowledge, Consumer Affairs (as per UGC guidelines)	Non Credit (Not included for CGPA)
	Total Credits	**146 - 175**
	Minimum credits to be earned for the award of the Degree	**160 (from A to D) and the successful completion of Mandatory Courses**

- General Electives are courses offered by different departments that do not have any prerequisites and could be of interest to students of any branch
- All students have to undertake co-curricular and extra-curricular activities that include activities related to NCC, NSS, Sports, Professional Societies, participation in identified activities which promote the growth of Departments and the College

Thiagarajar College of Engineering, Madurai-625015
Department of Computer science and Engineering
Scheduling of Courses – for those join in the year 2018 – 2019

Semester	Theory					Theory cum Practical	Practical			Mandatory Audit Course	Credits
	1	2	3	4	5	6	7	8	9	10	
I	18MA110 Engineering Calculus (4)	18PHC20 Physics (3)	18CHC30 Chemistry (3)	18EG140 English (2)	18ES150 Engineering Exploration (3)	18ME160 Engineering Graphics (4) -	18EG170 English Laboratory (1)	18PH180 Physics Laboratory (1)	18CH190 Chemistry Laboratory (1)		22
II	18MA210 Matrices and Ordinary Differential Equations (3)	18CS220 Problem Solving using Computers (3)	18CS230 Digital Circuits (3)	18CS240 Computer Organization and Architecture (3)	-	18CS260 Computer Programming (3)	18CS270 Digital Circuits Lab (1)	18CS280 Workshop (1)	18ES290 Lateral Thinking (1)	18CHAA0 Environmental Science	18
III	18CS310 Probability and Statistics (3)	18CS320 Principles of Programming Paradigms (3)	18CS330 Object Oriented Programming (3)	18CS340 Data Structures and Algorithms (3)	-	18CS360 Assembly Language Programming (3)	18CS370 Data Structures Lab (1)	18CS380 Object Oriented Programming Lab (1)	18ES390 Design Thinking (2)	-	19
IV	18CS410 Discrete Mathematics (3)	18CS420 Design and Analysis of Algorithms (3)	18CS430 System Software and Operating Systems (3)	18CS440 Database Management Systems (3)	18YYFX0 Foundation Elective (3)	18EG460 Professional Communication (2)	18CS470 System Software and Operating Systems Lab (1)	18CS480 Algorithms Lab (1)	19CS490 Project Management (3)	18CHAB0 Constitution of India	22
V	18CS510 Numerical Methods (3)	18CS520 Theory of Computation (3)	18CS530 Data Communication and Networks (3)	*18CSPX0 Program Elective (3)*	18YYGX0 General Elective (3)	18CS560 Software Engineering : Theory and Practice (3)	18CS570 Databases Lab (1)	18CS580 Network Programming Lab (1)	18ES590 System Thinking (2)	18CHAC0 Essence of Indian Knowledge	22
VI	18CS610 Compilers (3)	18CS620 Web Programming (3)	18CS630 Artificial Intelligence (3)	*18CSPX0 Program Elective (3)*	Foundation Elective / Program Elective (3)	18YYEX0 Engineering Science Elective (3)	18CS670 Web Programming Lab (1)	18CS680 Artificial Intelligence Lab (1)	18ES690 Engineering Design Project (3)		23
VII	18CS710 Accounting and Finance (3)	*18CSPX0 Program Elective (3)*	*18CSPX0 Program Elective (3)*	*18CSPX0 Program Elective (3)*	*General Elective / Program Elective (3)*	-	18CS770 Engineering Tools Lab (1)	-	18ES790 Capstone Design Project (3)		19
VIII	18CS810 Project (9)	*18CSPX0 Program Elective (3)*	*18CSPX0 Program Elective (3)*								15
										TOTAL	160

BS | HSS | ES | Core | PE | Open Electives | Project | Audit Courses

THIAGARAJAR COLLEGE OF ENGINEERING, MADURAI- 625 015
(A Govt. Aided, ISO 9001:2008 certified Autonomous Institution affiliated to Anna University)
Department of Computer Science and Engineering
Categorization of Courses

List of Humanities and Social Science Courses (9-11)

Theory:
1. 18EG140 - English (2)
2. 19CS490 – Project Management (3)
3. 18CS710 - Accounting and Finance (3)

Theory-cum-practical:
1. 18EG460 - Professional Communication (2)

Practical:
1. 18EG170 - English Laboratory (1)

List of Basic Science Courses (21)

Theory:
1. 18MA110 - Engineering Calculus (4)
2. 18MA210 – Matrices and Ordinary Differential Equations (3)
3. 18CS310 - Probability and Statistics (3)
4. 18CS410 - Discrete Mathematics (3)
5. 18PHC20 - Physics (3)
6. 18CHC30 - Chemistry (3)

Practical:
1. 18PH180 - Physics Laboratory (1)
2. 18CH190 - Chemistry Laboratory (1)

List of Engineering Science Courses (22-25)

Theory:
1. 18ES150 - Engineering Exploration (3)
2. 18CS220 - Problem Solving using Computers (3)
3. 18CS320 - Principles of Programming Paradigms (3)
4. 18CS510 - Numerical Methods (3)
5. 18CSEA0 – Data Science using Python (3) (Engineering Science Elective)
6. 18ES590 - System Thinking (2)

Theory-cum-Practical:
1. 18ME160 - Engineering Graphics (4)
2. 18ES390 - Design Thinking (2)

Practical:
1. 18CS280 - Workshop (1)
2. 18ES290 - Lateral Thinking (1)

List of Core Courses (55)

Theory:

1. 18CS230 - Digital Circuits (3)
2. 18CS240 - Computer Organization and Architecture (3)
3. 18CS330 - Object Oriented Programming (3)
4. 18CS340 - Data Structures and Algorithms (3)
5. 18CS420 - Design and Analysis of Algorithms (3)

6. 18CS430 - System Software and Operating Systems (3)
7. 18CS440 - Database Management Systems (3)
8. 18CS520 - Theory of Computation (3)
9. 18CS530 – Data Communication and Networks (3)
10. 18CS610 - Compilers (3)
11. 18CS620 - Web Programming (3)
12. 18CS630 - Artificial Intelligence (3)

Theory-cum-practical:

1. 18CS260 - Computer Programming (3)
2. 18CS360 - Assembly Language Programming (3)
3. 18CS560 - Software Engineering: Theory and Practice (3)

Practical:

1. 18CS270 - Digital Circuits Lab (1)
2. 18CS370 - Data Structures Lab (1)
3. 18CS380 - Object Oriented Programming Lab (1)
4. 18CS470 - System Software and Operating Systems Lab (1)
5. 18CS480 - Algorithms Lab (1)
6. 18CS570 - Databases Lab (1)
7. 18CS580 - Network Programming Lab (1)
8. 18CS670 - Web Programming Lab (1)
9. 18CS680 - Artificial Intelligence Lab (1)
10. 18CS770 - Engineering Tools Lab (1)

Project (15)

1. 18ES690 - Engineering Design Project (3)
2. 18ES790 - Capstone Design Project (3)
3. 18CS810 - Project (9)

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CONCEIVE DESIGN IMPLEMENT OPERATE (CDIO)

Degree: B.E., **Programme: Computer Science and Engineering**

A. Foundation Courses: **Credits to be earned: (52 – 57)**

a. Humanities and Social Science (09 - 11)

S.No	Course Code	Name of the Course	Number of Hours / Week			Credit	Prerequisite
			L	T	P		
THEORY							
1.	18EG140	English	2	-	-	2	Nil
2.	19CS490	Project Management	3	-	-	3	Nil
3.	18CS710	Accounting and Finance	3	-	-	3	Nil
THEORY CUM PRACTICAL							
1.	18EG460	Professional Communication	1	-	2	2	Basic English Knowledge
PRACTICAL							
1.	18EG170	English Laboratory	-	-	2	1	Nil

b. Basic Science (21)

S.No	Course Code	Name of the Course	Number of Hours / Week			Credit	Prerequisite
			L	T	P		
THEORY							
1.	18MA110	Engineering Calculus	3	1	-	4	Nil
2.	18MA210	Matrices and Ordinary Differential Equations	3	-	-	3	18MA110 Engineering Calculus
3.	18CS310	Probability and Statistics	2	1	-	3	Engineering Calculus
4.	18CS410	Discrete Mathematics	2	1	-	3	Nil
5.	18PHC20	Physics	3	-	-	3	Nil
6.	18CHC30	Chemistry	3	-	-	3	Nil
THEORY CUM PRACTICAL							
PRACTICAL							
1.	18PH180	Physics Laboratory	-	-	2	1	Nil
2.	18CH190	Chemistry Laboratory	-	-	2	1	Nil

c. Engineering Science (22 - 25)

S.No	Course Code	Name of the Course	**Number of Hours / Week**			Credit	Prerequisite
			L	T	P		
THEORY							
1.	18ES150	Engineering Exploration	3	-	-	3	Nil
2.	18CS220	Problem Solving using Computers	3	-	-	3	Nil
3.	18CS320	Principles of Programming Paradigms	2	1	-	3	Problem Solving using Computers, Computer Programming
4.	18CS510	Numerical Methods	2	1	-	3	Nil
THEORY CUM PRACTICAL							
1.	18ME160	Engineering Graphics	3	-	2	4	Nil
2.	18ES390	Design Thinking	1	-	2	2	Nil
3.	18ES590	System Thinking	1	-	2	2	Nil
4.	18CSEA0	Data Science using Python (Engineering Science Elective)	2	-	2	3	Basic knowledge on linear algebra, calculus, probability theory, statistics and Programming.
PRACTICAL							
1.	18CS280	Workshop	-	-	2	1	Nil
2.	18ES290	Lateral Thinking	-	-	2	1	Nil

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CONCEIVE DESIGN IMPLEMENT OPERATE (CDIO)

Degree: B.E **Programme: CSE**

B. Core Courses: **Credits to be earned: (55)**

S.No	Course Code	Name of the Course	Number of Hours / Week			Credit	Prerequisite
			L	T	P		
THEORY							
1.	18CS230	Digital Circuits	3	-	-	3	Nil
2.	18CS240	Computer Organization and Architecture	3	-	-	3	Nil
3.	18CS330	Object Oriented Programming	3	-	-	3	Programming fundamentals
4.	18CS340	Data Structures and Algorithms	3	-	-	3	Problem Solving methods and Programming Fundamentals
5.	18CS420	Design and Analysis of Algorithms	3	-	-	3	Problem Solving using Computers, Data Structures and Algorithms Data Structures Lab
6.	18CS430	System Software and Operating Systems	3	-	-	3	Computer Organization and Microprocessor
7.	18CS440	Database Management Systems	2	1	-	3	Data Structures and Algorithms
8.	18CS520	Theory of Computation	3	-	-	3	Nil
9.	18CS530	Data Communication and Networks	3	-	-	3	Digital Circuits
10.	18CS610	Compilers	3	-	-	3	Theory of Computation
11.	18CS620	Web programming	3	-	-	3	Nil
12.	18CS630	Artificial Intelligence	3	-	-	3	Programming ability, Knowledge of Data structures and algorithms
THEORY CUM PRACTICAL							
1.	18CS260	Computer Programming	2	-	2	3	Nil

2.	18CS360	Assembly Language Programming	2	-	2	3	Digital circuits
3.	18CS560	Software Engineering: Theory and Practice	2	-	2	3	Nil
PRACTICAL							
1.	18CS270	Digital Circuits Lab	-	-	2	1	Nil
2.	18CS370	Data Structures Lab	-	-	2	1	Computer Programming
3.	18CS380	Object oriented Programming Lab	-	-	2	1	C programming
4.	18CS470	System Software and Operating Systems Lab	-	-	2	1	Computer Organization and Microprocessor, Problem Solving using Computers
5.	18CS480	Algorithms Lab	-	-	2	1	Problem Solving using Computers, Data Structures and Algorithms, Data Structures Lab
6.	18CS570	Databases Lab	-	-	2	1	Database Management Systems
7.	18CS580	Network Programming Lab	-	-	2	1	Object oriented programming
8.	18CS670	Web Programming Lab	-	-	2	1	Web Programming fundamentals
9.	18CS680	Artificial Intelligence Lab	-	-	2	1	Nil
10	18CS770	Engineering Tools Lab	-	-	2	1	Nil

C. Elective Courses: (24 - 48)

i. Programme Specific Elective 12 - 24

S.No	Course Code	Name of the Course	Number of Hours / Week			Credit	Prerequisite
			L	T	P		
THEORY							
1.	18CSPA0	Data Warehousing and Mining	3	-	-	3	Concepts of databases.
2.	18CSPB0	Cryptography	2	1	-	3	Basics of Computer Networks
3.	18CSPC0	Kernel Programming	3	-	-	3	Basic Knowledge of Operating Systems
4.	18CSPE0	Wireless Networks	3	-	-	3	Data communication and Networks
5.	18CSPF0	Parallel Computing	3	-	-	3	Design and Analysis of Algorithms, Computer Architecture
6.	18CSPL0	Cloud Computing	3	-	-	3	Computer Programming, Object Oriented Programming
7.	18CSPM0	Internet of Things and its Applications	3	-	-	3	Data Communication and Networks, Problem Solving Using Computers
8.	18CSPP0	Robotic Process Automation	3	-	-	3	Nil
9.	18CSPU0	Edge Computing	3	-	-	3	Algorithms, Data Structure, Network Programming
10.	18CSPV0	Software Defined Networking	3	-	-	3	Data Communication and Networks
11.	18CSPY0	Natural Language Processing and Text Analytics	3	-	-	3	Basics of Python and Knowledge in Statistics and Machine Learning
12.	18CSPZ0	Software Testing	3	-	-	3	Nil
13.	18CSRA0	Interactions Design for XR	2	1	-	3	Nil
14.	18CSRB0	Cyber Penetration and Defense	3	-	-	3	Problem solving methods

15.	18CSRC0	Human Computer Interaction	3	-	-	3	Nil
THEORY CUM PRACTICAL							
PRACTICAL							

ii. **Programme Specific Elective for Expanded Scope** **09 – 12**

S.No	Course Code	Name of the Course	**Number of Hours / Week**			Credit	Prerequisite
			L	T	P		
THEORY							
1.	18CSPG0	Microservices Architecture	3	-	-	3	Nil
2.	18CSPH0	Blockchain Technology and Applications	3	-	-	3	Basics of Computer Networks
3.	18CSPJ0	5G Architecture and Protocols	3	-	-	3	Nil
4.	18CSPK0	Deep Learning	3	-	-	3	Nil
5.	18CSPN0	Storage Infrastructure Management	3	-	-	3	Fundamental knowledge on Computer Organization
6.	18CSPQ0	Applied Machine Learning	3	-	-	3	Linear Algebra and Calculus, Probability and Statistics, Programming in python
7.	18CSPR0	Service-oriented Architecture	3	-	-	3	Basics of Cloud computing systems
8.	18CSPS0	Big Data Analytics	3	-	-	3	Basics of database systems
9.	18CSPT0	Algorithmic Paradigms	3	-	-	3	Data Structures and Algorithms, Design and Analysis of Algorithms
10.	18CSPW0	Reinforcement Learning	3	-	-	3	Basic knowledge of Algorithms, Basic knowledge of Probability theory

One Credit and Two Credit Courses							
1.	18CS1A0	Heterogeneous Computing	1	-	-	1	C Programming
2.	18CS1B0	Cyber Security	1	-	-	1	Nil
3.	18CS1C0	Containerization Technologies	1	-	-	1	Nil
4.	18CS1D0	Cloud Object Storage	1	-	-	1	Nil
5.	18CS1E0	Data Analytics for Industrial Application	1	-	-	1	Nil
6.	18CS1F0	Practical Approach to Datawarehousing using Informatica	1	-	-	1	Basic knowledge on SQL and data base concepts
7.	18CS1G0	Basics of Web Application Security	1	-	-	1	Basics of Computer Networks
8.	18CS1H0	Healthcare Automation using Machine Learning	1	-	-	1	Basic concepts in machine learning
9.	18CS1J0	Edge Analytics	1	-	-	1	Knowledge on Networking and Data Science
10.	18CS1K0	Agile Product Development for Enterprises	1	-	-	1	Basic knowledge in Software Engineering Practice
11.	18CS1L0	Data Visualization using Tableau	1	-	-	1	Basic knowledge on Database concepts.
PRACTICAL							

iii. **General Electives (Courses Offered by CSE Department) 03 – 06**

S.No	Course Code	Name of the Course	**Number of Hours / Week**			Credit	Prerequisite
			L	T	P		
THEORY							
1.	18CSGA0	Object oriented Software Development	3	-	-	3	Basic of structured programming like C language
2.	18CSGB0	Programming using Python	3	-	-	3	Nil
3.	18CSGC0	Data Analytics using Python	3	-	-	3	Basic knowledge on linear algebra, calculus, probability theory, statistics and programming

4.	18CSGD0	Machine Learning using R	3	-	-	3	Nil
5.	18CSGE0	Applications of Virtual Reality	3	-	-	3	Nil
6.	18CSGF0	Deep Learning using Python	3	-	-	3	Basic knowledge on Programming, Statistics, Calculus, Linear Algebra, Probability
THEORY CUM PRACTICAL							
PRACTICAL							

iv. **Elective Foundation Courses: (HSS, BS or ES) 03 – 06**

S.No	Course Code	Name of the Course	**Number of Hours / Week**			Credit	Prerequisite
			L	T	P		
THEORY							
THEORY CUM PRACTICAL							
PRACTICAL							

D. Project, Seminar, Internship in Industry or at a Higher Learning Institutions (15)

S.No	Course Code	Name of the Course	**Number of Hours / Week**			Credit	Prerequisite
			L	T	P		
THEORY							
THEORY CUM PRACTICAL							
PRACTICAL							
1.	18ES690	Engineering Design Project	1	0	4	3	Nil
2.	18ES790	Capstone Design Project	0	0	6	3	Nil
3.	18CS810	Project	0	0	18	9	Nil

E. Mandatory Courses – Non Credit (Not included for CGPA)

S.No	Course Code	Name of the Course	**Number of Hours / Week**			Credit	Prerequisite
			L	T	P		
THEORY							
1.	18CHAA0	Environmental Science	1	-	1	-	Nil
2.	18CHAB0	Constitution of India	2	-	-	-	Nil
3.	18CHAC0	Essence of Indian Knowledge	2	-	-	-	Nil

THEORY CUM PRACTICAL							
PRACTICAL							

Total Credits – 160 (from A to D) and the Successful Completion of Mandatory Courses

CURRICULUM AND DETAILED SYLLABI

FOR

B.E. / B.Tech. DEGREE PROGRAMME

FIRST SEMESTER

FOR THE STUDENTS ADMITTED IN THE

ACADEMIC YEAR 2018-19 ONWARDS

THIAGARAJAR COLLEGE OF ENGINEERING

(A Government Aided ISO 9001:2008 certified Autonomous Institution affiliated to Anna University)

MADURAI – 625 015, TAMILNADU

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THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015
B.E. / B.Tech. Degree Programmes

COURSES OF STUDY
(For the candidates admitted from 2018-19 onwards)

FIRST SEMESTER

Course Code	Name of the Course	Category	No. of Hours / Week			credits
			L	T	P	
THEORY						
18MA110	Engineering Calculus	BS	3	1	-	4
18PHA20/ 18PHB20/ 18PHC20	Physics	BS	3	-	-	3
18CHA30/ 18CHB30/ 18CHC30	Chemistry	BS	3	-	-	3
18EG140	English	HSS	2	-	-	2
18ES150	Engineering Exploration	ES	3	-	-	3
THEORY CUM PRACTICAL						
18ME160	Engineering Graphics	ES	3	-	2	4
PRACTICAL						
18EG170	English Laboratory	HSS	-	-	2	1
18PH180	Physics Laboratory	BS	-	-	2	1
18CH190	Chemistry Laboratory	BS	-	-	2	1
Total			**17**	**1**	**8**	**22**

BS : Basic Science
HSS : Humanities and Social Science
ES : Engineering Science

L : Lecture
T : Tutorial
P : Practical

Note:
1 Hour Lecture is equivalent to 1 credit
1 Hour Tutorial is equivalent to 1 credit
2 Hours Practical is equivalent to 1 credit

THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015
B.E. / B.Tech. Degree Programme

SCHEME OF EXAMINATIONS
(For the candidates admitted from 2018-19 onwards)

FIRST SEMESTER

S.No.	Course Code	Name of the Course	Duration of Terminal Exam. in Hrs.	Marks			Minimum Marks for Pass	
				Continuous Assessment *	Terminal Exam **	Max. Marks	Terminal Exam	Total
THEORY								
1	18MA110	Engineering Calculus	3	50	50	100	25	50
2	18PHA20/ 18PHB20/ 18PHC20	Physics	3	50	50	100	25	50
3	18CHA30/ 18CHB30/ 18CHC30	Chemistry	3	50	50	100	25	50
4	18EG140	English	3	50	50	100	25	50
5	18ES150	Engineering Exploration	3	50	50	100	25	50
THEORY CUM PRACTICAL								
6	18ME160	Engineering Graphics	3	50	50	100	25	50
PRACTICAL								
7	18EG170	English Laboratory	3	50	50	100	25	50
8	18PH180	Physics Laboratory						
9	18CH190	Chemistry Laboratory	3	50	50	100	25	50

* CA evaluation pattern will differ from course to course and for different tests. This will have to be declared in advance to students. The department will put a process in place to ensure that the actual test paper follow the declared pattern.

** Terminal Examination will be conducted for maximum marks of 100 and subsequently be reduced to 50 marks for the award of terminal examination marks

18MA110	ENGINEERING CALCULUS

Category	L	T	P	Credit
BS	3	1	0	4

Preamble

This course aims to convey to the student a sense of the utility of calculus and develop technical competence. This course is designed to implement the calculus through geometrically, numerically, algebraically and verbally. Students will apply the main tools for analyzing and describing the behavior of functions of single and multi variables: limits, derivatives, integrals of single and multi variables to solve complex engineering problems using analytical methods and MATLAB.

Prerequisite

NIL

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Understand the concept of functions, limits and continuity	Understand
CO2	Compute derivatives and apply in solving engineering problems	Apply
CO3	Employ partial derivatives to find maxima minima of functions of multi variables	Apply
CO4	Demonstrate and apply the techniques of integration	Apply
CO5	Apply integrals of multivariable to find areas enclosed between two curves and volume enclosed between surfaces	Apply

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	S	M								
CO2	S	S	M	M								
CO3	S	S	S	M								
CO4	S	S	S	M								
CO5	S	S	S	M								
S- Strong; M-Medium; L-Low												

Assessment Pattern

Bloom's Category	Continuous Assessment Tests			Terminal Examination
	1	2	3	
Remember	10	10	10	0
Understand	30	30	30	30
Apply	60	60	60	70
Analyse	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

Course Level Assessment Questions

Course Outcome 1(CO1)

1. Define function and limit.
2. Estimate the value of $\lim\limits_{x \to 0} \dfrac{\sin x}{\sin \pi x}$.
3. If $f(x)$ is continuous on $(-\infty, \infty)$, what can you say about its graph?

Course Outcome 2(CO2)

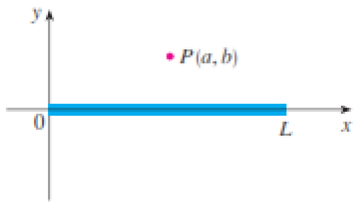
1. What is wrong with this equation $\frac{x^2+x-6}{x-2} = x+3$ and investigate why the equation $\lim\limits_{x \to 2} \dfrac{x^2+x-6}{x-2} = \lim\limits_{x \to 2}(x+3)$ is correct.
2. Between 0^oC and 30^0C , the volume V (in cubic centimeters) of 1 kg of water at a temperature T is given approximately by the formula V = 999.87 - 0.06426T + $0.0085043T^2$ - $0.0000679T^3$, Compute the temperature at which water has its maximum density.
3. The voltage, *v*, across a capacitor of capacitance*,* in series with a resistor of resistance, *v*, is given by $(t+1)e^{-1000\,t}$ where *C =1μF, E > 0,* is a constant. Determine *i* where $i = C\frac{dv}{dt}$.

Course Outcome 3(CO3)

1. Define partial derivative of a function of two variables.
2. Suppose that the temperature at a point (x, y, z) in space is given by $T(x, y, z) = \dfrac{80}{1+x^2+2y^2+3z^2}$, where T is measured in degrees Celsius and (x, y, z) in meters. In which direction does the temperature increase fastest at the point $(1,1,-2)$? Identify the maximum rate of increase.
3. Compute the dimensions of the rectangular box with largest volume if the total surface area is given as 64 cm^2 .
4. Show that the Cobb-Douglas production function $P = bL^{\alpha}K^{\beta}$ satisfies the equation $L\dfrac{\partial P}{\partial L} + K\dfrac{\partial P}{\partial K} = \alpha\dfrac{P}{L}$.

Course Outcome 4(CO4)

1. State fundamental theorem of calculus.
2. Find the volume of the solid obtained by rotating the region bounded by $y = x^3$, $y = 8$ and $x = 0$ about the y axis.
3. A charged rod of length L produces an electric field at point P(a,b) given by $E(P) = \displaystyle\int_{-a}^{L-a} \frac{\lambda b}{4\pi\varepsilon_0 (x^2+b^2)^{3/2}}\,dx$ where λ is the charge density per unit length on the rod and ε_0 is the free space permittivity (see the below figure). Evaluate the integral to determine an expression for the electric field E(P).



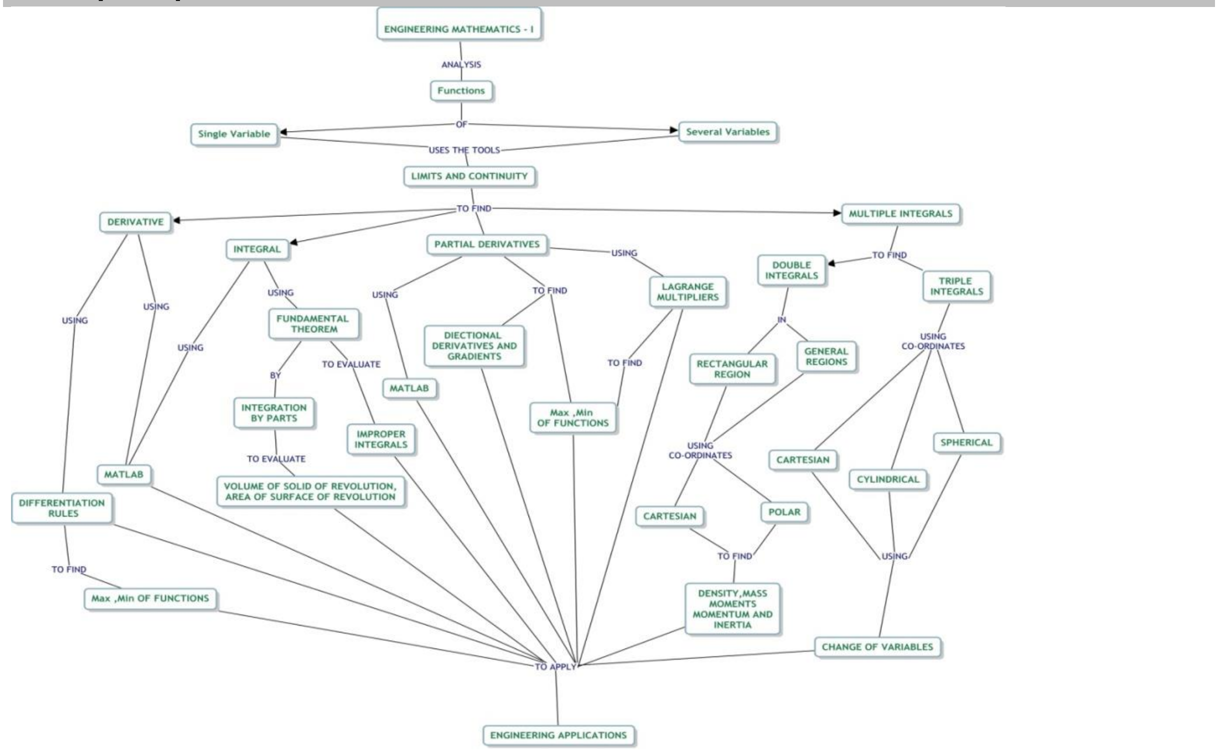
4. A cantilever beam of length *L*, fixed at one end and deflected by a distance *D* at the free end has strain energy *V* given by $V = \frac{EI}{2}\int_0^L \left(\frac{d^2y}{dx^2}\right)^2 dx$ where *EI* is the flexural rigidity. The deflection *y* at a distance *x* from the fixed end is given by $y = D\left[1-\cos\left(\frac{\pi x}{2L}\right)\right]$

   Find V .

Course Outcome 5(CO5)

1. Recall any three properties of double integrals
2. Calculate the static moments of homogeneous lamina with respect to the coordinate axes. The lamina is bounded by lines $\frac{x^2}{9}+\frac{y^2}{4}=1$, $2x+3y-6=0$.
3. Calculate the coordinates of the center of mass of homogeneous solid bounded by surfaces x=0, y = 0, z = 0, x +y = 1, $x^2 + y^2 = 1$.

Concept Map



Syllabus

DIFFERENTIAL CALCULUS **(12 hours)**

Representation of functions - New functions from old functions - Limit of a function - Continuity - Limits at infinity - Derivative as a function - Differentiation rules(formula and problems only) –The mean value theorem - Maxima and Minima of functions of one variable - Application problems in engineering – Application problems using MATLAB.

FUNCTIONS OF SEVERAL VARIABLES **(12 hours)**

Partial derivatives – Chain rule - Vector functions and their Derivatives - Directional derivatives and gradient vector - Maxima and minima of functions of two variables - Lagrange Multipliers - Application problems in engineering - Application problems using MATLAB.

INTEGRAL CALCULUS **(12 hours)**

Area under curves - The definite integrals – Fundamental theorem of calculus - Integration by parts - Volume of solid of revolution - Area of surface of revolution - Improper integrals - Application problems in engineering - Application problems using MATLAB

MULTIPLE INTEGRAL **(12 hours)**

Iterated integrals - Double integrals over general regions - Double integrals in polar coordinates - Applications of double integrals (density, mass, moments & moments of inertia problems only) - Triple integrals - Triple integrals in cylindrical coordinates - Triple integrals in spherical coordinates - Change of variables in multiple integrals - Application problems in engineering

Text Book

1) James Stewart, "Calculus Early Transcendentals", 7e, Cengage Learning, New Delhi, 2017.

DIFFERENTIAL CALCULUS:[Sections: 1.1, 1.3, 2.2,2.5,2.6,2.8, 3.1-3.6,4.1,4.2]
FUNCTIONS OF SEVERAL VARIABLES: Sections: 14.3, 14.5,13.1,13.2,14.6-14.8]
INTEGRAL CALCULUS: [Sections: 5.1-5.4,7.1, 6.2, 8.2 and 7.8]
MULTIPLE INTEGRAL: [Sections: 15.2-15.5, 15.7-15.10]

2) Lecture Notes on Engineering Mathematics-I Application Problems and Solution Manual, Department of Mathematics, Thiagarajar College of Engineering, Madurai.

Reference Books

1) Kuldeep Singh, "Engineering Mathematics Through Appplications",2e, Palgrave Macmillan, 2011.
2) Erwin Kreszig, "Advanced Engineering Mathematics",10th edition, Wiley, 2017.
3) George B. Thomas, " Thomas Calculus: early transcendentals ", Pearson, New Delhi, 2013.
4) R.K.Jain, S.R.K.Iyengar, ”Advanced Engineering Mathematics”5e, Narosa Publishing House, 2016.

Course Contents and Lecture Schedule

S.No	Topic	No. of Hours
1	**DIFFERENTIAL CALCULUS**	
1.1	Representation of functions, New functions from old functions	1
1.2	Limits of a function	1
1.3	Continuity, Limits at infinity	1
1.4	Tutorial	1
1.5	Derivatives as a function, Differentiation rules	2
1.6	The mean value theorem	1
1.7	Maxima and minima of function of one variable	1
1.8	Tutorial	1
1.9	Application problems in engineering	2
1.10	Application problems using MATLAB(Tutorial)	1

S.No	Topic	No. of Hours
2	**FUNCTIONS OF SEVERAL VARIABLES**	
2.1	Partial derivatives, Chain rule	2
2.2	Vector functions and their derivatives	1
2.3	Tutorial	1
2.4	Directional derivatives, Gradient vector	1
2.5	Maxima and minima of functions of two variables	2
2.6	Lagrange Multipliers	1
2.7	Tutorial	1
2.8	Application problems in engineering	2
2.9	Application problems using MATLAB(Tutorial)	1
3	**INTEGRAL CALCULUS**	
3.1	Area under curves, The definite integrals, fundamental theorem of calculus	2
3.2	Integration by parts	1
3.3	Tutorial	1
3.4	volume of solid of revolution, area of surface of revolution	2
3.5	Improper integrals	2
3.6	Tutorial	1
3.7	Application problems in engineering	2
3.8	Application problems using MATLAB(Tutorial)	1
4	**MULTIPLE INTEGRAL**	
4.1	Iterated integrals	1
4.2	Double integrals over general regions	1
4.3	Double integrals in polar coordinates	1
4.4	Tutorial	1
4.5	Applications of double integrals	1
4.6	Triple integrals	2
4.7	Tutorial	1
4.8	Triple integrals in cylindrical coordinates	1
4.9	Triple integrals in spherical coordinates	1
4.10	Change of variables in multiple integrals	1
4.11	Tutorial	1
	Total	48

Course Designers

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18PHA20	PHYSICS (Common to Civil, Mechanical and Mechatronics)	Category	L	T	P	Credit
		BS	3	0	0	3

Preamble

The course work aims in imparting fundamental knowledge of oscillations, waves and optics, and mechanics which are essential in understanding and designing mechanical systems and measuring devices.

Prerequisite

Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Solve for the solutions and describe the behavior of a damped harmonic oscillator and waves	Apply
CO2	Explain the fundamentals of optical phenomena and its application.	Understand
CO3	Use the vector analytical techniques for analysis of forces and moments in mechanical systems	Apply
CO4	Demonstrate ability to utilize principles of vector mechanics to analyze weather systems	Understand
CO5	Explain the fundamental concepts of kinetics and kinematic of rigid bodies for analysis of practical problems.	Understand
CO6	Use the principles of angular velocity to study three dimensional motion of rigid bodies	Apply

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	L	L					L	L		
CO2	M	L	L	-					L	L		
CO3	S	M	L	L					L	L		
CO4	M	L	L	-					L	L		
CO5	M	L	L	-					L	L		
CO6	S	M	L	L					L	L		
S- Strong; M-Medium; L-Low												

Assessment Pattern

Bloom's Category	Continuous Assessment Tests			Terminal Examination
	1	2	3	
Remember	20	20	20	0
Understand	30	30	30	50
Apply	50	50	50	50
Analyse	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. A 5.00×10^5 kg subway train is brought to a stop from a speed of 0.500 m/s in 0.400 m by a large spring bumper at the end of its track. What is the force constant k of the spring?
2. Show that the wave velocity of deep water waves is twice the group velocity.
3. Derive the law of reflection based on Fermats principle.

Course Outcome 2 (CO2):

1. Consider a lower energy level situated 200 cm^{-1} from the ground state. There are no other energy levels nearby. Determine the fraction of the population found in this level compared to the ground state population at a temperature of 300 K. Boltzmann's constant is equal to $1.38 \times 10^{-23} JK^{-1}$.The conversion from cm^{-1} to joules is given by: E(J) = 100hC E(cm^{-1}), where h is Planck's constant (6.62×10^{-34} Js) and c is the speed of light in a vacuum ($3 \times 10^8 ms^{-1}$)
2. Explain the principle, construction and working of Mach-Zehnder interferometer.
3. What is a four level solid state laser? Discuss the principle and operation of Nd:YAG Laser.

Course Outcome 3 (CO3):

1. A 10, 000 lb aircraft is descending on a cylindrical helix. The rate of descent is $\dot{z} = -10$ft/s, the speed is v = 211 ft/s, and $\dot{\theta} = 3^o \approx 0.05$rad/s. This is standard for gas turbine powered aircraft. Find out the force on the aircraft and the radius of curvature of the path
2. Derive Newton's second law of motion in spherical and cylindrical coordinate systems.
3. A particle attached to a string of length 2 m is given an initial velocity of 6 m/s. The string is attached to a peg and, as the particle rotates about the peg, the string winds around the peg. By conservation of angular momentum, find the length of string wound around the peg when the velocity of the particle is 20 m/s?

Course Outcome 4 (CO4):

1. Consider a situation where a cricket player (fielder) slides to a stop on level ground. Using energy considerations (in non conservative forces),calculate the distance the 60 kg cricket player slides, given that his initial speed is 7 m/s and the force of friction against him is a constant 430 N.
2. Compute the centripetal force per unit mass on a spacecraft in an 820 km circular Polar orbit as it flies over the equator and the South pole.
3. Solve Newton's equations of motion in polar coordinates

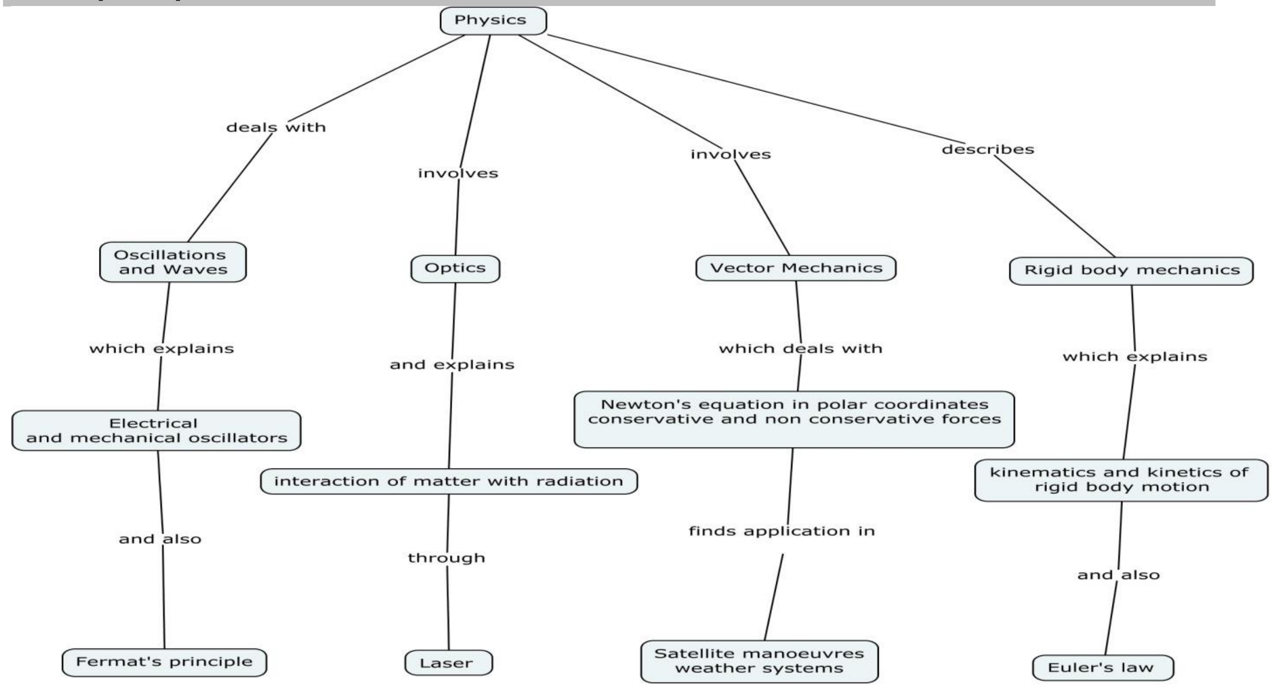
Course Outcome 5 (CO5):

1. A motor shaft attains a velocity of 1500 rpm in 3 seconds starting from rest. Assuming constant angular acceleration, find out the number of full revolution of the shaft during this period.
2. Derive Euler's equations of motion of a rigid body.
3. A cylinder of diameter 500 mm rolls down an inclined plane with uniform acceleration (of the center-of-mass) a = 0.1 m/s^2. At an instant t_0, the mass-center has speed v_0 = 0.5 m/s. (i) Find the angular speed ω and the angular acceleration $\dot{\omega}$ at t_0. (ii) How many revolutions does the cylinder make in the next 2 seconds?

Course Outcome 6 (CO6):

1. A solid right circular cone of base radius *r* and height *h* rolls on a flat surface without slipping. The centre of the circular base moves in a circular path around the z- axis (vertical axis passing through the tip of the cone) with a constant speed *v*. Determine the angular velocity and angular acceleration of the solid cone.
2. Derive an expression for angular velocity and its rate of change for three dimensional motion of a rigid body.
4. Discuss the conical motion of a rod with center of mass fixed.

Concept Map



Syllabus

Oscillations and Waves

Simple harmonic motion - Mechanical and Electrical simple harmonic oscillators - energy decay in a damped harmonic oscillator - Non-dispersive transverse and longitudinal waves in one dimension - Waves with dispersion - water waves- Acoustic waves- superposition of waves - wave groups and group velocity – Rayleigh criteria for limit of resolution and its applications to imaging.

Optics

Fermat's principle of stationary time - reflectance and transmittance - evanescent wave. Mach-Zehnder interferometer - Fraunhofer diffraction from a single slit and a circular aperture - Einstein's theory of matter radiation interaction and A and B coefficients –CO_2 – Nd-YAG lasers - applications of lasers.

Vector Mechanics of Particles

Transformation of scalars and vectors under Rotation transformation - Forces in Nature - Newton's laws and its completeness in describing particle motion - Solving Newton's equations of motion in polar coordinates -Conservative and non-conservative forces - curl of a force field -Conservation of Angular Momentum - Energy equation and energy diagrams – circular and elliptical orbits.- Applications to Satellite manoeuvres

Rigid Body Mechanics

Motion of a rigid body in the plane - Rotation in the plane - Kinematics in a coordinate system rotating and translating in the plane - Angular momentum about a point of a rigid body in planar motion - Euler's laws of motion - their independence from Newton's laws - Two-dimensional motion in terms of angular velocity vector, and its rate of change – Difference between 2D & 3D motion.

Text Book

1. Ian G.Main, Vibrations and waves in Physics -3rd edition, Cambridge University, Press, 1994.
2. M.K.Verma, Introduction to Mechanics, CRC Press, 2009.
3. JL Meriam and L.G. Kraige, Engineering Mechanics – Dynamics - 7th edition, Wiley,2015.
4. D. Kleppner and R. Kolenkow, An Introduction to Mechanics – 1st edition, McGraw Hill, 2009.

Reference Books

1. M.K.Harbola, Engineering Mechanics-2nd edition, Cengage Learning, 2012.
2. JL Synge & BA Griffiths, Principles of Mechanics, McGraw-Hill Book company Inc, 1949.
3. WT Thomson, Theory of Vibrations with Applications,-3rd edition, CBS Publishers, 2002.

Course Contents and Lecture Schedule

S No.	Topic	No. of Hours
1.	**Oscillations & Waves**	
1.1	Simple harmonic motion – Mechanical and Electrical simple harmonic oscillators.	2
1.2	Energy decay in a damped harmonic oscillator – Non-dispersive transverse and longitudinal waves in one dimension.	2
1.3	Waves with dispersion – water waves- Acoustic waves – superposition of waves – wave groups and group velocity.	1
1.4	Rayleigh criteria for limit of resolution and its applications to imaging	1
2	**Optics**	
2.1	Fermat's principle of stationary time - reflectance and transmittance - evanescent wave. Mach-Zehnder interferometer.	2
2.2	Fraunhofer diffraction from a single slit and a circular aperture .	1
2.3	Einstein's theory of matter radiation interaction and A and B coefficients .	1
2.4	CO_2 Laser.	1
2.5	Nd-YAG lasers Applications of lasers.	1
3.	**Vector Mechanics of Particles**	
3.1	Transformation of scalars and vectors under rotation transformation	2
3.2	Forces in Nature, Newton's laws and its completeness in describing particle motion	2
3.3	Solving Newton's equations of motion in polar coordinates	2
3.4	Conservative and non-conservative forces, curl of a force field, Conservation of angular momentum	2
3.5	Energy equation and energy diagrams, circular and elliptical orbits	2
3.6	Applications to Satellite manoeuvres	2
4.	**Rigid Body Mechanics**	
4.1	Motion of a rigid body in the plane, Rotation in the plane	2

S No.	Topic	No. of Hours
4.2	Kinematics in a coordinate system rotating and translating in the plane	2
4.3	Angular momentum about a point of a rigid body in planar motion	2
4.4	Euler's laws of motion, their independence from Newton's laws	2
4.5	Two-dimensional motion in terms of angular velocity vector, and its rate of change.	2
4.6	Distinction between 2D & 3D motion	2
	Total	**36**

Course Designers

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18PHB20	PHYSICS (Common to EEE and ECE)	Category	L	T	P	Credit
		BS	3	0	0	3

Preamble

The course work aims in imparting fundamental knowledge of oscillations and waves and electromagnetic theory which are essential in understanding and explaining engineering devices.

Prerequisite

Basic course (No prerequisite)

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Solve for the solutions and describe the behavior of a damped harmonic oscillator and waves	Apply
CO2	Explain the fundamentals of optical phenomena and its application.	Understand
CO3	Understand the fundamentals of electrostatics and Calculation of electric field and electrostatic potential for a charge distribution	Apply
CO4	Explain bound charges due to electric polarization and estimation of vector potential through concepts of magneto statics.	Understand
CO5	Describe and make calculations of plane electromagnetic waves in homogeneous media and derive Poynting theorem	Understand
CO6	Learn the propagation of EM waves and its applications by solving physical problems and Energy and Momentum carried by electromagnetic waves through linear media.	Apply

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	L	L					L	L		
CO2	M	L	L	-					L	L		
CO3	S	M	L	L					L	L		
CO4	M	L	L	-					L	L		
CO5	M	L	L	-					L	L		
CO6	S	M	L	L					L	L		
S- Strong; M-Medium; L-Low												

Assessment Pattern

Bloom's Category	Continuous Assessment Tests			Terminal Examination
	1	2	3	
Remember	20	20	20	20
Understand	30	30	30	30
Apply	50	50	50	50
Analyse	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Assuming a car is 900 kg and has a suspension system that has a force constant 6.5×10^4 N/m. The car hits a bump and bounces with an amplitude of 0.100 m. What is its maximum vertical velocity if no damping occurs?
2. Establish the connection between quality factor, width of response and energy dissipation.
3. State the Rayleigh's criteria for limit of resolution.

Course Outcome 2 (CO2):

1. Differentiate between laser light and ordinary light.
2. Predict the working of the CO2 laser without Helium gas in the mixture.
3. Explain the construction and working of Nd-YAG Laser

Course Outcome 3 (CO3):

1. Discuss the Continuous charge distribution and the electric field produced by it.
2. Derive Laplace's and Poisson's equation
3. Deduce Gauss' law.

Course Outcome 4 (CO4):

1. Summarize physical interpretation of bound charges
2. Define vector potential and give its significance.
3. Explain the magnetic field of a steady current and hence obtain Bio-Savart law .

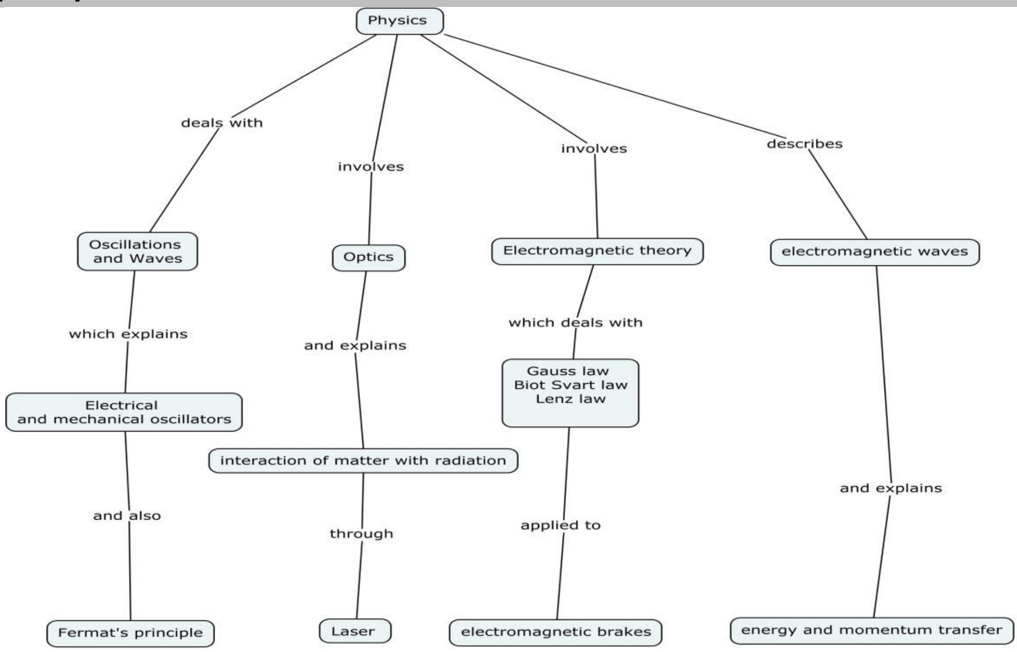
Course Outcome 5 (CO5):

1. Derive and interpret Continuity equation for current densities.
2. Write and explain the importance of Poynting vector
3. Deduce Faraday's law of electromagnetic from the Maxwell's equation

Course Outcome 6 (CO6):

1. Discuss the propagation of EM waves through vacuum.
2. Define and obtain expressions for transmission and reflection coefficients
3. Find the reflection and transmission coefficients of an electric field wave travelling in wave and incident normally on a boundary between air and a dielctric having Permeability µ0 and permittivity 4.74.

Concept Map



Syllabus

Oscillations and Waves **(6 hours)**

Simple harmonic motion - Mechanical and Electrical simple harmonic oscillators - energy decay in a damped harmonic oscillator - Non-dispersive transverse and longitudinal waves in one dimension - Waves with dispersion - water waves –Acoustic waves - superposition of waves - wave groups and group velocity – Rayleigh criteria for limit of resolution and its applications to imaging

Optics **(6 hours)**

Fermat's principle of stationary time - reflectance and transmittance - evanescent wave. Mach-Zehnder interferometer - Fraunhofer diffraction from a single slit and a circular aperture - Einstein's theory of matter radiation interaction and A and B coefficients –CO_2 – Nd-YAG lasers - applications of lasers.

Electromagnetic Theory **(12 Hours)**

Electrostatics: Introduction, Calculation of electric field and electrostatic potential for a charge distribution - Gauss' law, Divergence and curl of electrostatic field, Application: Faraday's cage and coffee-ring effect(qualitative only). Electrostatic field and potential of a dipole. Bound charges due to electric polarization; Electric displacement; Solving simple electrostatics problems in presence of dielectrics.

Magnetostatics: Bio-Savart law, Divergence and curl of static magnetic field; vector potential and calculating it for a given magnetic field using Stokes' theorem. Lenz's law; Electromagnetic breaking (qualitative only)

Electromagnetic waves **(12 hours)**

Continuity equation for current densities- Modifying equation for the curl of magnetic field – Energy in an electromagnetic field - Flow of energy and Poynting vector - Maxwell's equations- The wave equation- Plane electromagnetic waves in Vacuum– their transverse nature and Polarization ; relation between electric and magnetic fields of an electromagnetic wave -Energy and Momentum carried by electromagnetic waves, Propagation through linear media-Normal incidence - problems.

Text Books

1. Ian G.Main, Vibrations and waves in Physics -3rd edition, Cambridge University Press,1994.
2. David J. Griffiths, Introduction to Electrodynamics, Prentice Hall, Second Indian edition,1981.
3. Paul Lorrain , Dale R. Corson , Francois Lorrain, Electromagnetic Fields and Waves, 3rd Edition, W.H. Freeman, 1990.
4. A.A. Rangwala,A.S. Mahajan, Electricity and Magnetism – 1st edition , McGraw Hill Education, 2004.

Reference

1. Halliday Resnick Krane, Physics Volume 2, Fifth edition, Wiley Publications, 2002.
2. W. Saslow, Electricity, Magnetism and light, Academic press 2005.
3. WT Thomson, Theory of Vibrations with Applications,-3rd edition, CBS Publishers, 2002.

Course Contents and Lecture Schedule

S No.	Topic	No. of Hours
1.	**Oscillations & Waves**	
1.1	Simple harmonic motion – Mechanical and Electrical simple harmonic oscillators.	2
1.2	Energy decay in a damped harmonic oscillator – Non-dispersive transverse and longitudinal waves in one dimension.	2
1.3	Waves with dispersion – water waves – Acoustic waves – superposition of waves – wave groups and group velocity.	1
1.4	Rayleigh criteria for limit of resolution and its applications to imaging.	1
2	**Optics**	
2.1	Fermat's principle of stationary time - reflectance and transmittance - evanescent wave. Mach-Zehnder interferometer.	2
2.2	Fraunhofer diffraction from a single slit and a circular aperture .	1
2.3	Einstein's theory of matter radiation interaction and A and B coefficients	1
2.4	CO_2 Laser	1
2.5	Nd-YAG lasers Applications of lasers.	1
3	**Electromagnetic Theory**	
3.1	Electrostatics: Introduction, Calculation of electric field and electrostatic potential for a charge distribution - Gauss' law – work done- Electric potential problems. Divergence and curl of electrostatic field	4
3.2	Applications: Faraday's cage and coffee-ring effect. Electrostatic field and potential of a dipole.	2
3.3	Bound charges due to electric polarization; Electric displacement; Solving simple electrostatics problems in presence of dielectrics.	2
3.4	Magnetostatics: Bio-Savart law, Divergence and curl of static magnetic field	2
3.5	vector potential and calculating it for a given magnetic field using Stokes' theorem. Lenz's law; Electromagnetic breaking (qualitative only)	2
4	**Electromagnetic waves**	
4.1	Continuity equation for current densities- Modifying equation for the curl of	2

S No.	Topic	No. of Hours
	magnetic field –	
4.2	Energy in an electromagnetic field - Flow of energy and Poynting vector - Maxwell's equations- The wave equation-	3
4.3	Plane electromagnetic waves in Vacuum– their transverse nature and Polarization	2
4.4	Relation between electric and magnetic fields of an electromagnetic wave	2
4.5	Energy and Momentum carried by electromagnetic waves, Propagation through linear media- Reflection and Transmission coefficients, problems.	3
	Total	**36**

Course Designers

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18PHC20	PHYSICS (Common to CSE and IT)

Category	L	T	P	Credit
BS	3	0	0	3

Preamble

The course work aims in imparting fundamental knowledge of oscillations and waves and optics and quantum mechanics which are essential in understanding and explaining engineering devices.

Prerequisite

Basic course (No prerequisite)

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Solve for the solutions and describe the behavior of a damped harmonic oscillator and waves	Apply
CO2	Explain the fundamentals of optical phenomena and its application.	Understand
CO3	Explain the basic principles of Quantum mechanic	Understand
CO4	Use the principles of quantum mechanics to calculate observables on known wave functions	Apply
CO5	Solve Schrodinger equation for simple potentials ,scattering and related phenomena	Understand
CO6	identify and relate the Eigen value problems for energy, momentum, angular momentum and explain the idea of spin	Apply

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	L	L					L	L		
CO2	M	L	L	-					L	L		
CO3	M	L	L	-					L	L		
CO4	S	M	L	L					L	L		
CO5	M	L	L	-					L	L		
CO6	S	M	L	L					L	L		
S- Strong; M-Medium; L-Low												

Assessment Pattern

Bloom's Category	Continuous Assessment Tests			Terminal Examination
	1	2	3	
Remember	20	20	20	20
Understand	30	30	30	30
Apply	50	50	50	50
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

Course Level Assessment Questions

Course Outcome 1 (CO1)

1. Assuming a car is 900 kg and has a suspension system that has a force constant $6.5x10^4$ N/m. The car hits a bump and bounces with an amplitude of 0.100 m. What is its maximum vertical velocity if no damping occurs?
2. Establish the connection between quality factor, width of response and energy dissipation.
3. State the Rayleigh's criteria for limit of resolution.

Course Outcome 2 (CO2)

1. Find the ratio of population of two energy states in a Laser the transition between which is responsible for the emission of photons of wavelength6893A at a temperature of 300K.Comment on the type of emission based on the ration of population.
2. Analyze the role of mixture of gases for a CO_2 laser and predict the working of the laser without Helium gas in the mixture.
3. Differentiate between CO_2 laser and Nd-YAG Laser with respect to their construction and energy level diagram.

Course Outcome 3 (CO3)

1. List the properties of wave function.
2. Set up the time independent Schrodinger wave equation and explain the Eigen functions and Eigen values.
3. Describe an experiment to verify the uncertainty principle.

Course Outcome 4 (CO4)

1. Calculate the expectation value of the position of a particle trapped in a box of length 10A° wide.
2. Compute the smallest possible uncertainty in position of an electron moving with a Velocity of $3x10^7$ m.
3. An electron is constrained to a one dimensional box of side 1nm.Calculate the first four Eigen values in electron volt.

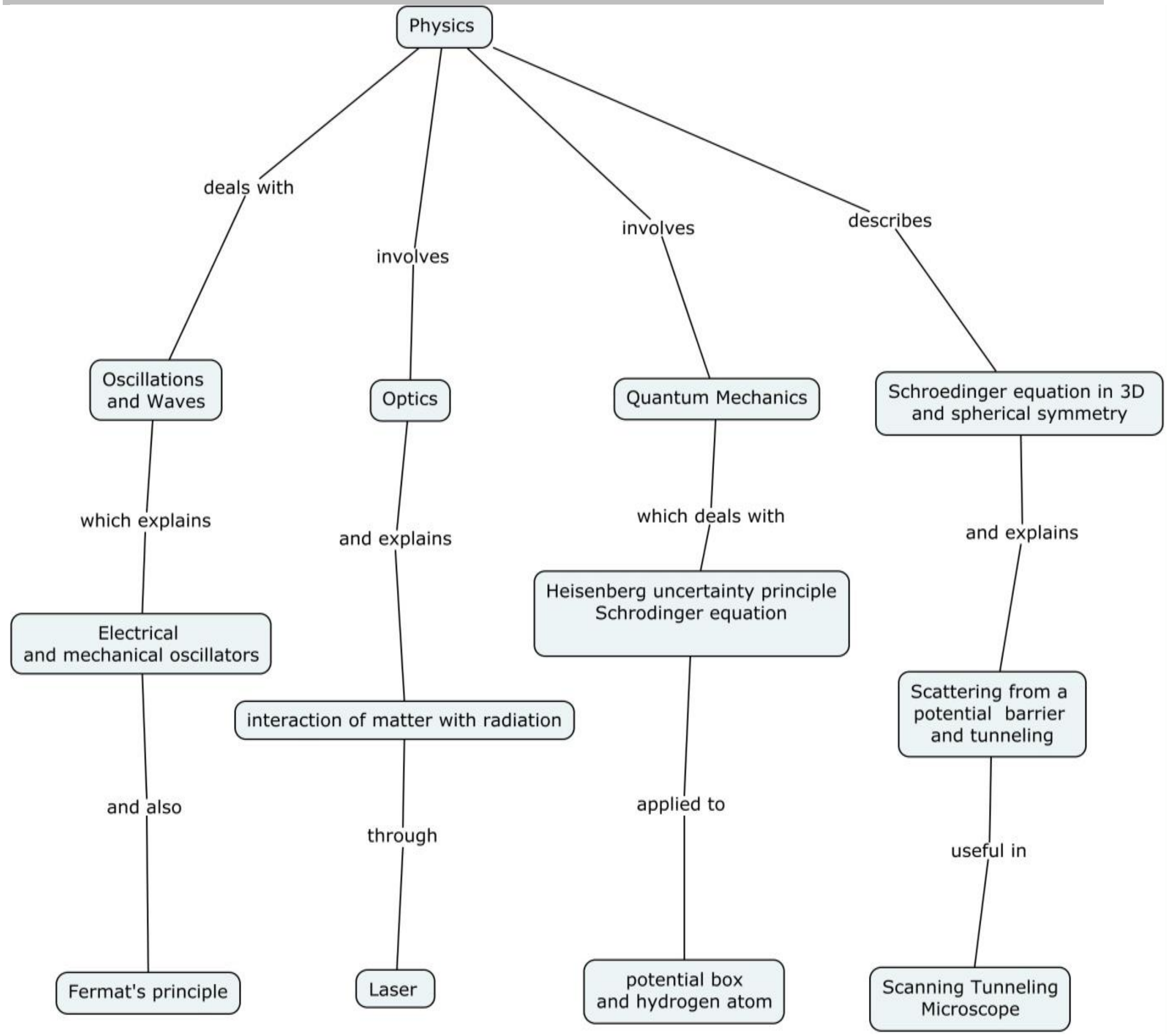
Course Outcome 5 (CO5)

1. Assuming the time independent Schrödinger wave equation, discuss the solution for a particle in a three dimensional potential well of infinite height.
2. Discuss the barrier tunneling phenomenon for a rectangular finite potential barrier of height $V_{o.}$
3. State the principle of STM and describe its working.

Course Outcome 6 (CO6)

1. Identify the degeneracies in hydrogen atom energy level based on the principle of quantum numbers.
2. Illustrate the vector model of orbital angular momentum
3. Given $\psi(x) = A\sin(kx)$. Find the Eigen values of the operator $O = \partial^2/\partial x^2$. Identify whether $\partial/\partial x$ is an Eigen operator

Concept Map



Syllabus

Oscillations and Waves: Simple harmonic motion - Mechanical and Electrical simple harmonic oscillators - energy decay in a damped harmonic oscillator - Non-dispersive transverse and longitudinal waves in one dimension - Waves with dispersion - water waves – Acoustic waves - superposition of waves - wave groups and group velocity – Rayleigh criteria for limit of resolution and its applications to imaging.

Optics : Fermat's principle of stationary time - reflectance and transmittance - evanescent wave. Mach-Zehnder interferometer - Fraunhofer diffraction from a single slit and a circular aperture - Einstein's theory of matter radiation interaction and A and B coefficients –CO_2 – Nd-YAG lasers - applications of lasers.

Introduction to Quantum mechanics

Wave nature of Particles, Time-dependent and time independent Schrodinger equation for wave function, Born interpretation, probability current, Expectation values, Free-particle wave function and wave-packets, Uncertainty principle – Derivation & Experiment. Solution of stationary-state Schrodinger equation for one dimensional problems– particle in a box, Square-well potential, linear harmonic oscillator.

Applying the Schrodinger equation

Numerical solution of stationary-state - Schrodinger equation for three dimensional problems for different potentials and related examples - Angular momentum operator - Hydrogen atom ground-state, orbitals - interaction with magnetic field, spin. Scattering from a potential barrier and tunneling; related examples like alpha-decay, field ionization Schrodinger equation for spherically symmetric potentials and scanning tunneling microscope.

Text Books

1. Ian G. Main, Vibrations and waves in Physics -3rd edition, Cambridge University press, ,1994.
2. David .J. Griifiths, Introduction to quantum mechanics -2nd edition, Cambridge University press, 2017.
3. P M Mathews, K.Venkatesan, Quantum mechanics, 2 nd edition, Tata McGraw-Hill Education, 2010.

Reference

1. http.//nptel.ac.in/courses/115106066/Quantum mechanics Prof. S. Lakshmi Bala, IIT Madras.
2. http://nptel.ac.in/courses/115101010/ Quantum mechanics Prof. S. H.Patil, IIT Bombay.
3. http://nptel.ac.in/courses/115104096/ Introduction to quantum mechanics, Prof Manoj K.Harbola, IIT Kanpur

Course Contents and Lecture Schedule

S No.	Topic	No. of Hours
1.	**Oscillations & Waves**	
1.1	Simple harmonic motion – Mechanical and Electrical simple harmonic oscillators.	2
1.2	Energy decay in a damped harmonic oscillator – Non-dispersive transverse and longitudinal waves in one dimension.	2
1.3	Waves with dispersion – water waves – Acoustic Waves – superposition of waves – wave groups and group velocity.	1
1.4	Rayleigh criteria for limit of resolution and its applications to imaging.	1
2	**Optics**	
2.1	Fermat's principle of stationary time - reflectance and transmittance - evanescent wave. Mach-Zehnder interferometer.	2
2.2	Farunhofer diffraction from a single slit and a circular aperture.	1
2.3	Einstein's theory of matter radiation interaction and A and B coefficients.	1
2.4	CO_2 Laser.	1
2.5	Nd-YAG lasers -Applications of lasers.	1
3	**Introduction to Quantum mechanics**	
3.1	Wave nature of Particles, Time-dependent and time independent Schrodinger equation for wave function.	3
3.2	Born interpretation, probability current, Expectation values.	3
3.3	Free-particle wave function and wave-packets, Uncertainty principle – Derivation & Experiment.	3
3.4	Schrodinger equation for one dimensional problems– particle in a box, square-well potential, linear harmonic oscillator.	3
4	**Applying the Schrodinger equation**	

S No.	Topic	No. of Hours
4.1	Numerical solution of stationary-state	1
4.2	Schrodinger equation for one dimensional problem for different potentials and related examples.	3
4.3	Angular momentum operator, Hydrogen atom ground-state, orbitals, interaction with magnetic field , spin	3
4.4	Scattering from a potential barrier and tunneling; related examples like alpha-decay, field ionization	3
4.5	Schrodinger equation for spherically symmetric potentials	1
4.6	Scanning tunneling microscope.	1
	Total	**36**

Course Designers

1. Dr. M.Mahendran mmphy@tce.edu
2. Mr. V.Veeraganesh vvgphy@tce.edu
3. Dr. A.L.Subramaniyan alsphy@tce.edu
4. Dr.T.Manichandran stmanichandran@tce.edu

18CHA30	CHEMISTRY (COMMON TO CIVIL, MECHANICAL AND MECHATRONICS)

Category	L	T	P	Credit
BS	3	0	0	3

Preamble

The objective of this course is to bestow a better understanding of basic concepts of chemistry and its applications on Civil, Mechanical and Mechatronics domain. It also imparts knowledge on properties of water and its treatment methods, spectroscopic techniques for material characterization, corrosion and protection of metals. This course also highlights preparation, properties and applications of polymer and composite materials. It also gives basic idea about adhesives and lubricants and their mechanisms.

Prerequisite

Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Identify the properties of water and its treatment methods	Understand
CO2	Summarize the Principles and Instrumentations of Spectroscopic techniques	Understand
CO3	Select the appropriate spectroscopic techniques for characterization of materials	Apply
CO4	Adapt the customized corrosion control methods	Apply
CO5	Dramatize the preparation, properties and applications of Engineering materials	Understand
CO6	Describe the mechanism of adhesion and lubrication	Understand

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1.	M	-	-	-	-	-	-	-	-	-	M	-
2.	M	L	L	-	-	-	-	-	-	-	-	-
CO3.	S	S	M	M	-	-	-	-	-	-	-	-
CO4.	S	S	M	M	-	-	L	-	-	-	L	-
CO5.	M	M	M	-	-	-	L	-	-	-	-	-
CO6.	M	-	L	-	-	-	-	-	-	-	-	-
S- Strong; M-Medium; L-Low												

Assessment Pattern

Bloom's Category	Continuous Assessment Tests			Terminal Examination
	1	2	3	
Remember	20	20	20	20
Understand	40	40	40	40
Apply	40	40	40	40
Analyze	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

Course Level Assessment Questions

Course Outcome 1 (CO1):

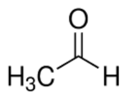
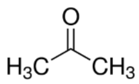
1. Distinguish between scale and sludge.
2. 100 ml of given water sample consumed 48 ml of EDTA during titration using EBT indicator. 35 ml of same EDTA consumed by 100 ml of standard hard water containing 1 mg of pure $CaCO_3$ per ml. Calculate the permanent, temporary and total hardness of given water sample in $CaCO_3$ equivalents.
3. Outline the steps involved in the waste water treatment process.

Course Outcome 2 (CO2):

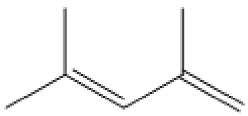
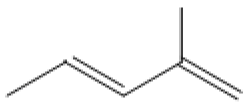
1. State Beer-Lambert law.
2. Write the selection rule in absorption spectroscopy.
3. Explain the procedure involved in finding the metals present in an alloy sample using ICP-OES.

Course Outcome 3 (CO3):

1. Compare the stretching frequencies of carbonyl functional groups in the following compounds

   i)  (ii) 

2. Following Woodward-Fiesher- scott rules, it has been observed that the following compounds have absorption maximum at (i) 225 nm, (ii) 220 (iii) 230. Explain which is which.

   a).  b).  c). 

3. Describe the function of different magnets available to generate magnetic field in MRI scanner.

Course Outcome 4 (CO4)

4. Illustrate the different forms of corrosion with appropriate mechanism
5. Dramatize suitable methods to prevent corrosion of iron bar used in construction.
6. Discuss in detail about the constituents and functions of paint.

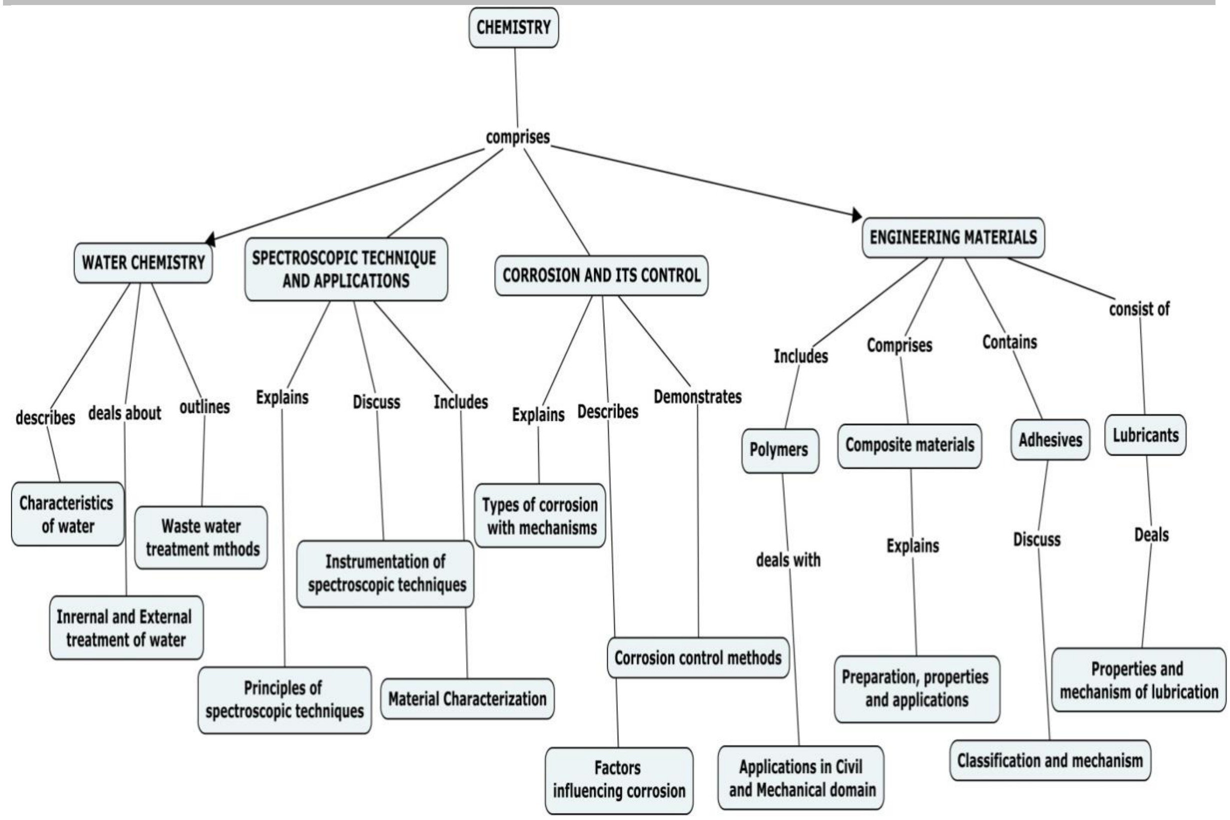
Course Outcome 5 (CO5)

1. Explain the application of composite materials in automobile engineering.
2. Demonstrate the applications of polymer in the enhancement of concrete properties.
3. Summarize the properties and application of reinforced composite materials.

Course Outcome 6 (CO6)

1. List the types of lubricant materials.
2. Identify the factors which influence the action of adhesive.
3. Discuss the mechanism of lubrication.

Concept Map



Syllabus

Water Chemistry : Water- sources-Hardness of water-types-Estimation of hardness of water by EDTA method. Disadvantages of hardwater -Boiler troubles- scale & sludge. Internal treatment methods. External treatment methods- zeolite, ion exchange. Desalination process- reverse osmosis, electrodialysis, multi stage flash distillation. Waste water treatment processes.

Spectroscopic technique and applications-Principles of spectroscopy and selection rules-Electronic spectroscopy, Fluorescence- applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules- Applications. Nuclear magnetic resonance and magnetic resonance imaging. Atomic Absorption Spectroscopy and Inductively Coupled Plasma-Optical Emission Spectroscopy- Principle, instrumentation and applications.

Corrosion and its prevention-Corrosion- causes- factors- types- chemical, electrochemical corrosion (galvanic, differential aeration), Corrosion of steel in various environments. Rate of corrosion. Corrosion control - material selection and design aspects - electrochemical protection – sacrificial anode method and impressed current cathodic method. Coatings – Metallic – Chromate conversion coating, electroplating – precious metal coating. Paints- constituents and function.

Engineering materials – Polymers - Introduction-classification-properties –applications in construction and manufacturing processes. Composite Materials: Introduction-Classification – Preparation, properties and applications. Fiber-Reinforced Composites-preparation, properties and applications..Adhesives- Introduction-classification-fundamental aspects – mechanism of adhesion- factors influencing adhesive action. Lubricants-introduction-classification-properties-functions-mechanism of lubrication.

Text Book

1. P.C. Jain and Monica Jain, A Textbook of Engineering Chemistry, DhanpatRai publications, New Delhi, 16th edition, 2015.
2. C. N. Banwelland E.M. McCash, “Fundamentals of Molecular Spectroscopy”, Tata McGraw-Hill (India), 5th Edition, 2013.

Reference Books

1. S.S. Dara and S.S.Umare, “A Textbook of Engineering Chemistry”, S.Chand & Company, 12th Edition, Reprint, 2013.
2. Shashi Chawla, “ A text book of Engineering Chemistry”, Dhanpat Rai & Co.(pvt) ltd, 3rd edition, reprint 2011.

Course Contents and Lecture Schedule

S. No.	Topic	No. of hours
1.0	**Water Chemistry**	
1.1	Introduction -Water- sources-Hardness of water-types	1
1.2	Estimation of hardness of water by EDTA method	2
1.3	Disadvantages of hard water -Boiler troubles- scale & sludge.	1
1.4	Internal treatment methods	1
1.5	External treatment methods- zeolite, ion exchange	1
1.6	Desalination process- reverse osmosis, electrodialysis, multi stage flash distillation	1
1.7	Waste water treatment processes	2
2.0	**Spectroscopic technique and applications**	
2.1	Introduction	1
2.2	Principles of spectroscopy and selection rules	1
2.3	Electronic spectroscopy, Fluorescence- applications in medicine.	1
2.4	Vibrational and rotational spectroscopy of diatomic molecules- Applications	2
2.5	Nuclear magnetic resonance and magnetic resonance imaging	2
2.6	Atomic Absorption Spectroscopy and Inductively Coupled Plasma-Optical Emission Spectroscopy- Principle, instrumentation and applications.	2
3.0	**Corrosion and its prevention**	
3.1	Corrosion- causes- factors-	1
3.2	types- chemical, electrochemical corrosion (galvanic, differential aeration), Corrosion of steel in various environments (Marine)	2
3.3	Rate of corrosion	1
3.4	Corrosion control - material selection and design aspects	1
3.5	electrochemical protection – sacrificial anode method and impressed current cathodic method	1
3.6	Coatings – Metallic - Chromate conversion coating, electroplating – precious metal coating.	2
3.7	Paints- constituents and function.	1
4.0	**Engineering materials**	
4.1	Polymers - Introduction-classification-properties	1
4.2	Applications in construction and mechanical domains	1

S. No.	Topic	No. of hours
4.3	Composite Materials: Introduction-Classification – Preparation, properties and applications of Polymer Matrix Composites,	1
4.4	Metal Matrix Composites, Ceramic Matrix Composites Carbon-Carbon Composites	2
4.5	Fiber-Reinforced Composites- Glass, Silica, Kevlar, carbon, boron, silicon carbide, and boron carbide fibers and nature-made composites, and applications.	2
4.6	Adhesives- Introduction-classification-fundamental aspects – mechanism of adhesion- factors influencing adhesive action	1
4.7	Lubricants-introduction-classification-properties-functions-mechanism of lubrication.	1
	Total	**36**

Course Designers:

1.	Dr. M.Kottaisamy	hodchem@tce.edu
2	Dr.(Mrs).K.Radha	krchem@tce.edu
2.	Dr.S.Rajkumar	rajkumarsubramanium@tce.edu
3.	Dr.M.Velayudham	mvchem@tce.edu

18CHB30	CHEMISTRY (Common to EEE and ECE)	Category	L	T	P	Credit
		BS	3	0	0	3

Preamble

This course work aims in imparting fundamental knowledge of materials and their applications in electrical, electronics and communication engineering. This course provides exposure to the students regarding the characterization of materials by spectroscopic methods. This course also deals with the selection of materials based on their properties for application in energy storage, energy conversion and electronic devices. It also extends the importance of water and gives better understanding of Water treatment processes.

Prerequisite

NIL

Course Outcomes

On the successful completion of the course, students will be able to

CO1.	Identify the properties of water and its treatment methods	Understand
CO2.	Summarize the Principles and Instrumentations of Spectroscopic Techniques	Understand
CO3.	Select the appropriate spectroscopic techniques for characteristics of materials	Apply
CO4.	Outline the importance of industrial electrochemical processes and protective coating	Understand
CO5.	Indicate the materials best suited for the construction of energy storage devices for different applications	Apply
CO6.	Identify the implications of material properties in the performance of electronic devices.	Apply

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M	L	-	-	-	-	-	-	-	-	L
CO2	M	M	L	-	-	-	-	-	-	-	-	-
CO3	S	S	L	-	-	-	-	-	-	-	-	-
CO4	M	M	M	M	-	-	L	-	-	-	-	L
CO5.	S	S	M	M	-	-	M	-	-	-	-	L
CO6	S	S	M	M	-	-	M	-	-	-	-	L
S- Strong; M-Medium; L-Low												

Assessment Pattern

Bloom's Category	Continuous Assessment Tests			Terminal Examination
	1	2	3	
Remember	20	20	20	20
Understand	30	30	30	30
Apply	50	50	50	50
Analyze	_	_	_	_
Evaluate	_	_	_	_
Create	_	_	_	_

Course Level Assessment Questions

Course Outcome 1 (CO1):

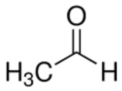
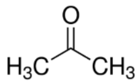
1. Distinguish between scale and sludge.
2. 100 ml of given water sample consumed 48 ml of EDTA during titration using EBT indicator. 35 ml of same EDTA consumed by 100 ml of standard hard water containing 1 mg of pure $CaCO_3$ per ml. Calculate the permanent, temporary and total hardness of given water samples in $CaCO_3$ equivalents.
3. Outline the steps involved in the waste water treatment process.

Course Outcome 2 (CO2):

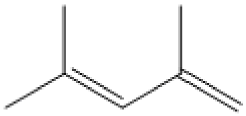
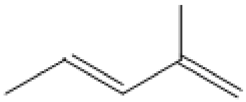
4. State Beer-Lambert law.
5. Write the selection rule in absorption spectroscopy.
6. Explain the procedure involved in finding the metals present in an alloy sample using ICP-OES.

Course Outcome 3 (CO3):

1. Compare the stretching frequencies of carbonyl functional groups in the following compounds

i)  (ii) 

2. Following Woodward-Fiesher- scott rules, it has been observed that the following compounds have absorption maximum at (i) 225 nm, (ii) 220 (iii) 230. Explain which is which.

a).  b).  c). 

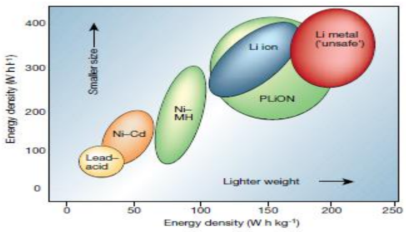
3. Describe the function of different magnets available to generate magnetic field in MRI scanner.

Course Outcome 4 (CO4)

1. Explain the drawbacks of gold electroplating.
2. Name the different types of electrolyte used in platinum electroplating.
3. Write the equations for hydrogen generation by electrolysis process under acidic and alkaline conditions.

Course Outcome 5 (CO5)

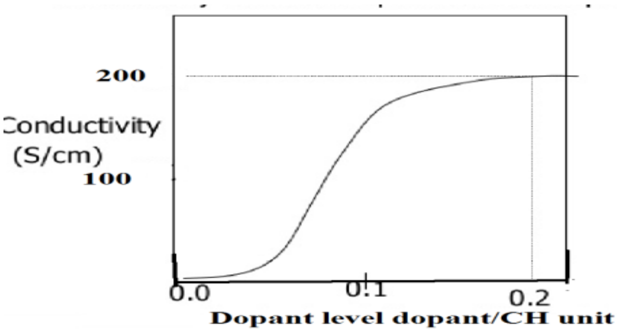
1. Illustrate the working principle, charging and discharging reactions in Lead acid battery.
2. With the help of comparative chart of different battery types, justify the reason for considering Lithium ion batteries as future power source.



3. Illustrate H_2-O_2 fuel cell construction and explain associated electrochemical reactions.

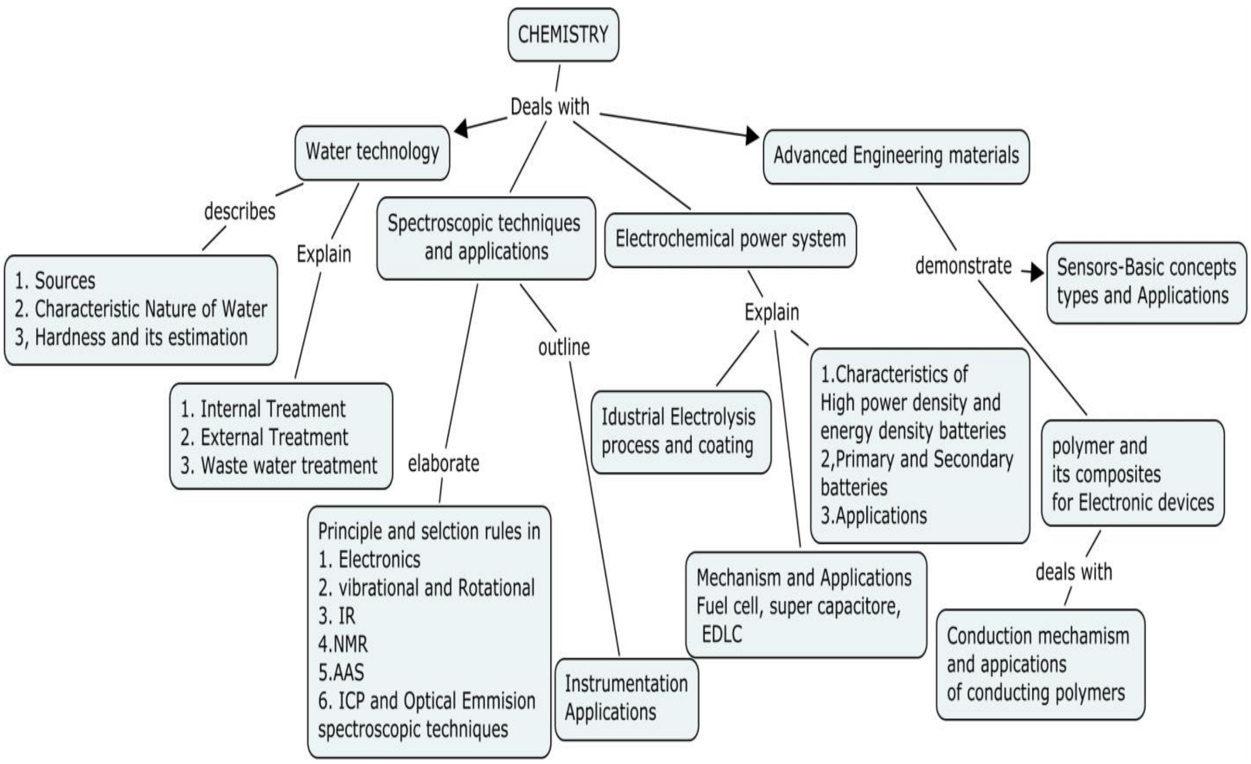
Course Outcome 6 (CO6)

1. Explain the conduction mechanism of polyaniline as a host for enzyme in biosensor.
2. In the following profile, identify the reason why the conductivity of polymer has been increased with dopant level.



3. Identify the suitable bio sensing materials for the detection of glucose in human blood serum.

Concept Map



Syllabus

Water Chemistry: Water- sources-Hardness of water-types-Estimation of hardness of water by EDTA method. Disadvantages of hardwater -Boiler troubles- scale & sludge.Internal treatment methods. External treatment methods- zeolite, ion exchange. Desalination process- reverse osmosis, electrodialysis, multi stage flash distillation. Waste water treatment processes.

Spectroscopic technique and applications -Principles of spectroscopy and selection rules- Electronic spectroscopy, Fluorescence- applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules- Applications. Nuclear magnetic resonance and magnetic resonance imaging. Atomic Absorption Spectroscopy and Inductively Coupled Plasma-Optical Emission Spectroscopy- Principle, instrumentation and applications.

Electrochemical power system-Electrochemistry–Basics - Industrial electrolytic process – Water electrolysis – Hydrogen generator- Electroplating - Decorative and functional coating- Value added coatings and Electroless process of making printed circuit board- Materials for Energy storage: Batteries **-** High energy density and Power density batteries -Operational characteristics – Primary and Secondary batteries– Fuel cells – Basic concept and types - Advantages and Disadvantages of fuel cell-Hydrogen Economy-Hydrogen storage- Super capacitors.

Advanced Engineering materials: Polymers and its composites for Electronic devices - Dielectric, mechanical and electrical properties-chemical methods for tailoring the properties- Conducting polymers – principle and preparation method-conduction mechanism–application of polymer and its composites in communication and flexible electronic devices - Frequency selective surfaces-Sensing properties of materials-concept-Applications

Text Book

1. P.C. Jain and Monica Jain, A Textbook of Engineering Chemistry, DhanpatRai publications, New Delhi, 16th edition, 2015.
2. C. N. Banwell and E.M. McCash, Fundamentals of Molecular Spectroscopy, TataMcGraw-Hill (India), 5th Edition, 2013.

Reference Books

1. A.J. Bard and L.R. Faulkner, Electrochemical Methods, Fundamentals and Application. Wiley,2001
2. 2.Y.R.Sharma, Elementary Organic Spectroscopy, S. Chand, 2007.
3. 3.ShashiChawla, A text book of Engineering Chemistry, Dhanpat Rai& Co.(pvt) Ltd, 3rd Edition, reprint 2013

Course Contents and Lecture Schedule

S.No	Topic	No. of Hours
1.0	**Water Chemistry**	
1.1	Introduction -Water- sources-Hardness of water-types	1
1.2	Estimation of hardness of water by EDTA method	2
1.3	Disadvantages of hard water -Boiler troubles- scale & sludge.	1
1.4	Internal treatment methods	1
1.5	External treatment methods- zeolite, ion exchange	1
1.6	Desalination process- reverse osmosis, electrodialysis, multi stage flash distillation	1
1.7	Waste water treatment processes	2
2.0	**Spectroscopic technique and applications**	
2.1	Introduction	1
2.2	Principles of spectroscopy and selection rules	1
2.3	Electronic spectroscopy, Fluorescence- applications in medicine.	1
2.4	Vibrational and rotational spectroscopy of diatomic molecules- Applications	2
2.5	Nuclear magnetic resonance and magnetic resonance imaging	2
2.6	Atomic Absorption Spectroscopy and Inductively Coupled Plasma-Optical Emission Spectroscopy- Principle, instrumentation and applications.	2
3.0	**Electrochemical power system**	

S.No	Topic	No. of Hours
3.1	Industrial electrolytic process – Water electrolysis – Hydrogen generator-Decorative and functional coating-Electroplating Protective coating (Zn and Ni);	**2**
3.2	Value added coatings (Au, Pt).and Electroless process of making printed circuit board	**1**
3.3	High energy density and Power density batteries-Operational characteristics – Primary (Zn/MnO_2 or Zn/Ag_2O) and Secondary batteries (Pb- acid and Lithium ion/polymer batteries)	**2**
3.4	Fuel cells – Basic concept and types Proton exchange membrane FC-Methanol FC-solid oxide FC- (principle only)	**2**
3.5	Advantages and Disadvantages of fuel cell-Hydrogen Economy-Hydrogen storage- Super capacitors – EDLC and Hybrid type (principle only)	**2**
4.0	**Advanced Engineering materials**	
4.1	Dielectric, mechanical and electrical properties-chemical methods for tailoring the properties-Doping-Functionalization-core/shell nanostructure	**2**
4.2	Conducting polymers – principle and preparation method-conduction mechanism-(conjugated polymers- conjugated doped polymers)	**2**
4.3	application of polymer and its composites in sensors, light emitting diodes. telecommunications, power transmissions	**2**
4.4	antistatic coatings, conducting adhesives, artificial nerves - EMI shielding, Frequency selective surfaces	**1**
4.5	Sensing properties of materials-concept-Applications- Electronic sensors in Environmental monitoring process	**2**
	Total	**36**

Course Designers:

1. Dr.M.Kottaisamy hodchem@tce.edu
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3. Dr.S.Balaji Sbalaji@tce.edu

18CHC30	CHEMISTRY (Common to CSE and IT)

Category	L	T	P	Credit
BS	3	0	0	3

Preamble

The objective of this course is to bestow the better understanding of basic concepts of chemistry and its applications in Computer Science and Engineering and Information Technology. This course provides exposure on corrosion and its protection in computer components. It also imparts knowledge on properties and application of nano-materials in data storage devices. Besides, it highlights properties of water and its treatment methods, spectroscopic techniques for material characterization, properties and applications of polymers.

Prerequisite

NIL

Course Outcomes

On the successful completion of the course, students will be able to

CO 1.	Identify the properties of water and its treatment methods	Understand
CO 2.	Summarize the principles and instrumentations of spectroscopic techniques	Understand
CO 3.	Select the appropriate spectroscopic techniques for characteristics of materials	Apply
CO 4.	Adapt the suitable corrosion control methods	Apply
CO 5.	Describe the preparation, properties and applications of polymers and nanomaterials.	Understand
CO 6.	Discuss the significance of nanomaterials in computer peripherals and data storage devices	Understand

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	-	-	-	-	-	-	-	-	-	L	-
CO2	M	L	L	-	-	-	-	-	-	-	-	-
CO3.	S	S	M	M	-	-	-	-	-	-	-	-
CO4.	S	S	M	M	-	-	L	-	-	-	L	-
CO5.	M	M	M	M	-	-	L	-	-	-	-	-
CO6.	M	M	M	M	L	-	M	-	-	-	-	-
S- Strong; M-Medium; L-Low												

Assessment Pattern

Bloom's Category	Continuous Assessment Tests			Terminal Examination
	1	2	3	
Remember	20	20	20	20
Understand	40	40	40	40
Apply	40	40	40	40
Analyze	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

Course Level Assessment Questions

Course Outcome 1 (CO1):

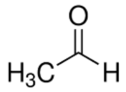
1. Distinguish between scale and sludge.
2. 100 ml of given water sample consumed 48 ml of EDTA during titration using EBT indicator. 35 ml of same EDTA consumed by 100 ml of standard hard water containing 1 mg of pure $CaCO_3$ per ml. Calculate the permanent, temporary and total hardness of given water samples in $CaCO_3$ equivalents.
3. Outline the steps involved in the waste water treatment process.

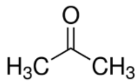
Course Outcome 2 (CO2):

1. State Beer-Lambert law.
2. Write the selection rule in absorption spectroscopy.
3. Explain the procedure involved in finding the metals present in an alloy sample using ICP-OES.

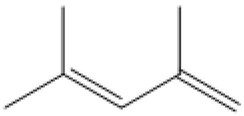
Course Outcome 3 (CO3):

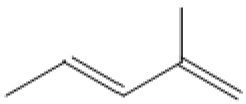
1. Compare the stretching frequencies of carbonyl functional groups in the following compounds

i) 

(ii) 

2. Following Woodward-Fiesher- scott rules, it has been observed that the following compounds have absorption maximum at (i) 225 nm, (ii) 220 (iii) 230. Explain which is which.

a). 

b). 

c). 

3. Describe the function of different magnets available to generate magnetic field in MRI scanner.

Course Outcome 4 (CO4):

1. Linear polarisation of steel specimen (0.1 x 0.1 cm^2) kept in 4% aqueous NaCl solution is studied. It gives corrosion current I_{corr} = 50 $\mu A/cm^2$.Equivalent weight and density of steel are 55.85 g/mol and 8.05 g/ cm^3 respectively. Calculate the rate of corrosion of steel in mm/year.
2. Demonstrate causes and control measures of corrosion in computer peripherals and electronic devices.
3. Explain the factors influencing rate of corrosion.

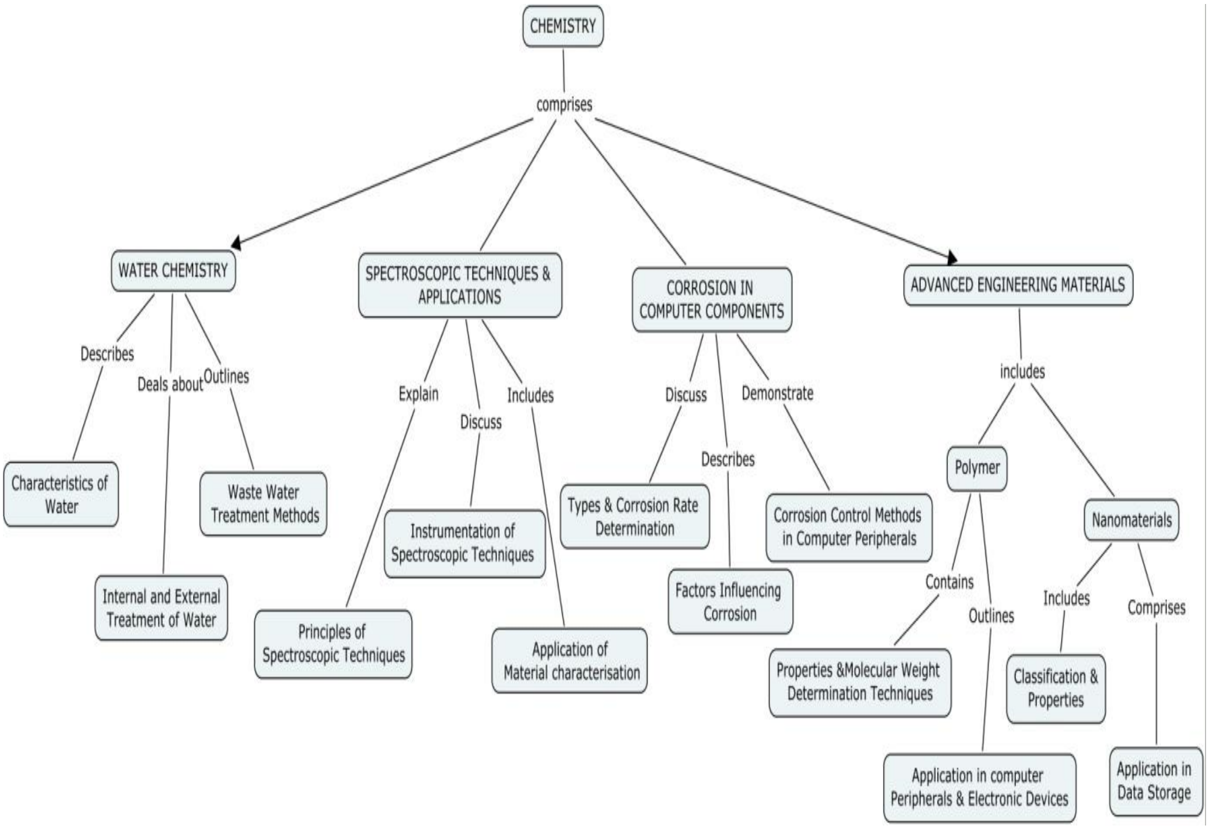
Course Outcome 5 (CO5):

1. Demonstrate the mechanism of conducting polymer of poly acetylene.
2. Explain the application of polymer material application in display devices.
3. Compare OLED vs LCD in display properties.

Course Outcome 6 (CO6):

1. Recall the classification of nanomaterials
2. Explain size dependent properties on nanomaterials
3. Describe the role of nanomaterials in data storage devices.

Concept Map



Syllabus

Water Chemistry:

Water- sources-Hardness of water-types-Estimation of hardness of water by EDTA method. Disadvantages of hardwater -Boiler troubles- scale & sludge. Internal treatment methods. External treatment methods- zeolite, ion exchange. Desalination process- reverses osmosis, electrodialysis, multi stage flash distillation. Waste water treatment processes.

Spectroscopic technique and applications:

Principles of spectroscopy and selection rules- Electronic spectroscopy, Fluorescence-applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules-Applications. Nuclear magnetic resonance and magnetic resonance imaging. Atomic Absorption Spectroscopy and Inductively Coupled Plasma-Optical Emission Spectroscopy-Principle, instrumentation and applications.

Corrosion in computer components:

Introduction -types of corrosion-electrochemical analysis-Polarization and Impedance - Rate of corrosion determination- influencing factors in corrosion-corrosion degradation in computer peripherals, electronic devices -control measures-self protecting corrosion products –Pilling Bed worth rule- precious metal coating and impact-salt spray- electroless plating-Printed Circuit Board (PCB) manufacturing.

Advanced Engineering Materials:

Polymers – introduction – structure- property relationship of polymer -conducting polymers – properties and applications in biosensors, organic light emitting diodes.Polymers in telecommunications, power transmission and liquid crystalline display devices, flexible electronic devices. Polymer composite–classification and applications in computer components. **Nanomaterials**: Difference between nano and bulk materials- classifications-size dependent properties. Data storage materials – properties and applications.

Text Book

1. P.C. Jain and Monica Jain, A Textbook of Engineering Chemistry, DhanpatRai publications, New Delhi, 16th edition, 2015.
2. C. N. Banwelland E.M. McCash, "Fundamentals of Molecular Spectroscopy", Tata McGraw-Hill (India), 5th Edition, 2013.

Reference Books

1. Shashi Chawla, " A text book of Engineering Chemistry", Dhanpat Rai & Co.(pvt) ltd 3rd edition, reprint 2011.
2. Mars Fontana, "Corrosion Engineering, Mc Graw Hill Education 3rd edition reprint, 2017.R.V.Gadag, A. Nityananda Shetty "Engineering Chemistry" I.K. international Publishing Pvt Ltd. 3rd edition 2014.

Course Contents and Lecture Schedule

S. No.	Topic	No. of hour
1.0	**Water Technology**	
1.1	Introduction -Water- sources-Hardness of water-types	1
1.2	Estimation of hardness of water by EDTA method	2
1.3	Disadvantages of hardwater -Boiler troubles- scale & sludge.	1
1.4	Internal treatment methods	1
1.5	External treatment methods- zeolite, ion exchange	1
1.6	Desalination process- reverse osmosis, electrodialysis, multi stage flash distillation	1
1.7	Waste water treatment processes	2
2.0	**Spectroscopic techniques and applications**	
2.1	Introduction	1
2.2	Principles of spectroscopy and selection rules	1
2.3	Electronic spectroscopy, Fluorescence- applications in medicine.	1
2.4	Vibrational and rotational spectroscopy of diatomic molecules-Applications	2
2.5	Nuclear magnetic resonance and magnetic resonance imaging	2
2.6	Atomic Absorption Spectroscopy and Inductively Coupled Plasma-Optical Emission Spectroscopy- Principle, instrumentation and applications.	2
3.0	**Corrosion in computer components**	
3.1	Types of corrosion, Electrochemical analysis – polarisation and impedance	2
3.2	Rate of corrosion determination	1
3.3	Factors influencing corrosion-local heat generation	2
3.4	Corrosion in computer peripherals and electronic devices	1
3.5	Corrosion control methods and precious metal coating	2
3.6	Printed Circuit Board Manufacturing	1
4.0	**Advanced Engineering Materials**	
4.1	Polymers - Structure property relationship of polymer	2
4.2	Conducting polymers – synthesis, properties and applications in	3

S. No.	Topic	No. of hour
	biosensors and OLED	
4.3	Polymer composites – classification and applications in computer components.	1
4.4	Nanomaterials – classification and size dependent properties	1
4.5	Properties of Data storage nanomaterials	2
	Total	**36**

Course Designers:

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3. Dr. S. Sivailango drssilango@tce.edu

18EG140	ENGLISH	Category	L	T	P	Credit
		HSS	2	0	0	2

Preamble

The course aims at developing communication skills in English essential for understanding and expressing the ideas in different academic, social, and professional contexts. The students acquire the skills of listening, speaking, reading, and writing competencies in English language, making them employable in the globalised scenario.

Prerequisite

NIL

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Recall the basics of language in terms of vocabulary, grammar, pronunciation, syntax and semantics.	Remember
CO2	Understand the grammatical nuances and use them accordingly in respective contexts.	Understand
CO3	Read and comprehend the content in English in general and technical contexts as well.	Understand
CO4	Write with coherence and cohesion effectively.	Apply
CO5	Apply the language in established structure with precision in social and professional contexts.	Apply

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1.										S		S
CO2.										S		M
CO3.										S		S
CO4.										S		S
CO5.										S		S

S- Strong; M-Medium; L-Low

Assessment Pattern

Bloom's Category	Continuous Assessment Tests			Terminal Examination
	1	2	3	
Remember	-	-	-	-
Understand	15	15	30	30
Apply	35	35	70	70
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

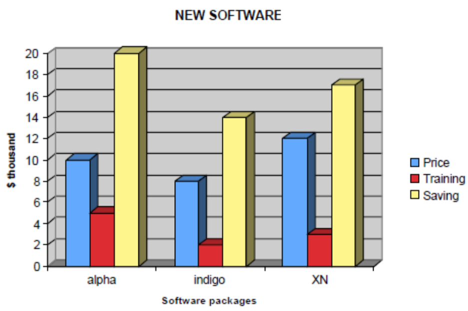
Course Level Assessment Questions

Course Outcomes 1, 2 and 3

1. Rewrite as directed.
   a) Write a basic definition of a " mobile".
   b)Combine the following sentences to bring out the "Purpose and Function".
   The coal gas is compressed. Condensation in the gas mains can be avoided.
   c) Expand the following nominal compounds: i) car race ii) race car
   d) Combine the following sentences using a relative clause.
   Smart meters are small computers. They provide real-time information on how much electricity is being used by each customer.
   e) Combine the following sentences to bring out the "Cause and Effect"
   Sand is mixed with the cement. It prevents the excessive shrinkage during drying.
   f) Give the words for the following transcriptions
   i) /tekˈnɒl.ə.dʒi/ **ii)** /prəˌnʌn*t*.siˈeɪ.ʃən/
   g) Write down the phonetic symbols of the letters underlined. i).**<u>Th</u>**ick ii) Plea**<u>s</u>**ure
   h) Syllabify the word and underline the stressed syllable: Communication
   i) Frame question tags for the following sentence: Don't open your books
   j) Fill in the blank with the correct form of the verb given in brackets.
   Tamil Nadu's share of students in the IITs and NITs ________ (register) a considerable drop in the recent years.
2. Read the following passage and answer the following (different types of) questions**.**
   - Descriptive questions for eliciting short answers
   - True or false
   - Sentence Completion
   - Synonyms/meaning of the words in the text

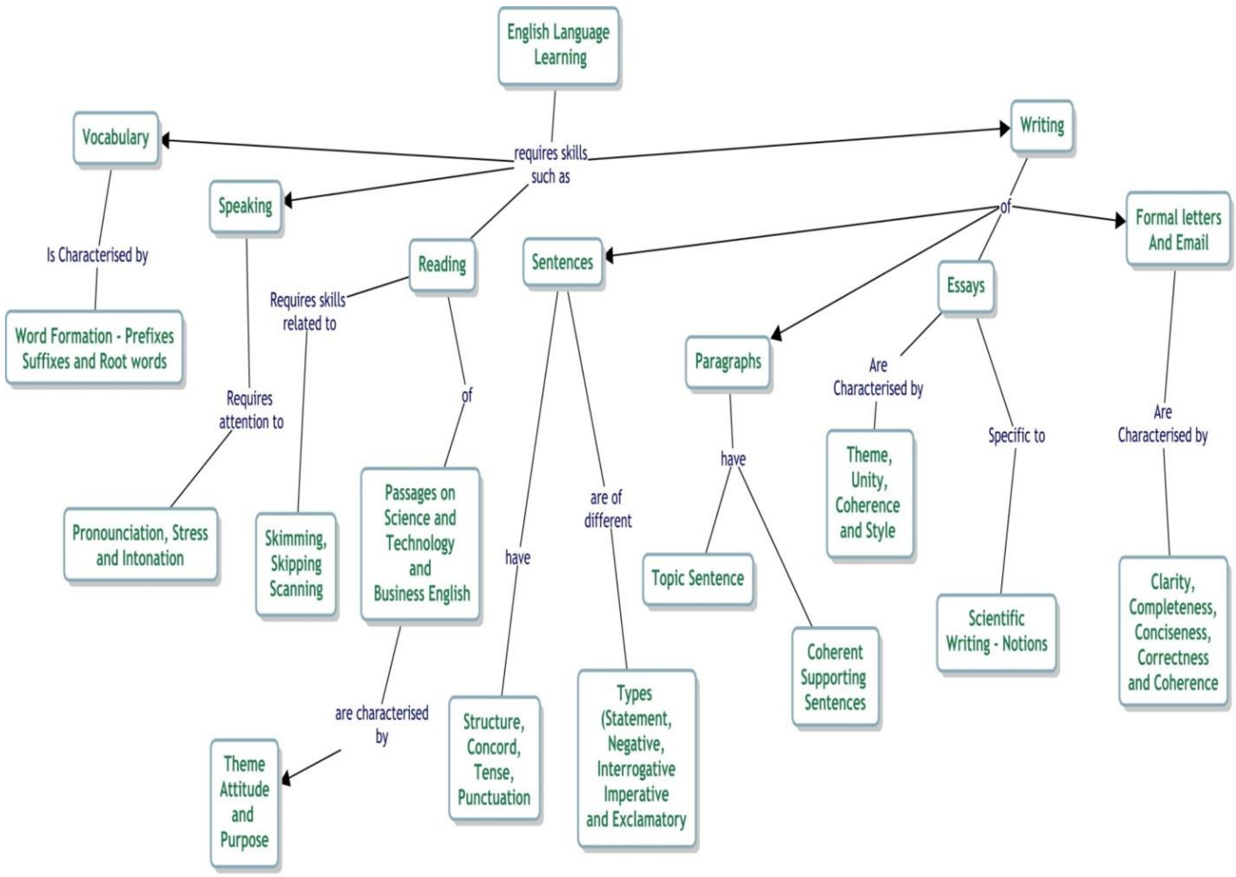
Course Outcomes 4 & 5

1. Write a paragraph in about 100-150 words on E-learning
2. Write a paragraph in about 100-150 words on Plastics
3. Write an e-mail to a company requesting permission to attend in-plant training for a fortnight.
4. Draft a letter to a company requesting you to undergo in-plant training there, inventing necessary details, in proper format.
5. Prepare a set of 10 instructions on how to draw money from an ATM.
6. Prepare a set of 12 recommendations to keep our environment clean.
7. Make notes of the passage given in appropriate format with a title andsummarize in about 100 words.
8. Interpret the following graphic data in about 150 words



9. Write an essay in about 250 words on 'The Impact of Technology on Nature'
10. Write an essay in about 250 words on 'Green Engineering')

Concept Map:



Syllabus:

MODULE- I

Basics of language – Phonetics - Phonemes, Syllables and Stress, Vocabulary – Word Analysis, Prefix, Suffix, Roots, Parts of Speech, Sentence Patterns.

MODULE- II

Basics of grammar – Tenses, Subject-Verb Agreement, Impersonal Passive Voice, Relative Clauses; Notions for Technical English – Noun Compounds, Classifications and Definitions, Cause and Effect, Purpose and Function, Numerical Adjectives, Reading Comprehension – Skimming, Scanning, Skipping (as tested in BEC Vantage Level)

MODULE-III

Writing with coherence and cohesion, Summarizing, Note-Making, Interpretation of Graphics, Writing Instructions and Recommendations, Paragraph and Essay Writing.

MODULE-IV

Writing with correct spelling, punctuation and grammar, Blog writing, E-mail Writing (BEC Vantage Writing-Unit I) – Formal Letters by students for Bonafide Certificate/Permission.

Suggested Reading:

Books:

1. Murphy, Raymond, English Grammar in Use with Answers; Reference and Practice for Intermediate Students, Cambridge: CUP, 2004
2. Jones, Daniel. An English Pronouncing Dictionary, Cambridge: CUP, 2006
3. Brook-Hart,Guy. Cambridge English- Business Benchmark-Upper Intermediate, CUP,2014.

4. Dhanavel, S.P. English and Communication Skills for Students of Science & Engineering, Orient BlackSwan, Chennai: 2016.
5. Swan, Michael. Practical English Usage.4th Edn. OUP. 2016.

Websites:

1. http://www.englishclub.com
2. http://owl.english.purdue.edu
3. https://www.oxfordonlineenglish.com
4. www.bbclearningenglish.com

Course Contents and Lecture Schedule

S.No	Topic	No. of Hours
1.	Introduction	1
2.	Sentence Patterns	1
3.	Tenses	2
4.	Subject-Verb Agreement	1
5.	Phonetics – Consonants, Vowels, Dipthongs	1
6.	Phonetics – Syllable and Stress	1
7.	Word Formation – Prefixes, Suffixes and Root Words	1
8.	Reading Comprehension - I (Skipping, Skimming, and Scanning)	1
9.	Note-Making and Summarizing	1
10.	Writing Instructions and Recommendations	1
11.	Tutorials	1
12.	Defining and Non-Defining Relative Clauses	1
13.	Impersonal Passive Voice	2
14.	Notions of Technical English – Noun Compounds, Definitions, Cause & Effect, Purpose and Function, Numerical Adjectives	1
15.	Paragraph / Essay Writing- Topic and Supporting Sentences, Coherence	2
16.	E-Mail Writing – (BEC Vantage Writing Task I)	1
17.	Formal Letters by students for Bonafide Certificate/Permission	1
18.	Interpretation of Graphics	1
19.	Reading Comprehension – II (As tested in BEC Writing Task III)	2
20.	Tutorials	1
Total		**24**

Course Designers:

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4	Dr. R. K. Jaishree Karthiga	jai@tce.edu

18ES150	ENGINEERING EXPLORATION

Category	L	T	P	Credit
ES	1	2	-	3

Preamble

The course Engineering Exploration provides an introduction to the engineering field. It is designed to help the student to learn about engineering and how it affects our everyday lives. On the successful completion of the course, students will be to explain how engineering is different from science and technology and how science, mathematics and technology are an integral part of engineering design.

Prerequisite

NIL

Course Outcomes

On the successful completion of the course, students will be able to

CO1. Explain technological & engineering development, change and impacts of engineering	Understand
CO2. Draw a product in enough detail that others can accurately build it and write specification sheet for a given product	Apply
CO3. Complete initial steps (Define a problem, list criteria and constraints, brainstorm potential solutions and document the ideas) in engineering design process	Apply
CO4. Draw sketches to a design problem and provide a trade-off matrix	Apply
CO5. Communicate possible solutions through drawings and prepare project report	Apply
CO6. Use reverse engineering to suggest improvements in a tool design	Apply
CO7. Apply the concept of engineering fundamentals in Civil, Mechanical, Electrical and Computer Engineering	Apply

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C01	M	L	-	-	-	-	-	-	-	-	-	-
C02	S	M	L	-	-	-	-	-	-	-	-	-
C03	S	M	L	-	-	-	-	-	-	-	-	-
C04	S	M	L	-	-	-	-	-	-	-	-	-
C05	S	M	L	-	-	-	-	-	-	-	-	-
C06	S	M	L	-	-	-	-	-	-	-	-	-
C07	S	M	L	-	-	-	-	-	-	-	-	-

S- Strong; M-Medium; L-Low

Assessment Pattern

S.No	Bloom's category	Continuous Assessment Tests			End Semester Examinations
		1	2	3	
1	Remember	20	20	20	20
2	Understand	20	20	20	20
3	Apply	60	60	60	60
4	Analyze	0	0	0	0
5	Evaluate	0	0	0	0

6	Create	0	0	0	0

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. What is the role of Engineer?
2. How do you believe the growth of engineering has impacted the product that we have today?
3. Select an engineering product, list the specifications and constraints that must be considered when designing the product. Make a list of tradeoff.

Course Outcome 2 (CO2):

1. List the steps of a design problem.
2. Identify the problem you see in the product you used in your daily life.
3. Determine the design constraint and criteria for a problem.
4. Create an isometric drawing of a design.

Course Outcome 3 (CO3):

1. List the five factors when considering development problem.
2. Imagine you have noticed the car you are riding is making a squeaking noise from the engine compartment. Define the problem with your vehicle. Classify the potential problem.
3. Imagine you are hired by your local city to develop a new public transportation.
    a. Define the problem.
    b. List the criteria and constraint.
    c. List the potential solution.

Course Outcome 4 (CO4):

1. Imagine you are an engineer who is designing a portable sitting device; you need to design a chair that will be portable that will fit in the trunk of the car which hold 100 kg individual and will be easily produced. Create sketches using a four step process to this design problem.
2. Imagine you are an engineer who develops method to automatically sort books at college library. Develop possible sketches and list potential solution and give the tradeoff matrix.
3. How can your research improve the design?

Course Outcome 5 (CO5):

1. What details are able to show with the perspective drawing?
2. What is the difference between mockup and prototype?
3. List five different question engineers must ask about function of the design.

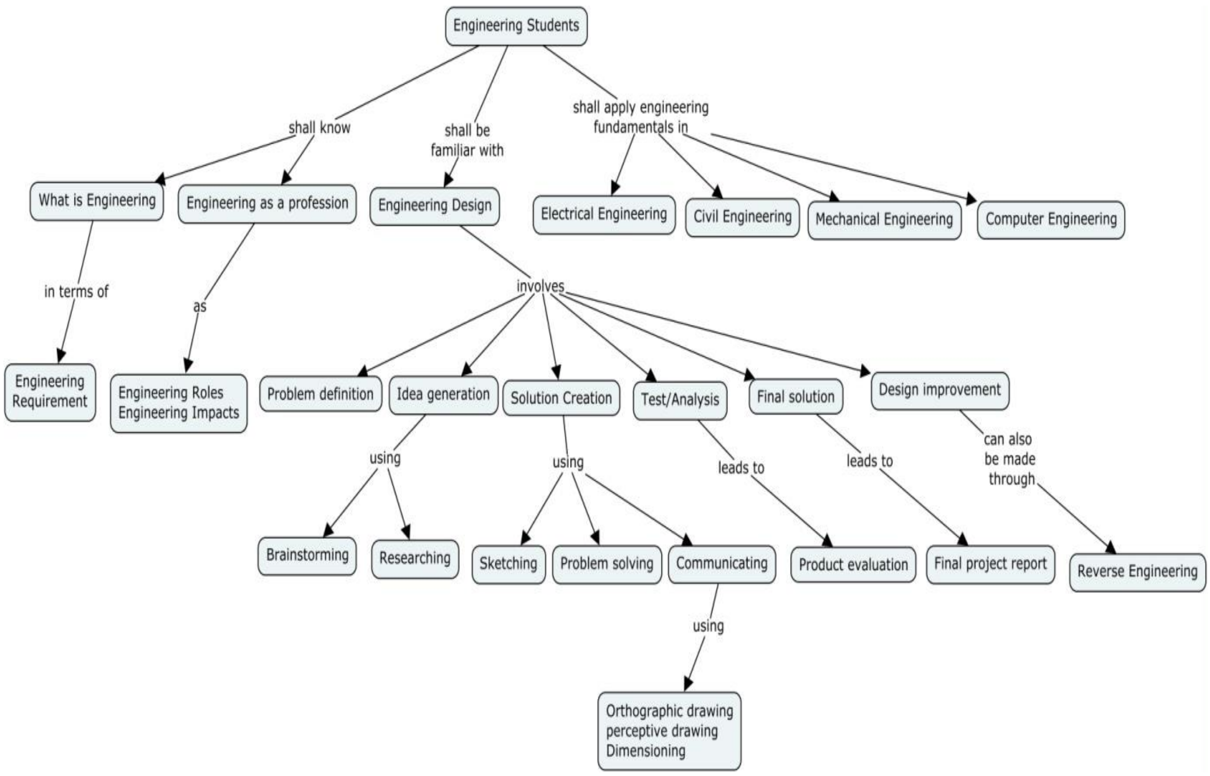
Course Outcome 6 (CO6):

1. Select a product to analyze with respect to function, fit, aesthetics, safety and environment impact. Write a summary on evaluation of the product. If you would like make changes to the design list the changes.
2. What design components should be reconsidered in reverse engineering processes? Why?
3. What are the benefits of reverse engineering?

Course Outcome 7 (CO7):

1. Explain ohms law and list the related formulas.
2. What role do you think the range selection plays in the accuracy of the measurements?
3. Why it is important for a civil engineer to study structural forces?
4. Describe the differences between fluids used in hydraulics and pneumatics.

Concept Map



Syllabus

What is Engineering: Engineering Requirement, Knowledge within Engineering disciplines, Engineering advancements **Engineering Design:** Problem definition, idea generation through brainstorming and researching, solution creation through evaluating and communicating, text/analysis, final solution and design improvement. **Defining problems and Brainstorming:** Researching design, sketching problem solving **Communicating solution**: Dimensioning orthographic drawing, perspective drawing **Modeling and Testing final output:** Product evaluation, reverse engineering, final project report. **Civil Engineering:** Structural forces structural analysis, bridge design components, structural design **Mechanical Engineering:** Types of motion, mechanical power system, mechanical power formula, mechanical design. **Electrical Engineering:** Reading analog multimeter, measuring current, voltage and resistance, electricity from chemicals, solar cells, magnets, Ohms law and watts law, circuit identification and circuit calculation, resistor color code, continuity **Computer Engineering:** Logic gates, algorithms, computer architecture, binary code

Reference Books

1. Ryan A.Brown, Joshua W.Brown and Michael Berkihiser: “Engineering Fundamentals: Design, Principles, and Careers”, Goodheart-Willcox Publisher, Second Edition, 2014.
2. Saeed Moaveni ,“Engineering Fundamentals: An Introduction to Engineering”, Cengage learning, Fourth Edition, 2011.

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1.	**What is Engineering**	
1.1	Engineering Requirement	1
1.2	Knowledge within Engineering disciplines,	1
1.3	Engineering advancements	1
2	**Engineering Design**	
2.1	Problem definition,	1
2.2	idea generation through brainstorming and researching	1
2.3	solution creation through evaluating and communicating,	1
2.4	text/analysis	1
2.5	final solution and design improvement	1
3	**Defining problems and Brainstorming:**	
3.1	Researching design	1
3.2	sketching problem solving	2
4	**Communicating solution**	
4.1	Dimensioning orthographic drawing	1
4.2	perspective drawing	1
5	**Modeling and Testing final output**	
5.1	Product evaluation	1
5.2	reverse engineering	1
5.3	final project report	1
6	**Civil Engineering**	
6.1	Structural forces structural analysis	2
6.2	bridge design components	2
6.3	structural design	1
7	**Mechanical Engineering**	
7.1	Types of motion	2
7.2	mechanical power system	1
7.3	mechanical power formula	1
7.4	mechanical design	1
8	**Electrical Engineering:**	
8.1	Reading analog multimeter, measuring current, voltage and resistance	1
8.2	electricity from chemicals, solar cells, magnets,	1
8.3	Ohms law and watts law, circuit identification and circuit calculation	1
8.4	resistor color code, continuity	2
9	**Computer Engineering**	

No.	Topic	No. of Lectures
9.1	Logic gates, algorithms,	1
9.2	computer architecture,	2
9.3	binary code	2
	Total	36

Course Designers:

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2. Dr. S.Baskar sbeee@tce.edu

18ME160	ENGINEERING GRAPHICS	Category	L	T	P	Credit
		ES	3	0	2	4

Preamble

Engineering Graphics is referred as language of engineers. An engineer needs to understand the physical geometry of any object through its orthographic or pictorial projections. The knowledge on engineering graphics is essential in proposing new product designs through drawings and in reading or understanding existing drawings. This course covers orthographic and pictorial projections, sectional views, development of surfaces and use of computer aided drafting tools.

Prerequisite

NIL

Course Outcomes

On successful completion of the course, students will be able to

CO1	Draw conic Sections such as ellipse, parabola, hyperbola and rectangular hyperbola.	Apply
CO2	Draw the orthographic projections (Elevation and Plan) of straight lines inclined to both reference planes.	Apply
CO3	Draw the orthographic projections (Elevation, Plan and End view) of plane surfaces inclined to both reference planes	Apply
CO4	Draw the orthographic projections (Elevation and Plan) of regular solids (Prisms, Pyramids, Cylinder and Cone) with axis inclined to any one reference plane.	Apply
CO5	Draw the orthographic projections (Elevation and Plan) of sectioned solids (Prisms, Pyramids, Cylinder and Cone) with axis perpendicular to horizontal plane and true shape of the sections.	Apply
CO6	Draw the development of surfaces (base and lateral) of sectioned regular solids (Prisms, Pyramids, Cylinder and Cone).	Apply
CO7	Draw the isometric projections of regular solids and combined solids (Prisms, Pyramids, Cylinder, Cone and sphere) and of solid parts from the orthographic views.	Apply
CO8	Develop computer-aided 3D models for the given part drawing (2D/3D) and draw orthographic views for the 3D model with appropriate dimensioning using CAD package. (Continuous Assessment only)	Apply

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1.	S	M	S	M	M	_	_	_	M	M	_	_
CO2.	S	M	S	M	M	_	_	_	M	M	_	_
CO3.	S	M	S	M	M	_	_	_	M	M	_	_
CO4.	S	M	S	M	M	_	_	_	M	M	_	_
CO5.	S	M	S	M	M	_	_	_	M	M	_	_
CO6.	S	M	S	M	M	_	_	_	M	M	_	_
CO7.	S	M	S	M	M	_	_	_	M	M	_	_
CO8.	S	M	S	M	S	_	_	_	M	M	_	_

Assessment Pattern

Bloom's Category	Continuous Assessment Test	Terminal Examination
Remember	0	0
Understand	0	0
Apply	100	100
Analyse	0	0
Evaluate	0	0
Create	0	0

Course Level Assessment Questions

Course Outcome 1 (CO1)

1. Draw an ellipse if the distance of focus from the directrix is 70 mm and the eccentricity is ¾.
2. Draw a parabola if the distance of focus from the directrix is 60 mm.

Course Outcome 2 (CO2)

2. One end "A" of a straight line AB 85 mm long is 10 mm above HP and 15 mm in front of VP. The line is inclined to HP at 40° and inclined to VP at 30°. Draw the projections.
3. A line CD has its end "C" 20 mm above HP and 25 mm in front of VP. The other end "D" is 45 mm above HP and 40 mm in front of VP. The distance between the end projectors is 60 mm. Draw its projections and find its true length.

Course Outcome 3 (CO3)

1. A semi circular plate of 80 mm diameter has its straight edge on V.P and inclined at 30° to H.P. The surface of the plate is inclined at 45° to V.P. Draw the projections of the plate.
2. A thin rectangular plate of 60 x 40 mm size has its shorter edge on H.P and inclined 30° to V.P. Draw the projections of the plate when its top view is a square of 40 mm side.

Course Outcome 4 (CO4)

1. A hexagonal prism of side of base 35 mm and axis length 80 mm rests on HP on one of its rectangular faces such that its axis is inclined to VP by 45°. Draw its elevation and plan.
2. A square pyramid of base side 40 mm and axis 75 mm long is resting on one of its base edges in such a way that one of its triangular faces is perpendicular to both HP and VP. Draw its front view and top view.

Course Outcome 5 (CO5)

1. A cone of base 75 mm diameter and axis 80 mm long is resting on its base on H.P. It is cut by a section plane perpendicular to VP, inclined at 45° to H.P and cutting the axis at a point 35 mm from the apex. Draw the front view, sectional top view and true shape of the section.
2. A hexagonal pyramid, base 30 mm side and axis 65 mm long is resting on its base on HP with two edges of the base parallel to V.P. It is cut by a section plane perpendicular to V.P and inclined 45° to H.P, intersecting the axis at a point 25 mm above the base. Draw the front view, sectional top view and true shape of the section.

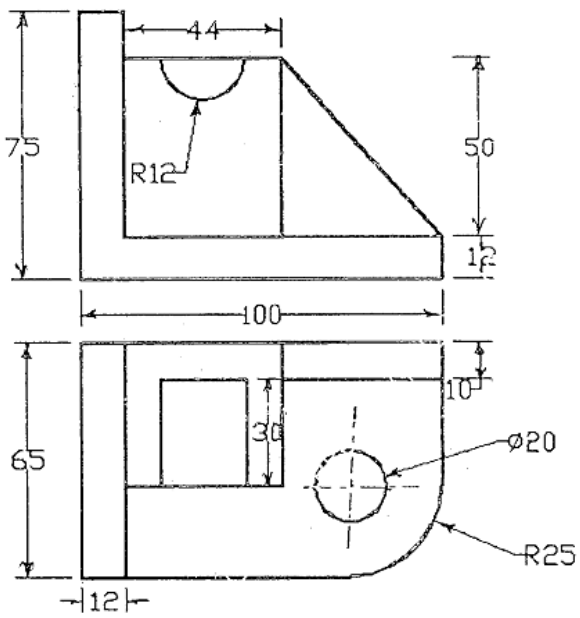
Course Outcome 6 (CO6)

1. A cone of base diameter 60 mm and axis 70 mm long is resting on its base on H.P. A section plane perpendicular to H.P and V.P cuts the cone at a distance of 10 mm from the axis. Draw the development of the cut solid.

2. A pentagonal prism of base side 30 mm and axis height 75 mm is resting on its base on HP such that rectangular face is parallel to V.P. It is cut by a cutting plane perpendicular to V.P and 30° inclined to H.P. It meets the axis 15 mm below the top base. Draw the development of the cut prism.

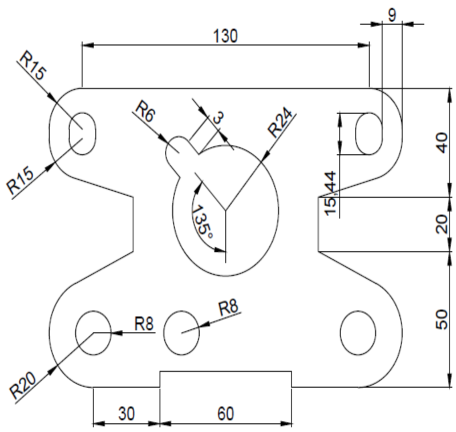
Course Outcome 7 (CO7)

1. Draw the isometric projection of hexagonal prism of base side 40 mm and height 60 mm with a right circular cone of base diameter 50 mm and altitude 50 mm resting on its top such that the axes of both solids are collinear and vertical.
2. Draw the isometric view of the part with the following orthographic views.

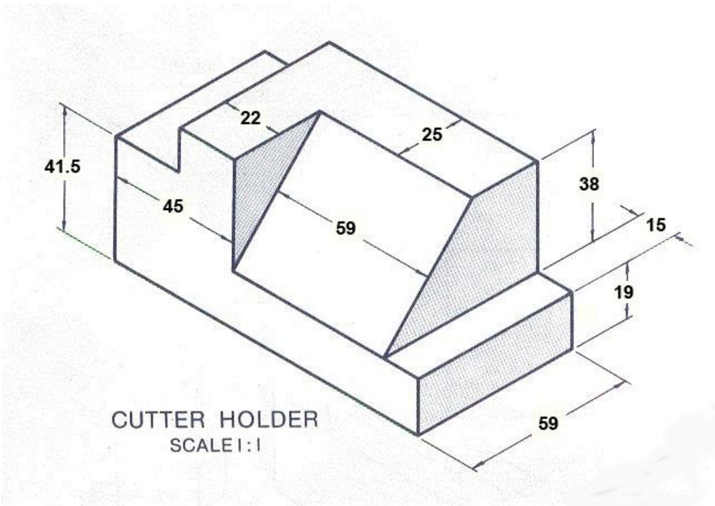


Course Outcome 8 (CO8)

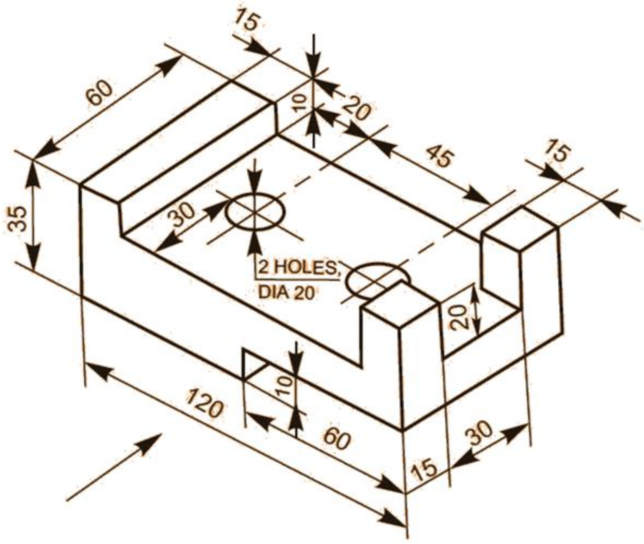
1. Develop a 2D model using CAD package for the given figure.



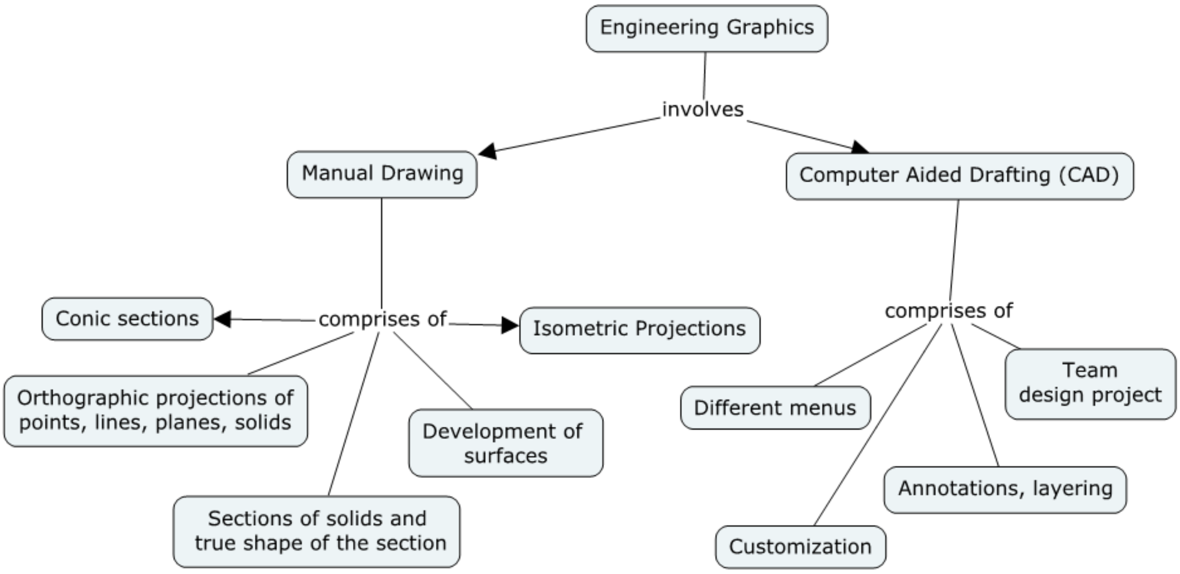
2. Develop a 3D model using CAD package for the given part drawing.



2. Draw the orthographic views for the given 3D model with appropriate dimensioning using CAD package.



Concept Map



Syllabus

Introduction- Significance of engineering graphics, Use of drawing instruments –Standards, Lettering, numbering and dimensioning, Principles of orthographic projections, First angle projection, Scales.

Conic Sections - Construction of ellipse, parabola, hyperbola (Eccentricity Method only) and rectangular hyperbola.

Projection (Elevation and Plan) of points located in all quadrants.

Projection (Elevation and Plan) of straight lines inclined to both reference planes - Determination of true lengths and true inclinations by rotating line method.

Projection (Elevation, Plan and End view) of planes inclined to both reference planes by rotating object method.

Projection (Elevation and Plan) of regular solids (Prisms, Pyramids, Cylinder and cone) by rotating object method when the axis is inclined to one of the reference planes.

Projection (Elevation and Plan) of sectioned solids (Prisms, Pyramids, Cylinder and cone) and true shape of the sections, when the axis of the solid is perpendicular to horizontal plane.

Development of surfaces (base and lateral) **of sectioned regular solids** (Prisms, Pyramids, Cylinder and Cone).

Isometric projection – Principle, isometric scale, Isometric views and Isometric projections of single solid and combined solids (Prisms, Pyramids, Cylinder, Cone and sphere) when the axis is vertical. **Conversion of orthographic projections** (Elevation, Plan and End view) of solid parts / engineering components into isometric view.

Computer Aided Drafting (For Continuous Assessment only)**:**

Overview of Computer Graphics, list of computer technologies, impact on graphical communication. Demonstrating knowledge of the theory of CAD software such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus

(Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects. Setting up of units and drawing limits.
Drawing geometric entities such as lines, arcs and circles in isometric views. Development of 3D wire-frame and shaded models. Dimensioning – Guidelines – ISO and ANSI standards for coordinate dimensioning - Defining local coordinate systems – Dimensioning in iso-metric and orthographic views.

Text Book

1. Bhatt N.D., Panchal V.M. and Ingle P.R., (2014) “Engineering Drawing”, Charotar Publishing House.

Reference Books

1. Natarajan K.V., “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2009.
2. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008
3. Venugopal K. and Prabhu Raja V., “Engineering Graphics”, New Age International (P) Limited, 2008.
4. Gopalakrishna K.R., “Engineering Drawing” (Vol. I&II combined), Subhas Stores, Bangalore, 2007.
5. Shah M.B, and Rana B.C (2008) “Engineering Drawing and Computer Graphics”, Pearson Education.
6. (Corresponding set of) CAD Software Theory and User Manuals.

Course Contents and Lecture Schedule

Sl.No	Topic	Lecture Hours	Practice Hours
1	**Introduction**- Significance of engineering graphics, Use of drawing instruments –Standards, Lettering, numbering and dimensioning, Principles of orthographic projections, First angle projection, Scales.	2	1
2	**Conic Sections** - Construction of Ellipse, Parabola, hyperbola and rectangular hyperbola (Eccentricity Method only).	2	3
3	**Projection (Elevation and Plan) of points** located in all quadrants.	2	1
4	**Projection (Elevation and Plan) of straight lines** inclined to both reference planes - Determination of true lengths and true inclinations by rotating line method.	4	2
5	**Projection (Elevation, Plan and End view) of planes** inclined to both reference planes by rotating object method.	5	2
6	**Projection (Elevation and Plan) of regular solids** (Prisms, Pyramids, Cylinder and cone) by rotating object method when the axis is inclined to one of the reference planes.	5	3
7	**Projection (Elevation and Plan) of sectioned solids** (Prisms, Pyramids, Cylinder and cone) and true shape of the sections, when the axis of the solid is perpendicular to horizontal plane.	4	2
8	**Development of surfaces** (base and lateral) **of sectioned regular solids** (Prisms, Pyramids, Cylinder and Cone).	4	2
9	**Isometric projection** – Principle, isometric scale, Isometric views and Isometric projections of single solid and combined solids (Prisms, Pyramids, Cylinder, Cone and sphere) when the	4	2

	axis is vertical. **Conversion of orthographic projections** (Elevation, Plan and End view) of solid parts / engineering components into isometric view.		
10	**Computer Aided Drafting** (For Continuous Assessment only)**:** **10.1** Overview of Computer Graphics, list of computer technologies, impact on graphical communication. Demonstrating knowledge of the theory of CAD software such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects. Setting up of units and drawing limits.	1	1
	10.2 Drawing geometric entities such as lines, arcs and circles in isometric views. Development of 3D wire-frame and shaded models. Dimensioning – Guidelines – ISO and ANSI standards for coordinate dimensioning - Defining local coordinate systems – Dimensioning in iso-metric and orthographic views.	3	5
	TOTAL	**36**	**24**

Question Pattern for Terminal Examination

Question Number	Description	Type	Marks
1	Conic sections	Either or type	10
2	Projection of lines	Either or type	15
3	Projection of planes	Either or type	15
4	Projection of solids	Either or type	15
5	Section of solids	Either or type	15
6	Development of surfaces	Either or type	15
7	Isometric projections of combined solids Or Orthographic views to isometric view	Either or type	15
Total			**100**

Marks Allocation for Continuous Assessment:

Sl. No	Description	Marks
1	Plates (Drawing sheets) submission	20
2	Computer Aided Drafting (CAD) Exercises	15
3	Continuous Assessment Test (CAT)	15
Total		**50**

Note:

1. One test or two tests will be conducted locally by respective faculty-in- charge during regular class hours to account for continuous assessment test (CAT) marks.
2. Terminal examination (3 hrs) will be conducted centrally by the office of controller of examinations.

Course Designers

1. Dr. A.Samuel Raja samuel1973@tce.edu
2. Prof. M.Kannan mknmech@tce.edu

18EG170	ENGLISH LABORATORY	Category	L	T	P	Credit
		HSS	0	0	2	1

Preamble

This practical course enables the students to develop and evaluate their basic English language skills in Language Lab, equipped with English Software, through individualized learning process and immediate feedback, and facilitates students with the need-based student-centric presentation sessions in a multi-media driven classroom environment.

Prerequisite

NIL

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Pronounce words intelligibly through listening and watching contents on social, technical and day-to-day conversations and respond to questions related to them	Apply
CO2	Apply appropriate lexicon in various contexts, by differentiating variations pertaining to spelling, pronunciation, meaning and grammar	Apply
CO3	Comprehend passages on various topics like general, business and science at various levels	apply
CO4	Read texts in newspapers, magazines, and articles on a variety of issues with clarity to understand and to be understood	Apply
CO5	Prepare and present on a topic to a group of audience with ICT and other educational aids	Apply

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										**S**		**S**
CO2										**S**		**M**
CO3										**S**		**S**
CO4										**S**		**M**
CO5										**S**		**S**

Assessment Pattern

Internal: No Continuous Assessment Test will be conducted

Students' performance will be assessed in the classroom as given below

- Spoken Task - General / Technical Presentation / BEC Speaking Tests II: 25 Marks
- Listening Task - Answering questions : 25 Marks

External: Tested on Phonetics, Grammar, and Vocabulary in the lab for 1 hour : 80 Marks

Submission of Students Record on Practical Tasks in the Class and Lab : 20 Marks

List of Experiments

S.No	Topic	Hours
	LAB ACTIVITES	
1	Listening	2
2	Vocabulary	2
3	Grammar	2
4	Phonetics	2
5	Reading Comprehension – I (General)	2
6	Reading Comprehension – II (BEC Vantage Level)	2
	CLASSROOM ACTIVITIES	
7	Reading Practice (Extensive Reading)	2
8	English through Audios & Videos (Note-Taking & answering questions)	2
9	Presentation - I	2
10	Presentation - II	2
11	Revision	2
12	Model Test	2
	Total	24

Software Used:

1. Business English Certificate-Vantage- Practice Software
2. English Software

Extensive Reading: (Not for Terminal Exam, Prescribed only for Spoken Tasks)

1. Khera, Shiv, You Can Win, Macmillan Books, New York, 2003.

Teaching Resources and Websites:

1. Oxford / Cambridge Online English Videos
2. Free Video Downloads from Youtube
3. https://learningenglish.voanews.com/
4. https://www.ted.com/talkshttp://
5. www.esl-galaxy.com/video.htm

Course Designers:

1	Dr. S. Rajaram	sreng@tce.edu
2	Dr.A.Tamilselvi	tamilselvi@tce.edu
3	Mr. R. Vinoth	vino@tce.edu
4	Dr. R. K. Jaishree Karthiga	jai@tce.edu

18PH180	PHYSICS LABORATORY	Category	L	T	P	Credit
		BS	0	0	2	1

Preamble

This course ensures that students learn to apply the basic physics concepts and carry out the experiments to determine the various physical parameters related to the material

- Learn the necessary theory to understand the concept involved in the experiment.
- Acquire the skills to carry out the experiment.
- Tabulate the observed data and use the formula to evaluate the required quantities.
- Plot the data in a graph and use it for calculation.

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Analyze mechanical ,electrical oscillations and determine their resonance frequency	Apply
CO2	Analyze the diffraction and interference patterns for characterization	Apply
CO3	Determine the numerical aperture and bending loss in optical fiber	Apply
CO4	Determine the Planck's constant by using LEDs	Apply
CO5	Plot the VI characteristics of solar cell	Apply
CO6	Determine the time constant of an RC circuit	Apply
CO7	Determine the reversibility of classical and quantum logic gates	Apply

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	S	S	-	-	-	-	-	-	-	-
CO2	S	S	S	S	-	-	-	-	-	-	-	-
CO3	S	S	S	S	-	-	-	-	-	-	-	-
CO4	S	S	S	S	-	-	-	-	-	-	-	-
CO5	S	S	S	S	-	-	-	-	-	-	-	-
CO6	S	S	S	S	-	-	-	-	-	-	-	-
CO7	S	S	S	S	-	-	-	-	-	-	-	-
S- Strong; M-Medium; L-Low												

List of Experiments

OSCILLATIONS AND WAVES

1. Torsion pendulum- Determination of Moment of inertia of a disc
2. Compound pendulum –Determination of acceleration due to gravity

OPTICS

3. Spectrometer-Determination of Refractive index of the material of the prism.
4. Laser Diffraction – Determination of wavelength of Laser and particle size in a thin film.
5. Air wedge –Determination of diameter of wire by interference principle.
6. Fiber optics-Determination of numerical aperture and bending losses.

QUANTUM MECHANICS

7. Photoelectric effect-Determination of Planck's constant
8. Solar cell-Plotting and studying of V-I characteristic
9. Study of Classical and quantum Logic gates.

ELECTROMAGNETIC THEORY

10. RC circuit –Determination of time constant
11. LCR Circuit- Determination of resonant frequency

Course Designers:

1. Dr. R. Vasuki rvphy@tce.edu
2. Dr. M.Mahendran mmphy@tce.edu
3. Mr. V.Veeraganesh vvgphy@tce.edu
4. Dr. A.L.Subramaniyan alsphy@tce.edu
5. Dr.D.Ravindran drphy@tce.edu

18CH190	CHEMISTRY LABORATORY

Category	L	T	P	Credit
BS	0	0	2	1

Preamble

This course aims to provide the students, a basic practical knowledge in chemistry. The objective of this course is to develop intellectual and psychomotor skills of the students by providing hands on experience in quantitative, electrochemical and photo-chemical analysis.

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Estimate the chemical water quality parameters of sample water	Apply
CO2	Demonstrate the rate of corrosion of steel by weight loss method	Apply
CO3	Estimate the strength of acidic solution and pH of soil by conductometric and pH metric titrations	Apply
CO4	Illustrate the strength of oxidisable materials present in given sample by potentiometric method	Apply
CO5	Adapt colorimetric method for determination of iron in water	Apply

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	M	-	-	-	L	-	L	-	-	-
CO2	S	S	M	-	-	-	L	-	L	-	-	-
CO3	S	S	M	-	-	-	L	-	M	-	-	-
CO4	S	M	-	-	-	-	-	-	-	-	-	-
CO5	S	S	M	-	-	-	L	-	-	-	-	-

List of Experiments

A. Quantitative analysis

1. Estimation of Total hardness of water
2. Estimation of Ca^{2+} and Mg^{2+} individual hardness of water samples
3. Estimation of alkalinity of water sample
4. Estimation of COD of industrial effluent
5. Estimation of Chloride in a water sample
6. Estimation of rate of corrosion of steel by weight loss method

B. Electrochemical and photochemical analysis

1. Conductometry Titration (Strong acid vs Strong base)
2. Potentiometric redox Titration ($K_2Cr_2O_7$ vs FAS, $KMnO_4$ vs FAS)
3. Determination of pH of soil by pH metric titration
4. Estimation of iron content of water sample using colorimeter

Course Designers:

Dr. M. Kottaisamy	hodchem@tce.edu
Dr. K. Radha	krchem@tce.edu
Dr. J. Shanmugapriya	shanamugapriya@tce.edu
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Dr. M. Velayudham	mvchem@tce.edu

CURRICULUM AND DETAILED SYLLABI

FOR

B.E DEGREE (Computer Science and Engineering) PROGRAMME

SECOND SEMESTER

FOR THE STUDENTS ADMITTED FROM THE

ACADEMIC YEAR 2018 - 2019 ONWARDS

THIAGARAJAR COLLEGE OF ENGINEERING
(A Government Aided ISO 9001-2008 certified
Autonomous Institution affiliated to Anna University)

MADURAI – 625 015, TAMILNADU

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THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015
B.E Degree (Computer Science and Engineering) Programme
COURSES OF STUDY
(For the candidates admitted from 2018 -19 onwards)

SECOND SEMESTER

Course Code	Name of the Course	Category	No. of Hours / Week			Credits
			L	T	P	
THEORY						
18MA210	Matrices and Ordinary Differential Equations	BS	3	-	-	3
18CS220	Problem Solving using Computers	ES	3	-	-	3
18CS230	Digital Circuits	PC	3	-	-	3
18CS240	Computer Organization and Architecture	PC	3	-	-	3
THEORY CUM PRACTICAL						
18CS260	Computer Programming	PC	2	-	2	3
PRACTICAL						
18CS270	Digital Circuits Lab	PC	-	-	2	1
18CS280	Workshop	ES	-	-	2	1
18ES290	Lateral Thinking	ES	-	-	2	1
MANDATORY AUDIT COURSE						
18CHAA0	Environmental Science	AC	1	-	1	-
Total			**15**	**-**	**9**	**18**

AC : Audit Course
BS : Basic Science
HSS : Humanities and Social Science
ES : Engineering Science
PC : Program Core

L : Lecture
T : Tutorial
P : Practical

Note:

1 Hour Lecture is equivalent to 1 credit

1 Hour Tutorial is equivalent to 1 credit

2 Hours Practical is equivalent to 1 credit

THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015
B.E Degree (Computer Science and Engineering) Programme

SCHEME OF EXAMINATIONS
(For the candidates admitted from 2018-19 onwards)

SECOND SEMESTER

S.No.	Course Code	Name of the Course	Duration of Terminal Exam. in Hrs.	Marks			Minimum Marks for Pass	
				Continuous Assessment	Terminal Exam *	Max. Marks	Terminal Exam	Total
THEORY								
1	18MA210	Matrices and Ordinary Differential Equations	3	50	50	100	25	50
2	18CS220	Problem Solving using Computers	3	50	50	100	25	50
3	18CS230	Digital Circuits	3	50	50	100	25	50
4	18CS240	Computer Organization and Architecture	3	50	50	100	25	50
THEORY CUM PRACTICAL								
5	18CS260	Computer Programming	3	50	50	100	25	50
PRACTICAL								
6	18CS270	Digital Circuits Lab	3	50	50	100	25	50
7	18CS280	Workshop	-	100	-	100	-	50
8	18ES290	Lateral Thinking	-	50	50	100	25	50
MANDATORY AUDIT COURSE								
9	18CHAA0	Environmental Science	-	50	50	100	25	50

* Terminal Examination will be conducted for maximum marks of 100 and subsequently be reduced to 50 marks for the award of terminal examination marks

18MA210	MATRICES AND ORDINARY DIFFERENTIAL EQUATIONS

Category	L	T	P	Credit
BS	3	0	0	3

Preamble

In engineering, particularly Solid Mechanics, Aerodynamics, Fluid Flow, Heat Flow and Robotics have application that requires an understanding of Vector Calculus and Differential Equations. Also Mathematical tool Laplace Transforms is very much essential to solve ordinary differential equations that occur in the above areas. Eigen values and Eigenvectors are extremely important while creating engineering models in control systems, designing bridges, communication systems and searching algorithms. The course is designed to impart the knowledge and understanding of the above concepts to all Engineers and apply them in their areas of specialization.

Prerequisite

18MA110 Engineering Calculus

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	Course Outcome Statement	Weightage in %
CO1	Compute the Laplace transform and inverse Laplace transform of different functions	10%
CO2	Solve the given initial value problem using Laplace transform	15%
CO3	Apply matrix algebra techniques for transformations of conic sections into principle axes	25%
CO4	Solve the model developed for the given system using ordinary differential equation	25%
CO5	Compute divergence and curl of vector functions	10%
CO6	Apply the concepts of vector differentiation and vector integration to fluid flow and heat transfer problems	15%

CO Mapping with CDIO Curriculum Framework

CO	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components
		Cognitive	Affective	Psychomotor	
CO1	TPS2	K2	A2	-	1.1
CO2	TPS3	K3	A3	-	1.1
CO3	TPS3	K3	A3	-	1.1
CO4	TPS3	K3	A3	-	1.1
CO5	TPS2	K2	A2	-	1.1
CO6	TPS3	K3	A3	-	1.1

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1.	S	M			-	-	-	-		-	-	
CO2.	S	S	S		-	-	-	-	M	-	-	M
CO3.	S	S		S	-	-	-	-		-	-	S

CO4.	S	S	S	S	-	-	-	-	M	-	-	M
CO5.	S	M										
CO6.	S	S	S									

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Assignment			Terminal Examination
	1	2	3	1	2	3	
Remember	10	10	10				10
Understand	30	30	30				20
Apply	60	60	60	100	100	100	70
Analyse	00	00	00				00
Evaluate	00	00	00				00
Create	00	00	00				00

Sample Questions for Course Outcome Assessment**

Course Outcome 1

1. Show that Laplace transform of $\frac{1}{\sqrt{t}}$ is $\frac{\sqrt{\pi}}{s}$.
2. Identify the inverse Laplace transform of $\log\left(\frac{s^2+1}{(s-1)^2}\right)$.
3. Discuss any three properties of Laplace transforms.

Course Outcome 2

1. Apply Laplace transform solve $y''+9y=\delta\left(t-\frac{\pi}{2}\right)$, $y(0)=2,\ y'(0)=0$.
2. By using Laplace transform, solve $x''(t)+3x'(t)+2x(t)=2(t^2+t+1)$; with $x(0)=2, x'(0)=0$.
3. Apply convolution theorem, Solve the Voltera integral equation of the second kind $y(t)-\int_0^t y(\tau)\sin(t-\tau)d\tau=t$.

Course Outcome 3

1. An elastic membrane in the $x_1\ x_2$ plane with boundary circle $x_1^2+x_2^2=1$ is stretched so that a point $P;(x_1,x_2)$ goes over into the point $Q;(y_1,y_2)$ given by $\begin{matrix} y_1=5x_1+3x_2 \\ y_2=3x_1+5x_2 \end{matrix}$
   Find the principal directions that is the directions of the position vector X of P for which the direction of the position vector Y of Q is the same or exactly opposite. Predict the boundary circle take under this deformation?
2. Discover the type of conic section the following quadratic form represents and transform it to principal axes: $Q=17x_1^2-30x_1x_2+17x_2^2=128$.

3. Diagonalize the matrix $\begin{bmatrix} 6 & 0 & 0 \\ 12 & 2 & 0 \\ 21 & -6 & 9 \end{bmatrix}$

Course Outcome 4

1. Reduce to first order and solve $y''-y'=0$
2. Compute the general solution for $y''+y'+(\pi^2+1/4)y=e^{-x/2}\sin \pi x$
3. Solve $(x^2D^2-4xD-6)y=c$

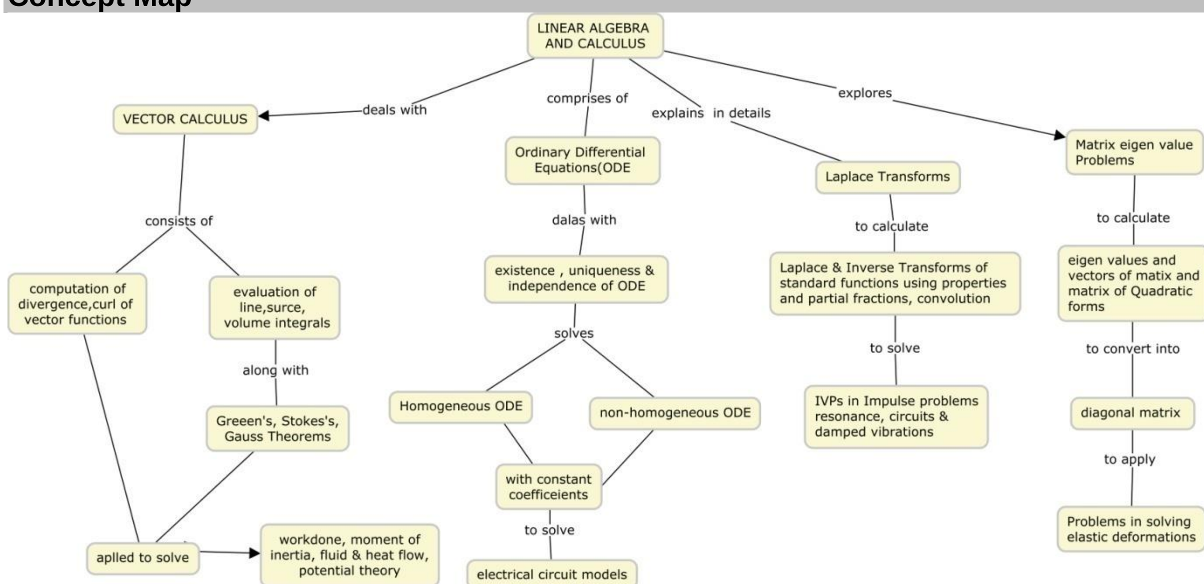
Course Outcome 5

1. Predict the value of $div(curl\vec{F})$.
2. If ϕ_1 and ϕ_2 are scalar point functions and $\vec{F}$ is a vector point function such that $\phi_1\vec{F}=\nabla\phi_2$ then identify $\vec{F}.curl\,\vec{F}$.
3. Estimate $curl\,\vec{v}$, where $\vec{v}=\left[e^{-z^2},e^{-x^2},e^{-y^2}\right]$.

Course Outcome 6

1. Predict the work done by the force $\vec{F}=[y^2,-x^2]$ acting on a particle in $y=4x^2$ from (0,0) to (1,4).
2. Compute the amount of fluid that crosses the surface in a flow per unit time at any one instant, if the velocity field is $\vec{v}=y\vec{\imath}+x\vec{\jmath}+z\vec{k}$ over the boundary of the region enclosed by the paraboloid z = 1- x^2 - y^2 and the plane z = 0.
3. Apply Stokes theorem to compute $\int_C \vec{F}.\vec{r}'ds$ where $\vec{F}=[y,xz^3,-zy^3]$ and C is circle $x^2+y^2=4, z=-3$.

Concept Map



Syllabus

LAPLACE TRANSFROMS: Laplace transform, Linearity, First Shifting theorem – Transforms of derivatives and integrals, ODEs – Unit step function, Second shifting theorem – Short

Impulses, Dirac's delta function, partial fractions – Convolution, Integral Equations – Differentiation and integration of transforms. **MATRIX EIGEN VALUE PROBLEM:** The Matrix Eigen value Problem, Determining Eigenvalues and Eigenvectors – Some Applications of Eigen value Problems – Symmetric, Skew symmetric and orthogonal matrices – Eigen bases, Diagonalization, Quadratic forms. **ORDINARY DIFFERENTIAL EQUATION:** Homogeneous Linear ODEs of second order – Homogeneous Linear ODEs with constant coefficients – Euler Cauchy Equation – Existence and uniqueness of solutions, Wronskian - Nonhomogeneous ODE – Modelling: Electric Circuits- Solution by Variation of Parameters. **VECTOR CALCULUS:** Divergence of a Vector Field- Curl of a Vector Field- Line Integrals- Path independence of line integrals- Green's Theorem in the plane- Surface Integrals- Triple Integrals, Divergence Theorem of Gauss- Applications of the Divergence Theorem- Stoke's Theorem.

Learning Resources

1. Erwin Kreszig, "Advanced Engineering Mathematics",10th edition, Wiley, 2017.
    a. Laplace transforms : [sections 6.1,6.2,6.3,6.4,6.5,6.6]
    b. Matrix eigen value problem : [sections 8.1,8.2,8.3,8.4]
    c. Ordinary differential equations : [sections 2.1,2.2,2.5,2.6,2.7,2.9,2.10]
    d. Vector calculus : [sections 9.8.9.9,10.1,10.2,10.4,10.6, 10.7,10.8,10.9]
2. Peter V.O'Neil, "Advanced Engineering Mathematics", 7th edition, Cengage Learning, 2017.
3. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education, New Delhi, 2016.
4. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.
5. Made Easy Team, Engineering Mathematics, Made Easy Publications, 2018.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1.	**LAPLACE TRANSFORMS**		
1.1	Laplace Transform. Linearity. First Shifting Theorem (*s*-Shifting)	2	CO1
1.2	Transforms of Derivatives and Integrals. ODEs	2	CO2
1.3	Unit Step Function (Heaviside Function). Second Shifting Theorem (*t*-Shifting)	1	CO1
1.4	Short Impulses. Dirac's Delta Function. Partial Fractions	1	CO1
1.5	Convolution. Integral Equations	2	CO2
1.6	Differentiation and integration of transforms	1	CO1
2	**MATRICES EIGEN VALUE PROBLEMS**		
2.1	Determining Eigenvalues and Eigenvectors	2	CO3
2.2	Some Applications of Eigenvalue Problems	1	CO3
2.3	Symmetric, Skew-Symmetric, and Orthogonal Matrices	2	CO3
2.4	Eigenbases. Diagonalization.	2	CO3
2.5	Quadratic Forms	2	CO3
3	**ORDINARY DIFFERENTIAL EQUATION**		
3.1	Homogeneous Linear ODEs of Second Order	2	CO4
3.2	Homogeneous Linear ODEs with Constant Coefficients	1	CO4
3.3	Euler–Cauchy Equations	1	CO4
3.4	Existence and Uniqueness of Solutions. Wronskian	1	CO4

3.5	Nonhomogeneous ODEs	2	CO4
3.6	Solution by Variation of Parameters	2	CO4
4	**VECTOR CALCULUS**		
4.1	Divergence and Curl of a Vector Field	2	CO5
4.2	Line Integrals	2	CO6
4.3	Green's Theorem in the Plane	1	CO6
4.4	Surface Integrals	1	CO6
4.5	Triple Integrals. Divergence Theorem of Gauss	1	CO6
4.6	Applications of the Divergence Theorem	1	CO6
4.7	Stoke's Theorem	1	CO6
	TOTAL No. of Hours	36	

Course Designers

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18CS220	PROBLEM SOLVING USING COMPUTERS

Category	L	T	P	Credit
ES	3	0	0	3

Preamble

This course is intended for the candidate who desires to learn problem-solving techniques and the design of computer solutions in a precise manner. The course emphasizes problem-solving methodologies, algorithm designs and developments and computer-programming skills.

Prerequisite

Nil

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage in %
CO1	Explain an algorithmic solution for the given requirements using problem decomposition and step-wise refinement. (Understand)	10
CO2	Construct algorithms for solving engineering problems using appropriate repetition and selection constructs. (Apply)	20
CO3	Demonstrate fundamental programming knowledge by designing structured programs and algorithms with the help of fundamental data structures. (Understand)	15
CO4	Solve searching, sorting and string manipulation problems using iteration or modularization as applicable. (Apply)	20
CO5	Describe methods for text processing and pattern searching. (Understand)	15
CO6	Develop programs based on the algorithms devised for solving problems. (Apply)	20

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	-	1.2
CO2	TPS3	Apply	Value	-	1.2,2.5.4
CO3	TPS2	Understand	Respond	-	1.2
CO4	TPS3	Apply	Value	-	1.2,2.4.1

CO5	TPS2	Understand	Respond	-	1.2
CO6	TPS3	Apply	Value	Mechanism	1.2,2.5.1,2.5.2, 2.4.7

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	M	M	L									L	M		
CO2	S	S	M		L	L		L	L			L	S	L	L
CO3	M	M	L		L							L	M		
CO4	S	S	M		L	L		L	L			L	S	L	L
CO5	M	M	L									L	M		
CO6	S	S	M		S	L		L	L			L	S	L	L

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Assignment			Terminal Examination
	1	2	3	1	2	3	
Remember	20	20	20	-	-	-	20
Understand	50	40	40	30	20	20	40
Apply	30	40	40	70	50	50	40
Analyse	-	-	-	-	-	-	-
Evaluate	-	-	-	-	-	-	-
Create	-	-	-	-	-	-	-

Assessment Pattern: Psychomotor

Psychomotor Skill	Assignment 2,3
Perception	-
Set	-
Guided Response	-
Mechanism	30
Complex Overt Responses	-
Adaptation	-
Origination	-

Sample Questions for Course Outcome Assessment

Course Outcome 1(CO1):

1. Draw the flowchart to find the biggest of 3 numbers (Understand)
2. Explain the pseudo code to get three marks of a student and find the average of 3 marks and display it. (Understand)

Course Outcome 2(CO2):

1. Write a pseudo code to generate Fibonacci series up to ‘n’ terms. (Apply)

2. Develop an algorithm that will read two integer numbers and an integer code from user. The value of the integer code should be 1, 2 or 3. The table below specifies the process to be taken based on the integer code. The program displays the computed result to the screen.(Apply)

Integer code	**Tasks/Actions to be taken**
1	Compute the sum of the two numbers
2	Compute the difference of the two numbers (first number– second number)
3	Compute the product of the two numbers
4	Display error

Course Outcome 3(CO3):

1. Discuss the logic of algorithm that will get an array of 10 character letters, count the number of vowels in the array. A letter, such as a, e, i, o, and u in the English alphabet represents a vowel. The algorithm is then to display the number of vowels in the array. (Understand)
2. Give an algorithm that gets the maximum and minimum value in a dictionary. (Understand)

Course Outcome 4 (CO4):

1. Develop an algorithm to compare two strings. (Apply)
2. Given an array arr = {4, 6, 72, 81, 91} and key = 81; How many iterations are done until the element is found in Binary Search? (Apply)
3. Develop an algorithm with swap_case function that works like this: (Apply)
   i/p : Hello
   o/p: hELLO

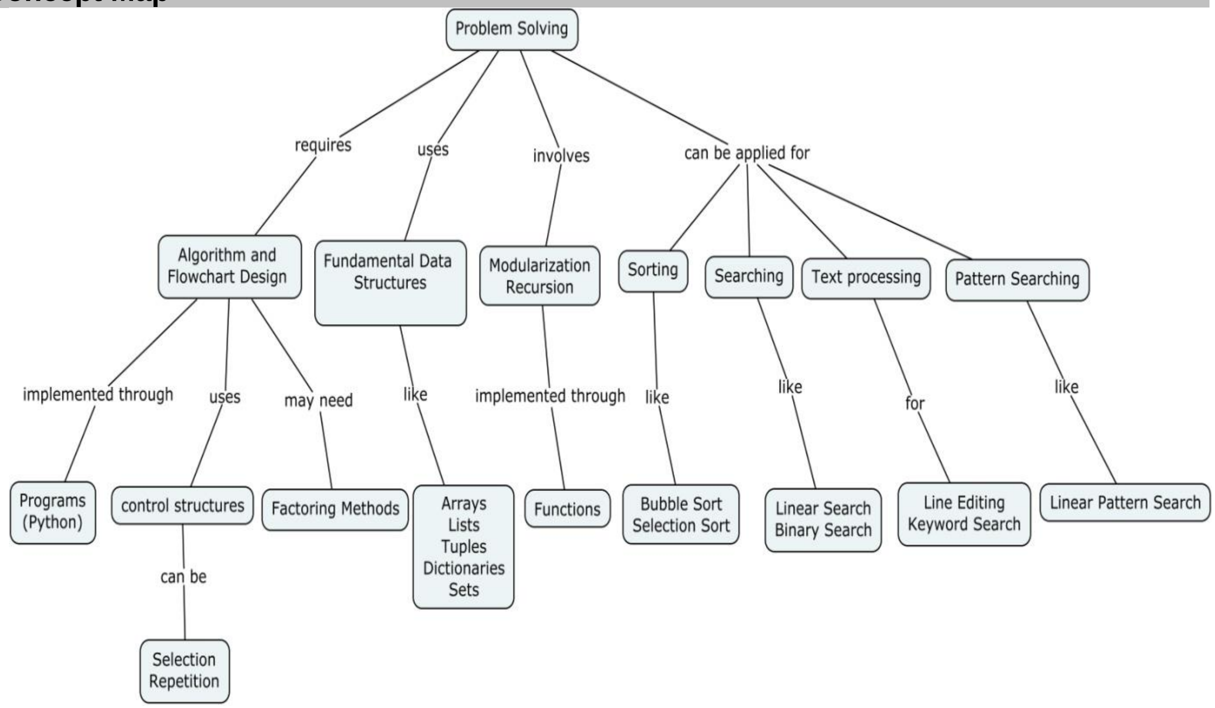
Course Outcome 5 (CO5):

1. What is text processing? (Understand)
2. Explain the algorithm for linear pattern searching. (Understand)

Course Outcome 6(CO6):

1. Write a program for binary search. (Apply)
   TestData :
   binary_search([1,2,3,5,8],6)
   Output:
   False
2. Write a program that accepts a string and calculate the number of digits and letters. (Apply)
   Sample Data : Version 5.6.2
   Output :
   Letters 7
   Digits 3
3. Write a program to remove an item from a set if it is present in the set. (Apply)

Concept Map



Syllabus

Introduction to Computer Problem Solving: Problem Solving aspect, Top down Design, Flowcharts, Developing an Algorithm

Efficiency of algorithms, Analysis of algorithms, Problem solving using fundamental algorithms - Exchanging the values of two variables, Counting. Selection Control Structures, Repetition Control Structures**,** Algorithms Using Selection and Repetition - Summation of a set of numbers, Reversing Digits of an Integer.

Factoring Methods – Finding Square root of a number, smallest divisor of an integer, Greatest common divisor of two integers, Generating Prime numbers, Implementation of fundamental algorithms and factoring methods.

Array Techniques: Array order reversal, Array Counting, Finding maximum and the minimum value in a set, Modularization and recursion. Collection data types– Tuples, Lists, Sets, and Dictionaries, Implementation of array techniques and Collection data types.

Sorting and Searching: Bubble Sort, Selection Sort, Linear Search, Binary Search, Implementation of sorting and searching.

Text Processing and Pattern Searching: Text line editing, keyword searching, and linear pattern searching, and Implementation of Text Processing and pattern searching.

Learning Resources

1. How to solve it by Computer, R.G Dromey, Pearson education, Delhi, 2008.
2. Simple Program Design, A Step-by-Step Approach, Lesley Anne Robertson, 5th Edition, Thomson, 2007.
3. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist'', 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)
4. Mark Summerfield. —Programming in Python 3: A Complete introduction to the Python Language‖, Addison-Wesley Professional, 2009.

5. Robert Sedgewick, Kevin Wayne, Robert Dondero, ―Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
6. Martin C. Brown, ―PYTHON: The Complete Reference‖, McGraw-Hill, 2001.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Lectures	Course Outcome
1	**Introduction to Computer Problem Solving**		
1.1	Problem Solving aspect, Top down Design	1	CO1
1.2	Flowcharts	1	CO1
1.3	Developing an Algorithm	1	CO1
1.4	Efficiency of algorithms, Analysis of algorithms	1	CO1
1.5	Problem Solving using Fundamental Algorithms - Exchanging the values of two variables, Counting	1	CO1
2	**Control Structures and Factoring Methods**		
2.1	Selection Control Structures, Repetition Control Structures	3	CO2
2.2	Summation of a set of numbers	2	CO2
2.3	Reversing Digits of an Integer	2	CO2
2.4	Factoring Methods: Finding Square root of a number, smallest divisor of an integer	2	CO3
2.5	Greatest common divisor of two integers, Generating Prime numbers.	3	CO3
2.6	Implementation of fundamental algorithms and factoring methods	3	CO6
3	**Array Techniques**		
3.1	Array order reversal, Array Counting, Finding maximum and the minimum value in a set.	2	CO4
3.2	Modularization and recursion	1	CO4
3.3	Collection data types – Tuples, Lists, Sets, and Dictionaries.	1	CO4
3.4	Implementation of array techniques and Collection data types.	2	CO6
4	**Sorting and Searching**		
4.1	Bubble Sort, Selection Sort	2	CO4
4.2	Linear Search, Binary Search	1	CO4
4.3	Implementation of sorting and searching.	2	CO6
5	**Text Processing and Pattern Searching**		
5.1	Text line editing	1	CO5
5.2	keyword searching, and linear pattern searching	1	CO5
5.3	Implementation of text processing	2	CO5
5.4	Implementation of pattern searching.	1	CO5
	Total	**36**	

Course Designers:

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2. Dr.M.Vijayalakshmi mviji@tce.edu

18CS230	**DIGITAL CIRCUITS**	Category	L	T	P	Credit
		PC	3	0	0	3

Preamble

The syllabus is designed for the students to understand and apply the basic principles of number systems, binary arithmetic, Boolean algebra, digital logic gates, design and implementation of combinational logic circuits and analysis and design of sequential logic circuits. It illustrates different methods for simplification of Boolean logic functions. These methods include algebraic simplification, karnaugh maps and Quine McCluskey tabulation technique. Then the principles of combinational logic circuits, their design and implementation using programmable logic are presented. Also, simulation of combinational logic circuits using HDL is discussed. The fundamental concepts of synchronous sequential logic circuits, their analysis and the design techniques are exemplified.

Prerequisite

Nil

Course Outcomes

CO Number	Course Outcome Statement	Weightage in %
CO1	Explain the principles of number systems, binary codes, arithmetic and code conversions (understand)	10
CO2	Perform simplification of logic functions by applying the theorems and postulates of Boolean algebra, the techniques of Karnaugh Maps and Quine McClusky tabulation. (Apply)	20
CO3	Design combinational logic circuits for various applications, implement them using logic gates or other devices like multiplexers, decoders or programmable logic devices. (Apply)	20
CO4	Understand the simulation of combinational logic circuits using HDL description. (Understand)	15
CO5	Construct the state tables and diagrams for the given sequential logic circuits.(Apply)	20
CO6	Design Moore and Mealy type sequential circuits and Implement them using different types of flip flops (Apply)	15

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	

CO1	TPS2	Understand	Respond	--	1.2
CO2	TPS3	Apply	Value	-	1.2,2.1.1
CO3	TPS3	Apply	Value	-	1.2,2.1.1
CO4	TPS2	Understand	Respond	--	1.2
CO5	TPS3	Apply	Value	--	1.2,2.1.1
CO6	TPS3	Apply	Value	--	1.2,2.1.1

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	M	L											L		
CO2	S	M	L										M		
CO3	S	M	L										M		
CO4	M	L											L		
CO5	S	M	L										M		
CO6	S	M	L										M		

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	**Continuous Assessment Tests**			**Assignment**			**Terminal Examination**
	1	**2**	**3**	**1**	**2**	**3**	
Remember	10	10	10	-	-	-	10
Understand	30	30	20	-	-	-	30
Apply	60	60	70	100	100	100	60
Analyse	-	-	-	-		-	-
Evaluate	-	-	-	-	-	-	-
Create	-	-	-	-	-	-	-

Assessment Pattern: Psychomotor

Psychomotor Skill	**Miniproject/Assignment/Practical Component**
Perception	-
Set	-
Guided Response	-
Mechanism	-
Complex Overt Responses	-
Adaptation	-
Origination	-

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Explain how the operation -43-91 may be performed using 1's and 2's complement notations. (Understand).
2. Explain the drawback of 1's complement form for representing signed binary numbers. (Understand)
3. Explain the conversion of the binary fraction 110011.011 to decimal(Understand)
4. Explain how Excess-3 is a self-complementing code. (Understand)

Course Outcome 2 (CO2):

1. Utilise the theorems of Boolean algebra to simplify f = a'bc'+a'b'+abc' (Apply)
2. Make use of Karnaugh map to obtain minimal POS form of g = ∑m(0,2,4,6,9,12,14) (Apply)
3. Construct the simplified SOP form of h = ∑m(3,5,7,9,13,15,17) + ∑d(12,14) using QM tabulation. (Apply)

Course Outcome 3 (CO3):

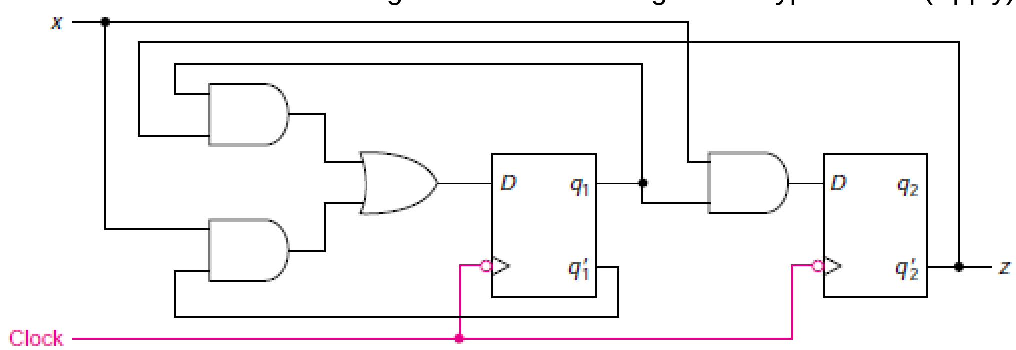
1. Design a 2- bit magnitude comparator to compare two binary numbers. (Apply)
2. Design a 4-input priority encoder (Apply)
3. Construct the ROM implementation of G = ∑m(0,1,2,4,7,9,12) (Apply)
4. Make use of a 4 to 1 multiplexer to implement the function h = ∑m(2,4,6,7) (Apply)
5. Make use of a 4 to 16 decoder to implement f = ∑m(3,5,7,8,9,15) (Apply)
6. Construct the PLA implementation of the functions f = AB'+AC+A'BC' and G = (AC+BC)' (Apply)

Course Outcome 4(CO4):

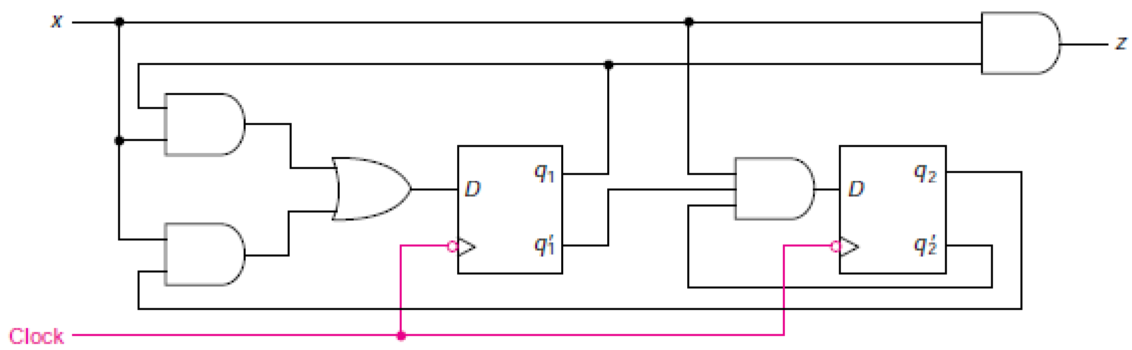
1. Explain the gate level description of a full adder. (Understand).
2. Explain the gate level description of a 2 to 4 decoder. (Understand)

Course Outcome 5 (CO5):

1. Construct the state table and diagram for the following Moore type circuit. (Apply)



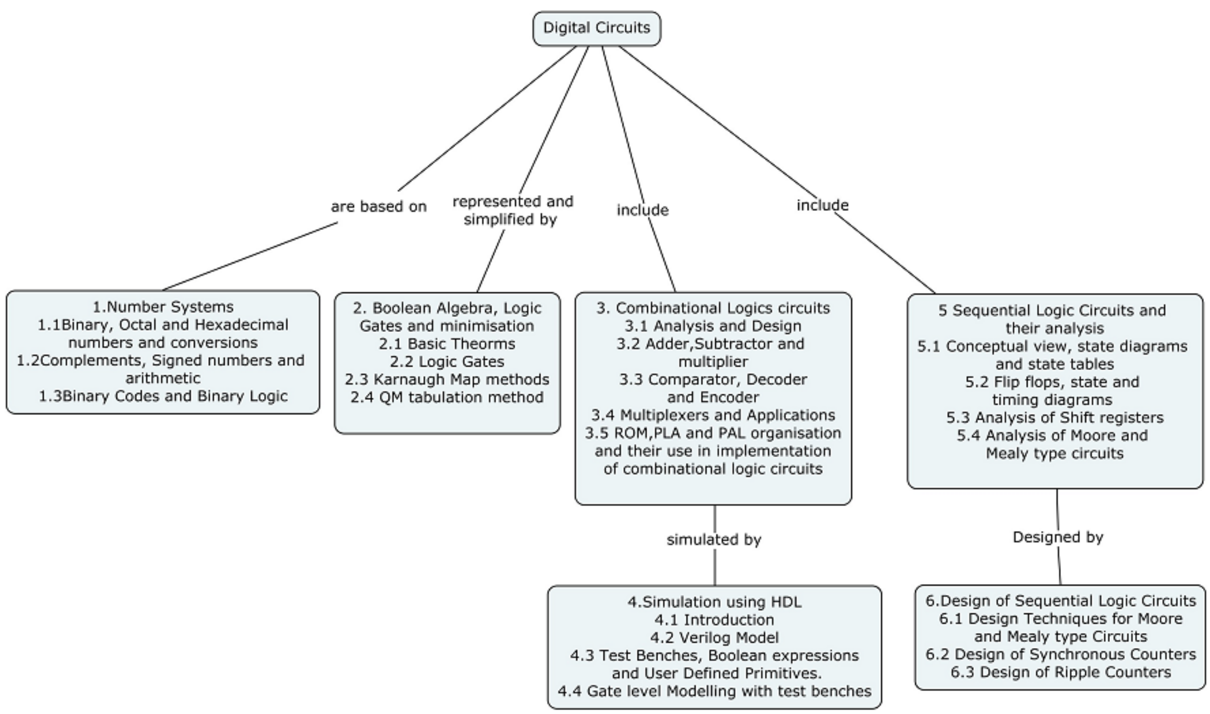
2. Construct the state diagram and table for the following Mealy type circuit and. (Apply)



Course Outcome 6 (CO6):

1. Design a 2-bit synchronous up counter and construct it using JK flip flops. (Apply)
2. Design a Moore type sequence detector to detect the overlapping input sequence 101 and implement it using D flip flops.(Apply)

Concept Map



Syllabus

Number Systems:

Binary Numbers, Octal and Hexadecimal Numbers and conversions, Complements - Signed Binary Numbers and arithmetic, Binary Codes and Binary Logic.

Boolean Algebra, Logic Gates and gate level minimisation

Basic Definition, Theorems and Properties of Boolean Algebra, Boolean functions, Digital Logic Gates and Other Logic Operations, The Karnaugh Map Method of minimisation– Three and Four Variable Maps, Quine-McCluskey (QM) Technique.

Combinational Logic Circuits:

Introduction to Combinational Circuits, Analysis and Design Procedure, Binary Adder-Subtractor, Binary multiplier, Magnitude comparator, Decoders and Encoders, Multiplexers and their applications. Organization of ROM, PLA and PAL and their application in implementing combinational logic circuits.

Simulation using HDL:

Introduction to Hardware Description Language, Verilog model of a simple combinational circuit, propagation delays, test benches, Boolean expressions, user defined primitives, gate level modelling with test benches.

Sequential Logic Circuits and their operation

Conceptual view of Sequential Circuits, State tables and diagrams. Flip-flops and their state and timing diagrams. Operation of shift registers. Principles and operation of Mealy and Moore machines.

Design of Sequential Logic Circuits

Design techniques for Moore and Mealy type circuits. Design of synchronous counters. Design of ripple counters.

Learning Resources:

1. M.Morris Mano & Michael D.Ciletti, Digital Design With an Introduction to Verilog HDL, fifth edition, Pearson, 2013.
2. Alan B Marcovitz, Introduction to Logic Design, third edition, McGraw Hill, 2010
3. Mohammed Ferdjallah, Introduction to digital systems, Modeling, Synthesis and simulation using VHDL, Wiley,2011.
4. D.P. Leach & A.P. Malvino, Digital Principles and Applications, sixth edition, Tata McGraw Hill,2006.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Lectures	Course Outcome
1	**Number Systems**		
1.1	Binary Numbers, Octal and Hexadecimal Numbers and conversions	1	CO1
1.2	Complements - Signed Binary Numbers and arithmetic	2	CO1
1.3	Binary Codes and binary logic	1	CO1
2	**Boolean Algebra, Logic Gates and gate level minimization :**		
2.1	Basic Definitions, Theorems and Properties of Boolean Algebra - Boolean functions	2	CO2
2.2	Digital Logic Gates and Other Logic Operations	1	CO2
2.3	Simplification of logic functions using Karnaugh Map	2	CO2

Module No.	Topic	No. of Lectures	Course Outcome
	Method – Three and four Variable Maps		
2.4	Quine-McCluskey(QM) Technique	2	CO2
3	**Combinational Logic Circuits**		
3.1	Introduction to Combinational Logic Circuits and their analysis and design	1	CO3
3.2	Binary Adder, Subtractor and multiplier	1	CO3
3.3	Magnitude comparator, decoder and encoder	1	CO3
3.4	Multiplexers and their applications	1	CO3
3.5	Organization of ROM, PLA and PAL and their application in implementing combinational logic circuits.	3	CO3
4	**Simulation of Combinational Logic Circuits using HDL**		
4.1	Introduction to Hardware Description Language	1	CO4
4.2	Verilog model of a simple combinational circuit, propagation delays	1	CO4
4.3	Test benches, Boolean expressions, user defined primitives	1	CO4
4.4	Gate level modeling with test benches.	2	CO4
5	**Sequential Logic Circuits and their operation**		
5.1	Conceptual view of sequential circuits, state tables and diagrams.	2	CO5
5.2	Types of flip flops, their state diagrams and timing diagrams	2	CO5
5.3	Operation of shift registers operation.	1	CO5
5.4	Principles and operation of Mealy and Moore type circuits	2	CO5
6	**Design of Sequential Logic Circuits**		
6.1	Design techniques for Moore and Mealy type circuits	3	CO6
6.2	Design of synchronous counters	2	CO6

Module No.	Topic	No. of Lectures	Course Outcome
6.3	Design of ripple counters	1	CO6
Total		36	

Course Designer:

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18CS240	COMPUTER ORGANIZATION AND ARCHITECTURE

Category	L	T	P	Credit
PC	3	0	0	3

Preamble

The syllabus is designed for the students to learn and understand the basic organization of computers and the working of its functional components. It gives a brief overview of the organization of a computer, simple Von Neumann machine organization of IAS computer, memory format and instruction execution in it. Then memory hierarchy, types of memories, organization of main memory, types of IO buses, and their operation and timing diagrams are presented. Then the elements of cache memory design, its mapping functions and replacement algorithms are emphasized followed by performance estimation of disk drives under interrupt driven and DMA driven approaches are discussed.

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage in %
CO1	Explain the evolutions of computers, the organizational features, structure, memory format and operation of IAS computers, components of a computer and its instruction cycle with and without interrupts.(Understand)	15
CO2	Estimate the data transfer rate and the length of the instruction cycle for synchronous read and write cycles, with an understanding of the bus interconnection and timing diagrams for synchronous and asynchronous buses. (Apply)	20
CO3	Explain the features of main memory organization and its types. (Understand)	15
CO4	Design the cache memory organization, its mapping functions and replacement algorithms and estimate the performance improvement(Apply)	20
CO5	Explain the features of IO transfer and DMA transfer using interrupts (Understand)	10
CO6	Perform integer and floating point arithmetic operations on binary numbers.(Apply)	20

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	-	1.2
CO2	TPS3	Apply	Value	-	1.2 ,2.1.1
CO3	TPS2	Understand	Respond	-	1.2
CO4	TPS3	Apply	Value	-	1.2 ,2.1.1

CO5	TPS2	Understand	Respond	-	1.2
CO6	TPS3	Apply	Value	-	1.2 ,2.1.1

Mapping with Programme Outcomesand Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	S												L		
CO2	S	S	M	L									S	L	
CO3	S												L		
CO4	S	S	S	M									S	L	
CO5	S												L		
CO6	S	S	M	L									S	L	

S- Strong; M-Medium; L-Low

AssessmentPattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Assignment			Terminal Examination
	1	2	3	1	2	3	
Remember	30	30	30	-	-	-	30
Understand	40	40	30	-	-	-	40
Apply	30	30	40	100	100	100	30
Analyse	-	-	-	-	-	-	-
Evaluate	-	-	-	-	-	-	-
Create	-	-	-	-	-	-	-

Assessment Pattern: Psychomotor

Psychomotor Skill	Miniproject/Assignment/Practical Component
Perception	-
Set	-
Guided Response	-
Mechanism	-
Complex Overt Responses	-
Adaptation	-
Origination	-

Sample Questions for Course Outcome Assessment

Course Outcome 1(CO1):

1. List the basic functions a computer can perform. (Remember)
2. Distinguish between computer structure and computer function? (Understand)
3. List the features of a Von Neumann computer? (Remember)

Course Outcome 2(CO2):

1. For a synchronous read operation, the memory module must place the data on the bus sufficiently ahead of the falling edge of the Read signal to allow for signal settling. Assume a

microprocessor bus is clocked at 10 MHz and that the Read signal begins to fall in the middle of the second half of T3. Determine the length of the memory read instruction cycle. When, at the latest, should memory data be placed on the bus? Allow 20 ns for the settling of data lines. (Apply)

2. Develop an ALP to perform Packed BCD addition . (Apply)

Course Outcome 3(CO3):

1. List the properties of semiconductor memory cells. (Remember)
2. Explain the operation of a DRAM cell.(Understand)
3. List the applications ROM. (Remember)

Course Outcome 4 (CO4):

1. For a direct-mapped cache, a main memory address is viewed as consisting of three fields. List and define the three fields. (Remember)
2. A set-associative cache consists of 64 lines, or slots, divided into four-line sets. Main Memory contains 4K blocks of 128 words each. Show the format of main memory addresses. (Understand)
3. Given the following specifications for an external cache memory: four-way set associative; line size of two 16-bit words; able to accommodate a total of 4K 32-bit words from main memory; used with a 16-bit processor that issues 24-bit addresses. Design the cache structure with all pertinent information and show how it interprets the processor's addresses. (Apply)
4. A computer system uses 16-bit memory addresses. It has a 2K-byte cache organized in a direct-mapped manner with 64 bytes per cache block. Assume that the size of each memory word is 1 byte. (a) Calculate the number of bits in each of the Tag, Block, and Word fields of the memory address. (b) When a program is executed, the processor reads data sequentially from the following word addresses: 128, 144, 2176, 2180, 128, 2176 All the above addresses are shown in decimal values. Assume that the cache is initially empty. For each of the above addresses, indicate whether the cache access will result in a hit or a miss.

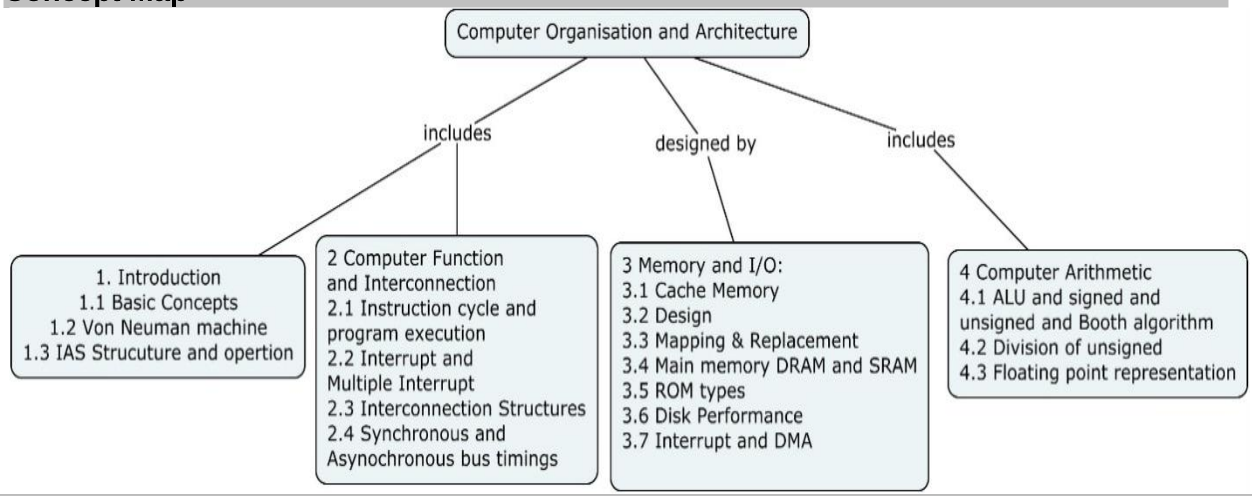
Course Outcome 5 (CO5):

1. State the need for DMA
2. Define Interrupt.

Course Outcome 6(CO6):

1. Use the Booth algorithm to multiply 23 (multiplicand) by 29 (multiplier), where each number is represented using 6 bits. (Apply)
2. Illustrate the steps required for Floating point addition and show the steps for performing addition of 0.8125_{ten} and -0.0625_{ten} (Apply)

Concept Map



Syllabus

Introduction: Computer organization and architecture, Vonneumann machine, Evolution of computers and generations, Introduction to IAS computer structure and operation.

Computer Function and Interconnection: Top level view of components and functions, Instruction cycle and program execution, Interrupts and instruction cycles, multiple interrupts, Interconnection structures, Bus interconnection, multiple buses, Synchronous and asynchronous bus timings.

Memory and I/O : Characteristics and hierarchy of memory, Cache memory principles and operation, Cache design and mapping functions, replacement algorithms, main memory, DRAM and SRAM, Types of ROMs, Module organization, Introduction to magnetic disks, I/O transfer and disk performance, interrupt driven and DMA transfers.

Computer Arithmetic : Arithmetic and Logic Unit, Integer multiplication of unsigned and signed numbers, Booth's algorithm, division of unsigned binary, Floating point arithmetic.

Learning Resources

1. William Stallings, Computer Organization and Architecture Designing for Performance, Nineth edition, Prentice Hall, 2013.
2. Andrew S Tanenbaum and Todd Austin, Structured Computer Organization, Sixth edition, Pearson, 2013.
3. Carl Hamacher, Computer Organization and Embedded Systems, Sixth edition, McGrawHill, 2012.
4. DodiyaTripti, Computer Organisation and Advanced Microprocessors, First edition, Cengage Learning India,2012.
5. Barry B.Brey, The Intel Microprocessors Architecture Programming and Interfacing, Eighth edition, Pearson Prentice Hall, 2009.
6. N.Senthil Kumar, M.Saravanan and S. Jeevananthan, Microprocessors and Microcontrollers, First edition, Oxford University Press, 2010.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Lectures	Course Outcome
1	**Introduction:**		
1.1	Computer organisation and architecture.	1	CO1
1.2	Evolution of generation of computers and VonNeuman machine.	2	CO1
1.3	Introduction to IAS computer structure and operation	2	CO1
2	**Computer Function and Interconnection:**		
2.1	Top level view of components and functions, Instruction cycle and program execution	1	CO2
2.2	Interrupts and instruction cycles, multiple interrupts	2	CO2
2.3	Interconnection structures, Bus interconnection, multiple buses	2	CO2
2.4	Synchronous and asynchronous bus timings.	2	CO2
3	**Memory and I/O:**		
3.1	Characteristics and hierarchy of memory, Cache memory principles and operation.	2	CO4
3.2	Cache design	3	CO4
3.3	mapping functions and replacement algorithms	2	CO4
3.4	Main memory, DRAM and SRAM	3	CO3
3.5	Types of ROMs, Module organization	3	CO3
3.6	Introduction to magnetic disks, I/O transfer and disk performance,	2	CO5
3.7	Interrupt driven and DMA transfers	2	CO5
4	**Computer Arithmetic:**		
4.1	Arithmetic and Logic Unit, Integer multiplication of unsigned and signed numbers, Booth's algorithm	3	CO6
4.2	Division of unsigned binary numbers	2	CO6
4.3	Floating point representation.	2	CO6
	Total	36	

Course Designers:

1. Mr.R.Chellamani rcmcse@tce.edu
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18CS260	COMPUTER PROGRAMMING

Category	L	T	P	Credit
PC	2	0	1	3

Preamble

The course on computer programming is intended to introduce the students to computational thinking, procedural programming and constructs of procedural programming. On Completion of the course students would be able to master structured programming and demonstrate applications on top of procedural programs.

Prerequisite

Nil

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage in %
CO1	Describe the basic components of the structured programming (Understand)	15
CO2	Implement different operations on arrays and strings(Apply)	20
CO3	Develop programs with recursive solutions utilizing functions (Apply)	15
CO4	Demonstrate dynamic memory allocation using pointers. (Apply)	15
CO5	Illustrate the appropriate algorithms for sorting and searching problems. (Apply)	15
CO6	Implement file operations in C Programming for a given application (Apply)	20

CO Mapping with CDIO Curriculum Framework

CO	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	Guided Response	1.2
CO2	TPS3	Apply	Value	Mechanism	1.2 ,2.2.3,2.5.1
CO3	TPS3	Apply	Value	Mechanism	1.2, 2.2.3,2.5.1
CO4	TPS3	Apply	Value	Mechanism	1.2,2.2.3,2.5.1
CO5	TPS3	Apply	Value	Mechanism	1.2,2.4.7,2.2.3,2.5.1
CO6	TPS3	Apply	Value	Mechanism	1.2,2.2.3,2.4.6,2.5.1

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	M	L											L		
CO2	S	M	L		L				L		L	L	M		L
CO3	S	M	L		L				L		L	L	M		L

CO4	S	M	L		L				L		L	L	M		L
CO5	S	M	L		L				L		L	L	M		L
CO6	S	M	L		L				L		L	L	M		L

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Practical Component			Terminal Examination
	1	2	3	1	2	3	
Remember	20	20	15				15
Understand	40	30	25	25	25	25	25
Apply	40	50	60	25	25	25	60
Analyse	-	-	-	-	-	-	-
Evaluate	-	-	-	-	-	-	-
Create	-	-	-	-	-	-	-

Assessment Pattern: Psychomotor

Psychomotor Skill	Practical Component
Perception	-
Set	-
Guided Response	25
Mechanism	25
Complex Overt Responses	-
Adaptation	-
Origination	-

Sample Questions for Course Outcome Assessment**

Course Outcome 1 (CO1):

1. Explain various data types.
2. Describe format specifiers.

Course Outcome 2 (CO2):

1. Write a C program that accepts an employee's ID, total worked hours of a month and the amount he received per hour. Print the employee's ID and salary (with two decimal places) of a particular month.
2. Write a program in C to input a string and print it.
3. Write a program in C to print individual characters of string in reverse order.

Course Outcome 3 (CO3):

1. Write a program in C to print first 50 natural numbers using recursion. (Apply)
2. Write a program in C to find the sum of the series 1!/1+2!/2+3!/3+4!/4+5!/5 using the function.(Apply)

Course Outcome 4 (CO4):

1. Write a program in C to demonstrate the use of &(address of) and *(value at address) operator. (Apply)
2. Write a program in C to find the maximum number between two numbers using a pointer(Apply)
3. Write a program in C to print all permutations of a given string using pointers.(Apply)

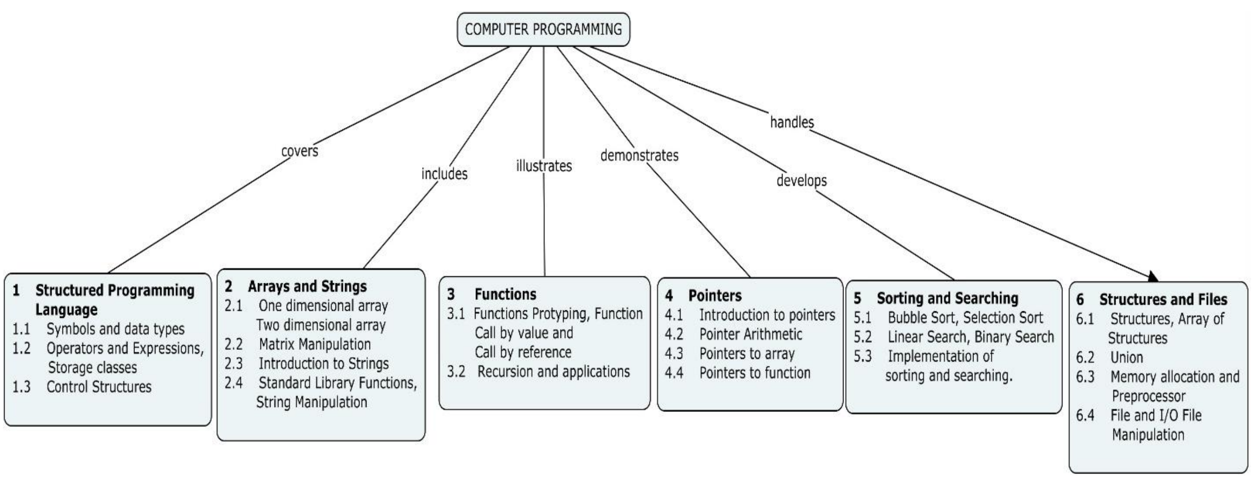
Course Outcome 5 (CO5):

1. Write a program for binary search. (Apply)
   TestData :
   binary_search([1,2,3,5,8],6)
   Output:
   False
2. Write a program that accepts a string and calculate the number of digits and letters. (Apply)
   Sample Data : Version 5.6.2
   Output :
   Letters 7
   Digits 3
3. Write a program to remove an item from a set if it is present in the set. (Apply)

Course Outcome 6(CO6):

1. Write a program in C to create and store information in a text file.(Apply)
2. Write a program to count the number of words, sentences and paragraphs in a given text using files.(Apply)
3. Write a C program to read name and marks of n number of students from user and store them in a file.(Apply)

Concept Map



Syllabus

Structured Programming Language Symbols and data types - Operators and Expressions - Storage classes - Looping control structures - Decision control structures - Case control structures.

Arrays and Strings One dimensional array - Two dimensional array - Matrix Manipulation - Introduction to Strings - Standard Library Functions - String manipulation applications.

Functions Function Prototyping - Function Call by value - Function Call by reference - Recursion.

Pointers Introduction to pointers - Pointer Arithmetic - Pointers to array - Pointers to function.

Sorting and Searching Bubble Sort, Selection Sort Linear Search, Binary Search Implementation of sorting and searching.

Data Handling Structures - Array of Structures -Union - Memory allocation - File and I/O - File Manipulation

Learning Resources

1. Programming In ANSI C, E. Balaguruswamy, McGrawHill Publications.7th Edition 2016,
2. YeshavantKanetkar: Understanding Pointers In C & C++ …5th Revised & Updated Edition Pointers in all its forms Fully working examples and Applications of Pointers,BPB Publications 5th edition, 2018
3. YashavantKanetkar: ANSI C Programming,, BPB Publications ,2nd Edition
4. YashavantKanetkar: Let us C, BPB Publications, 8th Edition,2008

Course Contents and Lecture Schedule

Module No.	Topic	No. of Lectures	Course Outcome
1	**Structured Programming Language**		
1.1	Symbols and data types	1	CO1
1.2	Operators and Expressions, Storage classes	1	CO1
1.3	Control Structures	2	CO1
2	**Arrays and Strings**		
2.1	One dimensional array Two dimensional array	1	CO2
2.2	Matrix Manipulation	1	CO2
2.3	Introduction to Strings	1	CO2
2.4	Standard Library Functions, String Manipulation	2	CO2
3	**Functions**		
3.1	Functions Prototyping, Function Call by value and Call by reference	1	CO3
3.2	Recursion and applications	2	CO3
4	**Pointers**		
4.1	Introduction to pointers	1	CO4
4.2	Pointer Arithmetic	1	CO4
4.3	Pointers to array	1	CO4
4.4	Pointers to function	1	CO4
5	**Sorting and Searching**		
5.1	Bubble Sort, Selection Sort	1	CO5
5.2	Linear Search, Binary Search	1	CO5
5.3	Implementation of sorting and searching	1	CO5
6	**Structures and Files**		
6.1	Structures, Array of Structures	1	CO6
6.2	Union	1	CO6
6.3	Memory allocation and Preprocessor	1	CO6
6.4	File and I/O File Manipulation	2	CO6

Course Contents and Lecture Schedule for Laboratory

Module No.	**Topic**	**No. of Lectures**	**Course Outcome**
1.	Write a Simple C program using constructs	2	CO1
2.	Write a C program to display multiple variables.	2	CO1
3.	Design a C Program for Array types	2	CO2
4.	Design a C Program for String manipulations	2	CO2

Module No.	Topic	No. of Lectures	Course Outcome
5.	Write a C Program using different types of function call	2	CO3
6.	Write a C Program for recursive function	2	CO3
7.	Write a program in C to store n elements in an array and print the elements using pointer	2	CO4
8.	Write a C Program using pointer to a function	2	CO4
9.	Write a C program to sort a list of elements using different sorting algorithms	2	CO5
10.	Write a C Program for implementing for binary search algorithm	2	CO5
11.	Write a C Program using structures and union	2	CO6
12.	Write a C Program for implementing file operation	2	CO6
	Total Hours	**24**	

Course Designers:

1. Mr. S.Prasanna sprcse@tce.edu
2. Ms. M.Nirmala Devi mnit@tce.edu
3. Dr.R.Leena Sri rlsit@tce.edu

		Category	L	T	P	Credit
18CS270	**DIGITAL CIRCUITS LAB**	PC	0	0	1	1

Preamble

Preamble: The laboratory course is designed to enable the students to design and construct practically the combinational and sequential logic circuits for different applications. The list of experiments starts with the verification of Boolean theorems and truth table of gates. Then the design and construction of a variety of circuits using gates, flip flops and other devices are performed. The simulation of simple circuits using Hardware Description Language is also performed. These experiments will reinforce the concepts learnt in the corresponding theory course.

Prerequisite

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	Course Outcome Statement	Weightage in %
CO1	Verify the truth tables of Boolean logic gates and theorems of Boolean algebra	10
CO2	Design half adder, full adder and parallel binary adder	10
CO3	Design BCD adder	10
CO4	Design multiplexer, demultiplexer/decoder and encoder	20
CO5	Design magnitude comparator	10
CO6	Design ripple counters	10
CO7	Design synchronous counters	10
CO8	Design sequential logic circuits	10
CO9	Simulate combinational logic circuits using HDL	10

.

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value	Mechanism	1.2, 1.2.7 ,2.2.3
CO2	TPS3	Apply	Value	Mechanism	1.2,1.2.7 ,2.2.3
CO3	TPS3	Apply	Value	Mechanism	1.2, 1.2.7 ,2.2.3
CO4	TPS3	Apply	Value	Mechanism	1.2, 1.2.7 ,2.2.3
CO5	TPS3	Apply	Value	Mechanism	1.2, 1.2.7 ,2.2.3
CO6	TPS3	Apply	Value	Mechanism	1.2, 1.2.7 ,2.2.3
CO7	TPS3	Apply	Value	Mechanism	1.2, 1.2.7. ,2.2.3
CO8	TPS4	Apply	Value	Mechanism	1.2, 1.2.7 ,2.2.3
CO9	TPS3	Apply	Value	Mechanism	1.2, 1.2.7 ,2.2.3

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO7.	S	M	M		S	L	L	S	S	S		M	M	M	M
CO8.	S	M	M		S	L	L	S	S	S		M	M	M	M
CO 3	S	M	M		S	L	L	S	S	S		M	M	M	M
CO 4	S	M	M		S	L	L	S	S	S		M	M	M	M
CO 5	S	M	M		S	L	L	S	S	S		M	M	M	M
CO 6	S	M	M		S	L	L	S	S	S		M	M	M	M
CO 7	S	M	M		S	L	L	S	S	S		M	M	M	M
CO 8	S	M	M		S	L	L	S	S	S		M	M	M	M
CO 9	S	M	M		S	L	L	S	S	S		M	M	M	M

Assessment Pattern: Cognitive Domain

Cognitive Levels	Model Examination	Terminal Examination
Remember		
Understand		
Apply	50	50
Analyse		
Evaluate		
Create		

Assessment Pattern: Psychomotor

Psychomotor Skill	Mini project /Practical Component/Observation
Perception	
Set	
Guided Response	
Mechanism	50
Complex Overt Responses	--
Adaptation	
Origination	

List of Experiments/Activities with CO Mapping

Experiment	CO
Verification of truth tables of logic gates and theorems of Boolean algebra, using digital IC trainer kit.	CO1
Design, construction and testing of half adder, full adder and 2-bit parallel binary adder.	CO2
Design of single digit BCD adder, its construction using 4-bit parallel binary adder ICs and verification of output.	CO3
Design, construction and testing of 4 to 1 multiplexer, 2*4 decoder/1 to 4 demultipexer and realization of half adder using it.	CO4
Design, construction and testing of 4*2 encoder and realization of binary to gray code converter using decoder-encoder cascade.	CO4
Design, construction and testing of 2-bit binary magnitude comparator	CO5
Design, construction and testing of ripple up and down counters for a given modulus and also for any specified count sequence.	CO6
Design, construction and testing of synchronous counters for any specified count sequence.	CO7
Implement sequence detectors.	CO8
Simulation of a half adder, full adder, encoder and decoder using HDL	CO9

Course Designers:

1. C.Sridharan (cscse@tce.edu)
2. R.Chellamani (rcmcse@tce.edu)

18CS280	WORKSHOP

Category	L	T	P	Credit
ES	0	0	1	1

Preamble

This is the foundation practical course for CSE students. The aim of this course is to impart fundamental hands-on skill in carrying out experiments at higher semester practical courses.

Prerequisite

Nil

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Realize the importance of earthing in electrical safety and trouble shoot the electrical wiring and measure electrical parameters	8
CO2	Accurately discriminate and use fuses, circuit breakers, AFO, CRO, digital and analog meters in electronic circuits	17
CO3	Solder and desolder of electronic components and convert schematic into PCB layout and fabrication	25
CO4	Assemble and configure a computer and install software's on hardware	25
CO5	Work with Unix and DOS commands.	8
CO6	Design and develop a document or report using Desktop publishing software.	17

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	Guided Response	1.2, 2.4.5
CO2	TPS2	Understand	Respond	Guided Response	1.2, 2.4.5
CO3	TPS2	Understand	Respond	Guided Response	1.2, 2.4.5
CO4	TPS3	Apply	Value	Mechanism	1.2, 2.4.5
CO5	TPS3	Apply	Value	Mechanism	1.2, 2.4.5
CO6	TPS3	Apply	Value	Mechanism	1.2, 2.4.5

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S		L		M				M	M			M	M	M
CO2	S		L		M				M	M			M	M	M
CO	S		L		M				M	M			M	M	M

3															
CO 4	S		L		M				M	M			M	M	M
CO 5	S		L		M				M	M			M	M	M
CO 6	S		L		M				M	M			M	M	M

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Model Examination	Terminal Examination
Remember	---	---
Understand	20	---
Apply	50	---
Analyse	---	---
Evaluate	---	---
Create	---	---

Assessment Pattern: Psychomotor

Psychomotor Skill	Mini project /Practical Component/Observation
Perception	---
Set	--
Guided Response	10
Mechanism	20
Complex Overt Responses	--
Adaptation	--
Origination	---

List of Experiments/Activities with CO Mapping

<table>
<tr><th>Ex.No</th><th>List of Experiments</th><th>No. of Hours</th><th>Course Outcome</th></tr>
<tr><td colspan="4">Electrical and Electronics Engineering</td></tr>
<tr><td>1.</td><td>Earthing practice and its significances; Wiring practices and testing</td><td>2</td><td>CO1</td></tr>
<tr><td>2.</td><td>Realization and Discrimination of fuses and Circuit breakers; Functionalities of RPS/AFO/CRO</td><td>2</td><td rowspan="2">CO2</td></tr>
<tr><td>3.</td><td>Functionalities and Selection of Analog and Digital meters</td><td>2</td></tr>
<tr><td colspan="4">Electronics and Communication Engineering</td></tr>
<tr><td>4.</td><td>Identifying electronic components and understanding PCB glossary</td><td>2</td><td rowspan="3">CO3</td></tr>
<tr><td>5.</td><td>Conversion of schematic into PCB layout and PCB fabrication</td><td>2</td></tr>
<tr><td>6.</td><td>Practicing of soldering and desoldering</td><td>2</td></tr>
<tr><td colspan="4">Computer Science and Engineering</td></tr>
</table>

7.	Computer Assembly and Configuration: PC Assembling: Steps for assembling a PC-commonly used devices an overview, assembling a SMPS in a cabinet, fixing a processor in a mother board, assembling RAM in a motherboard, pinning a cooling fan in a mother board, Assembling a hard disc drive in a cabinet, assembling a CD/DVD ROM in a cabinet. Assembling a floppy drive in a cabinet, fixing motherboard In a cabinet, Connecting the cables from the SMPS to motherboard, hard disc, drives &etc, Establishing data connection for to motherboard, hard disc, drives. Fixing wires for power restart switches, fixing wires for power & HDD LED's, fixing wires for external USB and Audio connections	6	CO4
8.	System Installation:Steps for installing software's for hardware, Hardware & Software Trouble Shooting		
9.	Practice on different DOS and Unix commands. Basic configuration management of Windows operating system	2	CO5
10.	Practice on designing and preparing reports using word, Power-point and Excel applications	4	CO6

Learning Resources

1. Unix &DOS commands http://www.yolinux.com/TUTORIALS/unix_for_dos_users.html
2. MS-Office https://support.office.com/en-us/office-training-center
3. PC troubleshooting: http://h10032.www1.hp.com/ctg/Manual/c00772931.pdf

Course Designers

1. Dr. S. Sudha ssj@tce.edu

18ES290	LATERAL THINKING

Category	L	T	P	Credit
ES	0	0	2	1

Preamble

The purpose of thinking is to collect information and to make the best possible use of it. Vertical thinking is concerned with proving or developing concept patterns. Lateral thinking is concerned with restructuring such patterns (insight) and provoking new ones (creativity). Lateral and vertical thinking are complementary. Skill in both is necessary. Although the emphasis in education has always been exclusively on vertical thinking, the need for lateral thinking arises from the limitations of the behaviour of mind as a self-maximizing memory system. Lateral thinking can be learned, practised and used. It is possible to acquire skill in it just as it is possible to acquire skill in mathematics. The course provides formal opportunities to practise lateral thinking and also an explanation of the processes involved.

Prerequisite

NIL

Course Outcomes

On the successful completion of the course students will be able to

CO #	Course Outcome Statement	Weightage in %
CO1	Explain the concept of lateral thinking, distinguish it from vertical thinking.	10
CO2	Use lateral thinking for problem solving	10
CO3	Generate Alternatives, challenge assumptions and suspend judgment and Practice lateral thinking in design process	20
CO4	Apply the concept of factorization and reversal method for restructuring	20
CO5	Organize brainstorming sessions	10
CO6	Use PO for innovation	10
CO7	Aware of limitation of established patterns and practice lateral thinking in small projects	20

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	-	2.3.1, 3.2.6
CO2	TPS3	Apply	Value	-	2.4.1, 2.4.2, 2.4.3
CO3	TPS3	Apply	Value	-	2.4.1, 2.4.2, 2.4.3, 2.4.5, 2.4.6
CO4	TPS3	Apply	Value	-	2.3.1, 2.4.2, 2.4.3
CO5	TPS4	Analyse	Organize	-	3.1.1, 3.1.2, 3.2.1, 3.2.2
CO6	TPS3	Apply	Value	-	2.1.4, 2.3.1, 2.4.1, 2.4.2, 2.4.3, 2.4.6
CO7	TPS5	Evaluate	Characterize	-	2.3.4, 4.5.1, 4.6.1

Mapping with Programme Outcomes and Programme Specific Outcomes

CO #	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	-	-	-	-	-	-	-	-	-	L
CO2	S	M	L	-	-	-	-	-	-	-	-	L

CO3	S	M	L	-	-	-	-	S	L	L	-	L
CO4	S	M	L	-	-	-	-	S	L	L	-	L
CO5	S	S	M	L	-	-	-	S	S	S	-	L
CO6	S	M	L	-	-	-	-					L
CO7	S	S	S	M	-	S	-	-	S	S	-	S

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Continuous Assessment

Worksheets (5) : 20 Marks

Case Studies (3) : 30 Marks

Terminal Examination

Ability Test : 50 Marks

Case Study (Best) Presentation and Viva Voce : 50 Marks

Syllabus

The way the mind works, Difference between lateral and vertical thinking, Attitudes towards lateral thinking, Basic nature of lateral thinking, The use of lateral thinking Techniques, The generation of alternatives, Challenging assumptions, Innovation, Suspended judgment, Design, Dominant ideas and crucial factors, Fractionation, The reversal method, Brainstorming, Analogies, Choice of entry point and attention area, Random stimulation, Concepts/divisions/polarization, The new word PO, Blocked by openness, Description/problem solving/design

Learning Resources

1. Edward de Bono, “Lateral Thinking: Creativity Step by Step”, Happer Collins Publisher, 1990.
2. Edward de Bono, “Six Thinking Hats”, Little Brown and Company Publisher, 1985.
3. Edward de Bono’s Thinking Course, Video Lecture, Weblink: https://www.yputube.com/watch?v=AUq_AL2LNEw

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1.	The way the mind works	1	CO1
1.1	Difference between lateral and vertical thinking	1	CO1
1.2	Attitudes towards lateral thinking	1	CO2
2.	Basic nature of lateral thinking	1	CO2
2.1	The use of lateral thinking techniques	1	CO2
2.2	The generation of alternatives	1	CO3
2.3	Challenging assumptions	1	CO3
2.4	Innovation	1	CO3
2.5	Suspended judgment	1	CO3
3.	Design	1	CO3
3.1	Dominant ideas and crucial factors	1	CO3
3.2	Fractionation	1	CO4
4.	The reversal method	1	CO4
4.1	Brainstorming	1	CO5
4.2	Analogies	1	CO5
4.3	Choice of entry point and attention area	1	CO5
4.4	Random stimulation	1	CO5

4.5	Concepts/divisions/polarization	1	CO5
4.6	The new word PO	2	CO6
5.	Blocked by openness	2	CO7
5.1	Description/problem solving/design	2	CO7

Course Designers:

1. S J. Thiruvengadam sjtece@tce.edu

18CHAA0	ENVIRONMENTAL SCIENCE

Category	L	T	P	Credit
ES	1	0	1	-

Preamble

The objective of this course is intended to make the students to understand the basic concepts of environment, ecology and pollution of the current environmental issues and to participate in various activities on conserving and protecting the environment.

Prerequisite

NIL

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome	Weightage*** in %
CO1	Describe the importance and progression of ecological system	15%
CO2	Explain the significance of natural resources	10%
CO3	Demonstrate the effects of pollution on environment and human beings	15%
CO4	Practice the suitable management method during disaster episode	10%
CO5	Explain the ethics and values related to Environment	15%
CO6	Describe the Traditional values and Impact of modernization on Environment	10%
CO7	Carry out group activities	25%

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	Guided Response	1.1,2.3.1,2.3.2,2.3.4
CO2	TPS2	Understand	Respond	Guided Response	1.1,2.3.1,2.3.2,2.3.4
CO3	TPS3	Apply	Value	Mechanism	1.1,2.1.1,2.1.5,2.4.1,4.1.2
CO4	TPS3	Apply	Value	Mechanism	1.1,2.4.1,2.4.7,4.1.1,4.1.2
CO5	TPS2	Understand	Respond	Guided Response	1.1,2.5.1,2.5.2,
CO6	TPS2	Understand	Respond	Guided Response	1.1,2.4.7,2.5.4,
CO7	TPS4	Analyse	Organise	Complex Overt Responses	3.1.1,3.1.2,3.1.3,3.1.4,4.1.1,4.1.2

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	-	-	-	-	L	S	-	-	-	-	-
CO2	M	-	-	-	-	L	-	L	-	-	-	-

CO3	M	M	-	-	L	M	S	-	-	-	-	-
CO4	M	-	L	L	L	M	M	-	-	-	-	-
CO5	L	-	-	-	-	-	-	M	-	-	-	-
CO6	L	L	-	-	-	-	M	-	-	-	-	-
CO7	S	M	M	M	M	M	-	-	S	M	M	-

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Assignment#			Terminal Examination***
	1	2	3	1	2	3	
Remember	0	20	0	NA	NA	NA	Presentation on Case study report
Understand	0	40	0				
Apply	0	40	0				
Analyse	0	0	0				
Evaluate	0	0	0				
Create	0	0	0				

Assignment: Marks will be given for the review I, II & III of case study presentation.

*** Case study presentation and evaluation

- ❖ Each group comprise of maximum three students
- ❖ Students will submit the case study report similar to final year project report
- ❖ Evaluation of case study presentation is based on the approved rubrics

Method of Evaluation

a)Internal assessment

S.No	Description	Max.marks	Final conversion
1	CAT -II	50	40
2	Assignment marks (from Review I,II & III)	3 X 10 =30	10
		Total	50

b) End semester examination – Case study presentation

Performance Index	Marks per Individual
Originality of the work	20
Data collected	20
Suggestion to overcome for the identified issues	20
Final Presentation	40
Total	100

Model Titles for Case Study:

1. Environmental impacts of quarry industries in Melur Taluk.
2. A study on impacts of tanneries on ground water and soil quality in Dindigul district.
3. Effect of pharmaceutical industry on groundwater quality in poikaraipatty village, Alagar Kovil.
4. Solid waste and waste water management in TCE hostel.
5. Environmental effect of Kudankulam atomic power plant.
6. Case study on effect of Sterlite industry.

7. Effect on ground water and soil quality by dyeing industries in Tiruppur.
8. Effect of textile wastes in Karur District.
9. Segregation of waste and its recycling by Madurai Municipality at Vellakkal
10. Effect of fire work waste on atmosphere in Sivakasi region

Sample Questions for Course Outcome Assessment**

Course Outcome 1(CO1):
1. Describe the Universal Energy flow model in an Ecosystem.
2. Discuss the conversion of one ecosystem into another ecosystem with example.
3. Explain the multidisciplinary nature of the environment.

Course Outcome 2 (CO2):
1. Summarize the importance of Natural resources to animals and human beings.
2. Describe the role of an individual in the conservation of Natural resources.

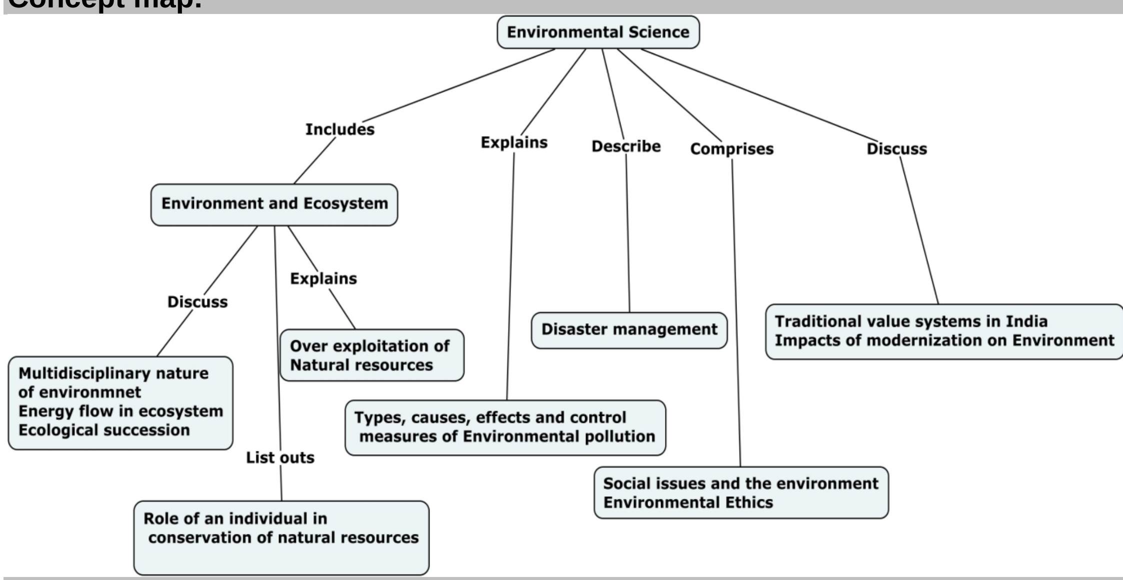
Course Outcome 3(CO3):
1. Demonstrate the effects and control measures of air pollution
2. Investigate the sources and management methods of e-waste.

Course Outcome 4(CO4):
1. Dramatize the mitigation methods adopted in severe cyclone affected areas.
2. Suggest the precautionary steps to prevent life from flood.

Course Outcome 5 (CO5):
1. Discuss the need for public awareness on environmental protection.
2. Identify the requirement for the equitable utilization of natural resources.

Course Outcome 6(CO6):
1. Describe the traditional value systems of India.
2. Recall the environmental related points discussed in our Indian Vedas.
3. List out the impacts of modernization on environment

Concept map:



Syllabus

Environment and Ecosystem - Multidisciplinary nature of environment- Ecosystem- Energy flow in ecosystem-Ecological succession-Over exploitation of Natural resources-Role of an individual in conservation of natural resources. **Environmental pollution and control -** Environmental pollution – types, causes, effects and control measures - Disaster management strategies. **Environmental Ethics and Values -** Social issues and the environment -need for public awareness, Environmental Ethics- need for equitable utilization of natural resources-Traditional value systems in India, Impacts of modernization on Environment

Awareness and actual activities:

- ✓ Group meeting on water management, promotion of recycle use, reduction of waste,
- ✓ Plantation
- ✓ Cleanliness drive
- ✓ Drive on segregation of waste
- ✓ Energy saving
- ✓ Lectures by Environmentalist
- ✓ Slogan and poster making event

Learning Resources

1. Kaushik,A & Kaushik.C.P, Environmental Science and Engineering, 6th Edition, New Age International, 2018.
2. Erach Bharucha, Text book of Environmental studies for Undergraduate courses, 2nd Edtion, UGC, 2013.
3. Gilbert M.Masters, Introduction to Environmental Engineering and Sciences, 2nd Edition, Pearson , 2004.
4. Garg S.K & Garg, Ecological and Environmental studies, Khanna Publishrers, 2006.
5. Wright &Nebel, Environmental science towards a sustainable future, 8th Editon,Prentice Hall of Indial Ltd, 2002.
6. Documentary titled “HOME” by Yves Bertrand, Video Link: https://www.youtube.com/watch?v=jqxENMKaeCU

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1.0	**Environment and Ecosystem**		
1.1	Multidisciplinary nature of environment-Ecosystem	1	CO1
1.2	Energy flow in ecosystem – Universal energy flow model	1	CO1
1.3	Ecological succession	1	CO1
1.4	Over exploitation of Natural resources	1	CO2
1.5	Role of individual in conservation of natural resources	1	CO2
2.0	**Environmental pollution and control**		
2.1	Environmental pollution – types(Air, Water,soil,Marine),	2	CO3
2.2	causes (gaseous, liquid, solid, plastic, e-waste, biomedical waste and radiations),	2	CO3
2.3	**E**ffects and control measures of Pollution	2	CO3
2.4	Disaster managements during cyclone, Tsunami, flood, draught and earthquake	2	CO4
3.0	**Environmental Ethics and Values**		
3.1	Social issues and the environment -need for public awareness	1	CO5
3.2	Environmental Ethics- need for equitable utilization of natural resources	1	CO5
3.3	Traditional value systems in India,	1	CO6
3.4	Impacts of modernization on Environment	2	CO6
4.0	**Awareness and actual activities**		
4.1	Group meeting on water management, promotion of recycle use, reduction of waste	2	CO7
4.2	Plantation	1	CO7
4.3	Cleanliness drive	1	CO7

4.4	Drive on segregation of waste	1	CO7
4.5	Energy saving	1	CO7
4.6	Lectures by Environmentalist	1	CO7
4.7	Slogan and poster making event	Through online	CO7

Course Designers:

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CURRICULUM AND DETAILED SYLLABI

FOR

B.E DEGREE (Computer Science and Engineering) PROGRAMME

THIRD SEMESTER

FOR THE STUDENTS ADMITTED FROM THE

ACADEMIC YEAR 2018 - 2019 ONWARDS

THIAGARAJAR COLLEGE OF ENGINEERING
(A Government Aided ISO 9001-2008 certified
Autonomous Institution affiliated to Anna University)

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THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015
B.E Degree (Computer Science and Engineering) Programme
COURSES OF STUDY
(For the candidates admitted from 2018 -19 onwards)

THIRD SEMESTER

Course Code	Name of the Course	Category	No. of Hours / Week			Credits
			L	T	P	
THEORY						
18CS310	Probability and Statistics	BS	2	1	-	3
18CS320	Principles of Programming Paradigms	ES	2	1	-	3
18CS330	Object Oriented Programming	PC	3	-	-	3
18CS340	Data Structures and Algorithms	PC	3	-	-	3
THEORY CUM PRACTICAL						
18CS360	Assembly Language Programming	PC	2	-	2	3
18ES390	Design Thinking	ES	1	-	2	2
PRACTICAL						
18CS370	Data Structures Lab	PC	-	-	2	1
18CS380	Object oriented Programming Lab	PC	-	-	2	1
Total			**13**	**2**	**8**	**19**

AC : Audit Course
BS : Basic Science
HSS : Humanities and Social Science
ES : Engineering Science
PC : Program Core

L : Lecture
T : Tutorial
P : Practical

Note:

1 Hour Lecture is equivalent to 1 credit

1 Hour Tutorial is equivalent to 1 credit

2 Hours Practical is equivalent to 1 credit

THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015
B.E Degree (Computer Science and Engineering) Programme
SCHEME OF EXAMINATIONS
(For the candidates admitted from 2018-19 onwards)

THIRD SEMESTER

S.No.	Course Code	Name of the Course	Duration of Terminal Exam. in Hrs.	Marks			Minimum Marks for Pass	
				Continuous Assessment	Terminal Exam *	Max. Marks	Terminal Exam	Total
THEORY								
1	18CS310	Probability and Statistics	3	50	50	100	25	50
2	18CS320	Principles of Programming Paradigms	3	50	50	100	25	50
3	18CS330	Object oriented Programming	3	50	50	100	25	50
4	18CS340	Data Structures and Algorithms	3	50	50	100	25	50
THEORY CUM PRACTICAL								
5	18CS360	Assembly Language Programming	3	50	50	100	25	50
6	18ES390	Design Thinking	-	50	50	100	25	50
PRACTICAL								
7	18CS370	Data Structures Lab	3	50	50	100	25	50
8	18CS380	Object oriented Programming	3	50	50	100	25	50

* Terminal Examination will be conducted for maximum marks of 100 and subsequently be reduced to 50 marks for the award of terminal examination marks

18CS310	PROBABILITY AND STATISTICS

Category	L	T	P	Credit
BS	2	1	0	3

Preamble

An engineering student needs to have some basic mathematical tools and techniques to apply in diverse applications in Engineering. This emphasizes the development of rigorous logical thinking and analytical skills of the student and appraises him the complete procedure for solving different kinds of problems that occur in engineering. Based on this, the course aims at giving adequate exposure in random variables, probability distributions, regression and correlation, test of hypothesis and analysis of variance.

Prerequisite

Engineering Calculus

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Apply conditional probability, Bayes' theorem to solve real world problems.	10
CO2	Compute probability, expectation and variance of random variables.	10
CO3	Apply the concept of expectation and moment generating functions to discrete and continuous distributions and find the probability values for the defined distributions	20
CO4	Apply the concept of linear and nonlinear correlation, linear and nonlinear regressions to engineering problems	20
CO5	Test the hypothesis on mean, variance, proportion of small and large samples, for goodness of fit and independence of attributes	25
CO6	Design and conduct of engineering experiments involving a single factor, two factors and three factors.	15

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value		1.1.1, 2.1.4
CO2	TPS2	Understand	Respond		1.1.1, 2.1.4
CO3	TPS3	Apply	Value		1.1.1, 2.1.4
CO4	TPS3	Apply	Value		1.1.1, 2.1.4
CO5	TPS3	Apply	Value		1.1.1, 2.1.5, 2.2.1, 2.2.4
CO6	TPS3	Apply	Value		1.1.1, 2.1.5, 2.2.1, 2.2.4

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L		L	L						L	M	L	
CO2	M	M	L		L	L						L	M	L	

CO3	S	M	L		L	L						L	M	L	
CO4	S	M	L		L	L						L	M	L	
CO5	S	M	L		L	L						L	M	L	
CO6	M	M	L		L	L						L	M	L	

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continious Assessment Tests			Assignment			Terminal Examinations
	1	2	3	1	2	3	
Remember	10	10	10	-	-	-	-
Understand	30	30	30	-	-	-	30
Apply	60	60	60	100	100	100	70
Analyse							
Evaluate							
Create							

Assessment Pattern: Psychomotor

Psychomotor Skill	Miniproject /Assignment/Practical Component
Perception	
Set	
Guided Response	
Mechanism	
Complex Overt Responses	
Adaptation	
Origination	

Sample Questions for Course Outcome Assessment**

Course Outcome 1(CO1):

1. Two competing software companies are after an important contract. Company A is twice as likely to win this competition as company B. What is the probability to win the contract?
2. (Reliability of backups) There is a 1% probability for a hard drive to crash. Therefore, it has two backups, each having a 2% probability to crash, and all three components are independent of each other. The stored information is lost only in an unfortunate situation when all three devices crash. What is the probability that the information is saved?
3. (Diagnostics of computer codes) A new computer program consists of two modules. The first module contains an error with probability 0.2. The second module is more complex; it has a probability of 0.4 to contain an error, independently of the first module. An error in the first module alone causes the program to crash with probability 0.5. For the second module, this probability is 0.8. If there are errors in both modules, the program crashes with probability 0.9. Suppose the program crashed. What is the probability of errors in both modules?

Course Outcome 2(CO2):

1. The weekly demand for propane gas (in 1000s of gallons) from a particular facility is an RV X with pdf $f(x) = \begin{cases} 2\left(1 - \frac{1}{x^2}\right), & 1 \le x \le 2 \\ 0, & otherwise \end{cases}$. Compute the cdf of X and Compute E(X), V(X).

2. An electronic store sells a particular model of a laptop computer. Ther are only four laptops in stock, and the manager wonders wht today's demand for this particular model will be. She learns from the marketing department that the probability distribution for x, the daily demand for the laptop is as shown in the table.

x	0	1	2	3	4	5
P(x)	0.10	0.40	.020	0.15	0.10	0.05

Find the mean, variance and standard deviation of x. Is it likely that five or more customers will want to buy the laptop today?

Course Outcome 3(CO3):

1. Estimate the moment generating function of the random variable X given pdf f(x) = $2e^{-2x}$; x > 0
2. Predict the value of 'a' if P(X = x) = a $(2/3)^x$; x = 1,2,3……
3. If the probability that an applicant for a driver's license will pass the road test on any given trial is 0.8. What is the probability that he will finally pass the test (a) on the fourth trail and (b) in fewer than 4 trails?

Course Outcome 4(CO4):

1. Compute $R_{1.23}$ if r_{12} =0.77; r_{13} =0.72; r_{23} =0.52.
2. Coefficient of correlation between x and y is 0.48. Their covariance is 36. The variance is 16. Find the standard deviation of y.
3. The data below represent investments, in $1000s, in the development of new software by some computer company over an 11-year period,

Year	X	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Investment	Y	17	23	31	29	33	39	39	40	41	44	47

Identify the regression model with Y as a dependent variable, estimate the variance of Y.

Course Outcome 5 (CO5):

1. Define Type I and Type II errors.
2. Twenty people were attacked by a disease and only 18 survived. Will you reject the hypothesis that the survival rate if attacked by the disease is 85% in favor to the hypothesis that it is more at 5% level?
3. A manufacturer of sprinkler systems used for fire protection in office buildings claims that the true average system-activation temperature is 130°. A sample of n = 9 systems, when tested, yields a sample average activation temperature of 131.08°F. If the distribution of activation times is normal with standard deviation 1.5°F, does the data contradict the manufacturer's claim at 1% significance level?

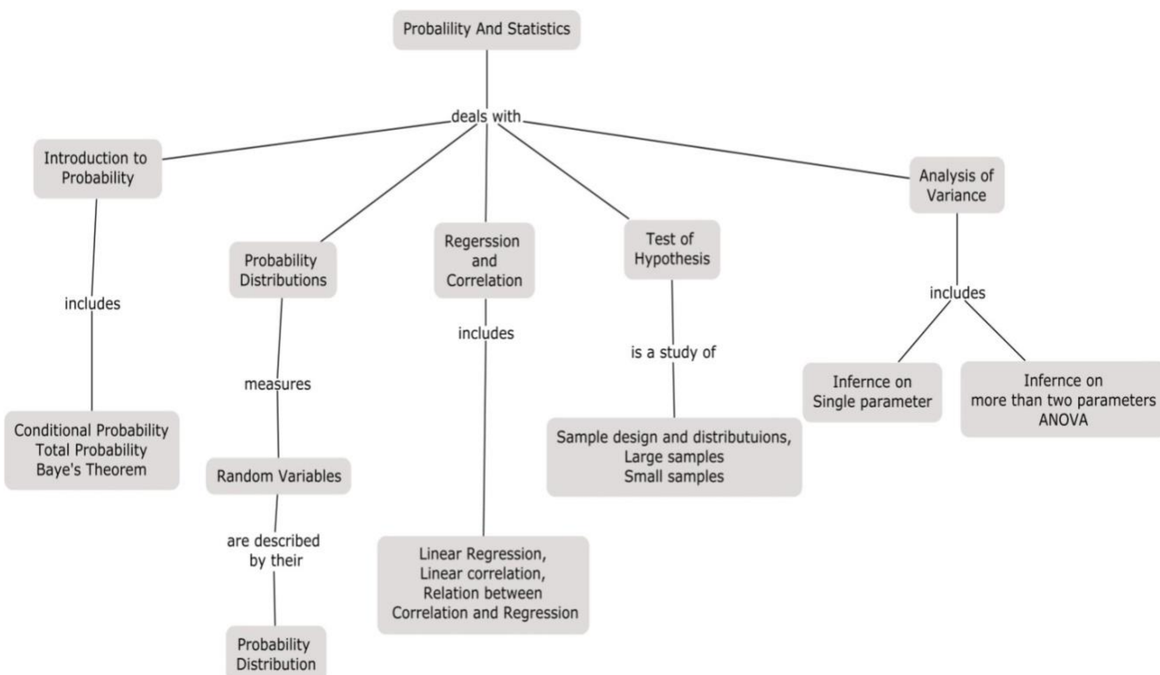
Course Outcome 6 (CO6):

1. Define designed experiment.
2. The following data refers to yield of tomatoes (kg/plot) for four different levels of salinity. *Salinity level* here refers to electrical conductivity (EC), where the chosen levels were EC 1.6, 3.8, 6.0 and 10.2 nmhos/cm.

1.6	59.5	53.3	56.8	63.1	58.7
3.8	55.2	59.1	52.8	54.5	
6.0	51.7	48.8	53.9	49.0	
10.2	44.6	48.5	41.0	47.3	46.1

Use the *F* test at level to test for any differences in true average yield due to the different salinity levels.

Concept Map



Syllabus

Introduction to Probability: Events and their Probability, Rules of Probability, Axioms of Probability, Computing probabilities of events, Application in reliability, Combinatorics, Conditional Probability and Independence (Baye's theorem).

Probability Distributions: Random Variable, Discrete Random Variable, Continuous Random Variable, Expected Values, The Binomial distribution, The Poisson distribution, hyper geometric distribution ,The Normal distribution, The Exponential Distribution.

Regression and Correlation: Least square estimation, Method of Least squares, Linear regression, Regression and Correlation.

Test of Hypothesis: Hypotheses and test procedures - tests concerning a population mean - tests concerning a population proportion - *z* tests and confidence intervals for a difference between two Population means - the two-sample *t* Test and confidence interval - inferences concerning a difference between population proportion - inferences concerning two population variances

The Analysis of Variance: Single-Factor ANOVA - Two-Factor ANOVA - Three-Factor ANOVA.

Learning Resources

1. Michael Baron, "Probability and Statistics for Computer Scientists" second edition, CRC press, USA, 2014.
   Introduction to Probability: Sections 2.1, 2.1.1, 2.2, 2.2.1, 2.2.2, 2.2.3, 2.3, 2.3.1, 2.3.2, 2.4
   Regression and Correlation: Sections 11.1, 11.1.2, 11.1.3, 11.1.4
2. Jay L. Devore, "Probability and Statistics for Engineering and the Sciences" (English) 8th Edition, Cengage Learning India Pvt Ltd, New Delhi, 2012.
   Probability Distributions: Sections 3.1, 3.2,3.5(hyper geometric distribution only), 4.1, 3.3, 4.2, 3.4, 3.6, 4.3, 4.4
   Test of Hypothesis: Sections 8.1, 8.2, 8.3, 9.1, 9.2, 9.4, 9.5
   The Analysis of Variance: Section 10.1, 11.1, 11.3
3. Miller, Fan, "Probability and Statistics for Engineers", Prentice Hall of India, 2001.
4. S.C.Gupta, V.K.Kapoor, " Fundamentals of Mathematical Statistics", Eighth Edition, Sultan Chand and Sons, New Delhi, 2001.
5. JohnVerzani, "Using R for Introductory Statistics",Chapman & Hall / CRC press,2005.

Course Contents and Lecture Schedule

S.No	Topics	No. of Lectures	Course Outcome
1	**Introduction to Probability**		
1.1	Events and their probability, Rules of Probability, Axioms of Probability,	1	CO1
1.2	Application in reliability	1	CO1
	Tutorial	1	CO1
1.3	Combinatorics	1	CO1
1.4	Conditional Probability and Independence (Baye's Theorem)	2	CO1
	Case studies problem solving R-Tool – Assignment I	1	CO1
2	**Probability Distributions**		
2.1	Random Variables, Discrete and Continuous Random Variables, Expected Values	1	CO2
	Tutorial	1	CO2
2.2	The Binomial distribution	1	CO3

2.3	The Poisson distribution and hyper geometric distribution	1	CO3
	Tutorial	1	CO3
2.4	The Normal distribution	1	CO3
2.5	The Exponential distribution	1	CO3
	Tutorial	1	CO3
3	**Regression and Correlation**		
3.1	Least square estimation	1	CO4
3.2	Method of least squares	1	CO4
	Tutorial	1	CO4
3.3	Linear regression	2	CO4
3.4	Regression and Correlation	1	CO4
	Case studies problem solving R-Tool – Assignment II	1	CO4
4	**Test of Hypothesis**		
4.1	Hypotheses and test procedures	1	CO5
4.2	Tests concerning a population mean and population proportion	1	CO5
	Tutorial	1	CO5
4.3	*z* Tests and confidence intervals for a difference between two population means	1	CO5
4.4	The two-Sample *t* Test and confidence interval	1	CO5
	Tutorial	1	CO5
4.5	Inferences concerning a difference between population proportions and population variances	1	CO5
	Tutorial	1	CO5
5	**The Analysis of Variance**		
5.1	Single-Factor ANOVA	1	CO6
5.2	Two-Factor ANOVA	1	CO6
	Tutorial	1	CO6
5.3	Three- Factor ANOVA	2	CO6
	Case studies problem solving R-Tool – Assignment III	1	CO6
	Total	36	

Course Designers:

1. Dr.A.Anitha anithavalli@tce.edu
2. Ms. H.Sri Vinodhini srivinodhini@tce.edu

18CS320	PRINCIPLES OF PROGRAMMING PARADIGMS

Category	L	T	P	Credit
ES	2	1	0	3

Preamble

The course will give a brief introduction to the basic principles of programming languages. Student will learn the concepts of prevalent programming paradigms like Imperative programming, Functional programming and Logic programming with suitable case studies.

Prerequisite

Problem Solving using Computers

Computer Programming

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Illustrate different programming paradigms and describe the language processing activities.	15
CO2	Solve engineering problems using imperative paradigm based sequential programming	20
CO3	Solve engineering problems using concurrent programming	15
CO4	Solve engineering problems using functional paradigm	15
CO5	Solve engineering problems using logic paradigm	15
CO6	Develop scripts for given specification using scripting language	20

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	Guided Response	1.2, 2.3.1
CO2	TPS3	Apply	Value	Mechanism	1.2, 2.1.1, 2.1.2, 4.5.1, 4.5.3
CO3	TPS3	Apply	Value	-	1.2, 2.1.1, 2.1.2, 4.5.1, 4.5.3
CO4	TPS3	Apply	Value	Mechanism	1.2, 2.1.1, 2.1.2, 4.5.1, 4.5.3
CO5	TPS3	Apply	Value	-	1.2, 2.1.1, 2.1.2, 4.5.1, 4.5.3
CO6	TPS3	Apply	Value	-	1.2, 2.1.1, 2.1.2, 4.5.1, 4.5.3

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M		L										L		
CO2	M	L	M	L	M								M	M	

CO3	M	L	M	L	L								M	L	
CO4	M	L	M	L	M								M	M	
CO5	M	L	M	L	L								M	L	
CO6	M	L	M	L	L								M	L	

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Assignment			Terminal Examination
	1	**2**	**3**	1	2	3	
Remember	30	20	20	-	-	-	10
Understand	30	20	20	70	40	20	15
Apply	40	60	60	30	60	80	75
Analyse	-	-	-	-	-	-	-
Evaluate	-	-	-	-	-	-	-
Create	-	-	-	-	-	-	-

Assessment Pattern: Psychomotor

Psychomotor Skill	Miniproject /Assignment/Practical Component
Perception	-
Set	-
Guided Response	20
Mechanism	80
Complex Overt Responses	-
Adaptation	-
Origination	-

Sample Questions for Course Outcome Assessment**

Course Outcome 1 (CO1):

1. List the characteristics of high level language.
2. Differentiate compiler and interpreter.

Course Outcome 2 (CO2)

1. Construct a code snippet for stack implementation using procedural abstraction.
2. Identify and use the two prominent parameter passing methods using suitable OO code snippet.

Course Outcome 3 (CO3)

1. Apply the rendezvous method of Ada to three concurrent executing processes and give their code snippet. Assume the synchronized task of three processes.
2. Demonstrate the use of ‘rendezvous’ in Ada with an example

Course Outcome 4 (CO4)

1. Apply the definition of function ‘append(x,y)’ to the lists x=[1,2,3] and y=[4,5,6] and illustrate the evaluation of the function using abstract syntax trees.
2. Write the steps of approaches used to evaluate an expression with suitable examples.
3. Demonstrate the usage of Let statement in List Functional Programming.

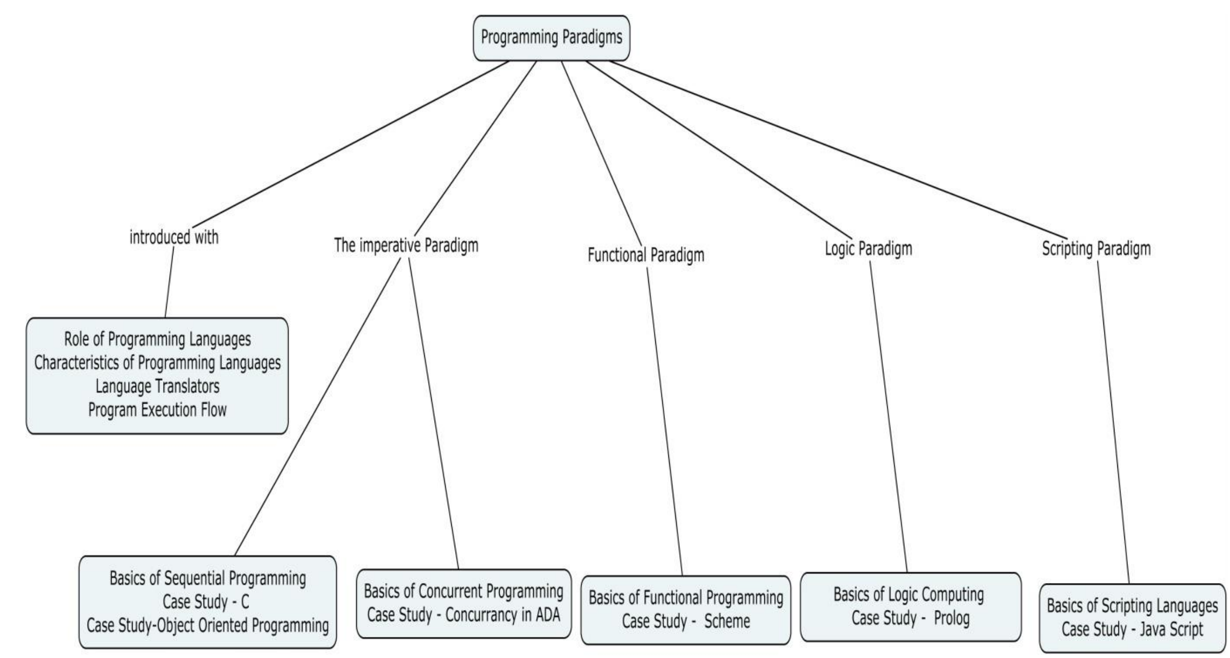
Course Outcome 5 (CO5)

1. Write a ‘link’ file in Prolog which has Facts and Rules to link between programming languages. Demonstrate a) satisfiable query with no variables, b) satisfiable query with variables and c) Failure query.
2. Identify the usage of existential quantifiers and universal quantifiers in Prolog with examples.
3. Name the benefits obtained by using relations in Logic programming.

Course Outcome 6 (CO6)

1. Write a Java Script to validate all fields of the user course registration form.
2. Write a Java Script to invoke a function for an onclick event.

Concept Map



Syllabus

Fundamentals of Programming Language processing - Role of programming languages, Characteristics and need for programming languages. Language translators and program execution flow. Introduction to programming paradigms.

The Imperative Paradigm – Introduction to imperative programming languages, **Sequential Programming: Case Study 1**: Basics of C - Procedural abstraction, Semantics – Expression, Assignment, Control Flow, Input/output and exception handling semantics. **Case Study 2**: Object Oriented Programming - Groupings of Data and Operations, Object Model –

Polymorphism, Encapsulation, Abstraction, Inheritance, and Information Hiding. **Concurrent Programming: Case Study**: Implicit Synchronization, Concurrency as interleaving, Safe Access to Shared Data, Semaphore, Mutual Exclusion, and Concurrency in ADA.

The Functional paradigm – Introduction to functions, **Case study: Scheme** – Expression, Expression Evaluation, Lists, Elementary values, Control flow, Defining functions and Let expressions.

The Logic paradigm – Computing with Relations, **Case Study: Prolog** – Introduction, Data Structures, Programming Techniques and Control in Prolog.

Scripting Language – Basics of Scripting Language, **Case Study: Java Script –** Syntax of writing Java Script, Variables and Assignment, Functions.

Learning Resources

1. Michael L. Scott, “Programming Language Pragmatics”, Fourth Edition, Morgan Kaufmann, 2016.
2. Seyed Mohamed Buhari, “Principles of Programming Languages A Paradigm approach”, Tata McGraw-Hill, 2011.
3. Ravi Sethi, “Programming Languages: Concepts and Constructs”, AT&T Bell Laboratories, 2nd edition, Addison Wesley, 2007.
4. Axel Rauschmayer, “Speaking JavaScript”, O’Reilly Media, 2015.
5. David A.Watt, “Programming Language Concepts and Paradigms”, Prentice Hall, 1990.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1.	**Fundamentals of Language processing (5)**		
1.1	Role of programming languages	1	CO1
1.2	Characteristics and need for programming languages	1	CO1
1.3	Language translators and program execution flow	2	CO1
1.4	Introduction to programming paradigms	1	CO1
2	**Imperative Paradigm (14)**		
2.1	Introduction to imperative programming languages	1	CO2
	Sequential Programming		
2.2	**Case Study 1: C Programming**		
2.2.1	Procedural abstraction	1	CO2
2.2.2	Semantics – Expression, Assignment, Control Flow, Input/output and exception handling semantics. Tutorial	2	CO2
2.3	**Case Study 2: Object-Oriented Programming**		
2.3.1	Groupings of data and operations	1	CO2
2.3.2	Object Model - Encapsulation, Abstraction and Information Hiding. Tutorial	2	CO2
2.3.3	Object Model – Polymorphism and Inheritance Tutorial	2	CO2
2.4	**Case Study 3: Concurrent Programming**		
2.4.1	Implicit Synchronization	1	CO3

Module No.	Topic	No. of Hours	Course Outcome
2.4.2	Concurrency as interleaving	1	CO3
2.4.3	Safe Access to Shared Data, Semaphore, Mutual Exclusion,	1	CO3
2.4.4	Concurrency in ADA Tutorial	2	CO3
3	**Functional Paradigm (5)**		
3.1	Introduction to Functions	1	CO4
3.2	Scheme - Expression, Expression Evaluation, Lists, Elementary values	2	CO4
3.3	Control flow, Defining functions and Let expressions	2	CO4
4	**Logic Paradigm (6)**		
4.1	Computing with Relations	2	CO5
4.2	Prolog – Basics & Data Structures	2	CO5
4.3	Programming techniques & Control in Prolog - Tutorial	2	CO5
5	**Scripting Language (6)**		
5.1	Basics of Scripting Language	1	CO6
5.2	Java Script - Syntax of writing Java Script	2	CO6
5.3	Variables and Assignment	1	CO6
5.4	Functions - Tutorial	2	CO6

Course Designers:

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2. M.Suguna mscse@tce.edu

18CS330	OBJECT ORIENTED PROGRAMMING

Category	L	T	P	Credit
PC	3	0	0	3

Preamble

This syllabus is intended for the Computer science students and enables them to learn Object Oriented Programming and the design of computer solutions in a precise manner. The syllabus emphasizes on OOP concepts, Functions, Polymorphism, Inheritance and I/O. The intention is to provide sufficient depth in these topics to enable candidates to apply Object Oriented Programming approach to programming. The modules in the syllabus reflect solving general problems via programming solution. Thus, modules collectively focus on programming concepts, strategies and techniques; and the application of these toward the development of programming solutions.

Prerequisite

Programming fundamentals

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Construct Object oriented programs using methods and passing arrays, objects, and array of objects to them.	25
CO2	Demonstrate Compile-time and Run-time polymorphism using object oriented programs	15
CO3	Illustrate the relationships between objects using inheritance hierarchies and aggregation	15
CO4	Develop Object Oriented programs to handle data using Files and Object Serialization and Exception handling	10
CO5	Develop Object Oriented programs to handle exceptions using Exception handling	10
CO6	Develop Object Oriented programs to demonstrate event driven programming, concurrent programming and network programming.	25

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value	Mechanism	1.2, 4.5.3
CO2	TPS3	Apply	Value	Mechanism	1.2, 4.5.3
CO3	TPS3	Apply	Value	Mechanism	1.2, 4.5.3
CO4	TPS3	Apply	Value	Mechanism	1.2, 4.5.3
CO5	TPS3	Apply	Value	Mechanism	1.2, 4.5.3
CO6	TPS3	Apply	Value	Mechanism	1.2, 4.5.3

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	S	M	M	M		M	M	M	M	M	S	M	M
CO2	S	S	S	M	M	M		M	M	M	M	M	S	M	M
CO3	S	S	S	M	M	M		M	M	M	M	M	S	M	M

CO4	S	S	S	M	M	M		M	M	M	M	M	S	M	M
CO5	S	S	S	M	M	M		M	M	M	M	M	S	M	M
CO6	S	S	S	M	M	M		M	M	M	M	M	S	M	M

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Assignment			Terminal Examination
	1	**2**	**3**	1	2	3	
Remember	30	20	20	-	-	-	
Understand	30	20	20	-	-	-	20
Apply	40	60	60	80	80	80	60
Analyse				20	20	20	20
Evaluate							
Create							

Assessment Pattern: Psychomotor

Psychomotor Skill	Miniproject/Assignment/Practical Component
Perception	-
Set	-
Guided Response	25
Mechanism	50
Complex Overt Responses	25
Adaptation	-
Origination	-

Sample Questions for Course Outcome Assessment**

Course Outcome 1(CO1):

1. Define a method signature.
2. List the difference between inline and non-inline functions.
3. Write about the benefits of Object oriented Programming.
4. Write a Java program to create 2 two-dimensional arrays which hold numbers. Write a method which takes the arrays as arguments to perform matrix multiplication.
5. Assume a class in Java named Car that keeps track of price of cars. It has instance variables carName, price and taxRate. Write a method that computes the total price(including tax) of the Car object with the values passed as arguments. Create 2 Car objects and display their total price.

Course Outcome 2(CO2):

1. Recollect the term compile time polymorphism.
2. Define overriding
3. Discuss in detail about run time polymorphism.
4. Write a Java program to create 2 overloaded methods named findAt to find the digit / character at the position specified. One method takes a number and position as arguments. Another method takes a string and position as arguments.

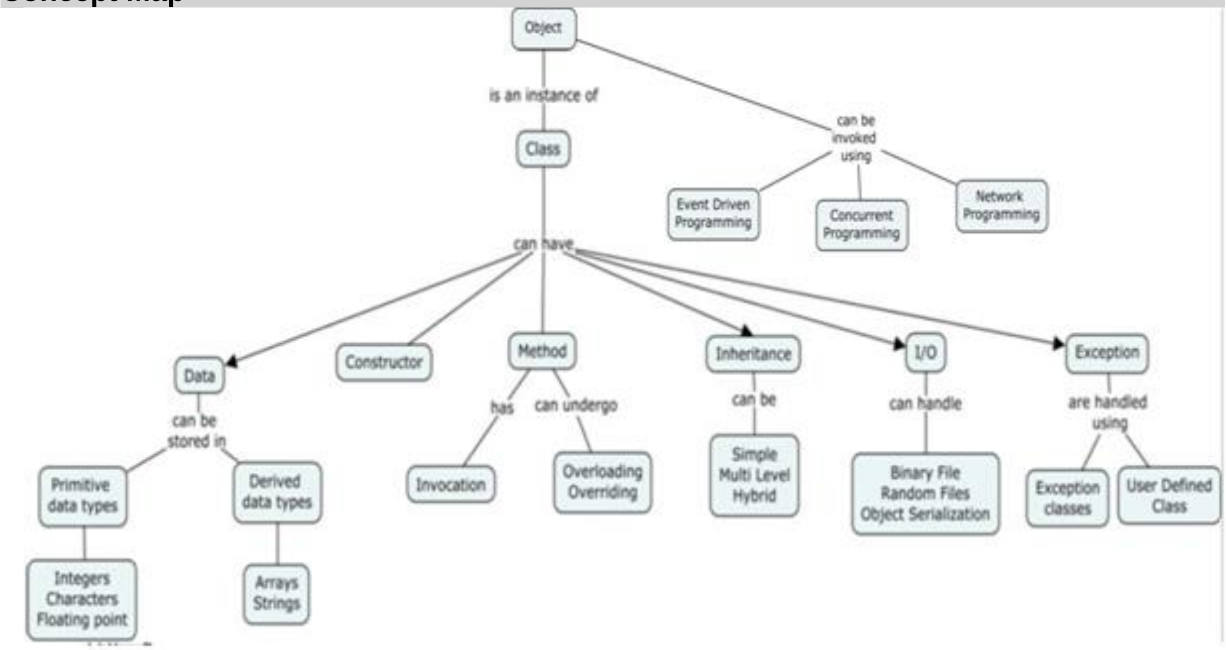
Course Outcome 3(CO3):
1. State the difference between aggregation and composition.
2. Explain about Inheritance hierarchies with an example program.
3. Discuss about public and protected derivations with an example program.
4. Write a class implementation in Java to demonstrate the aggregate relationship between a **Department** and a **Course.** The Department offers several courses and each course has an associated credit. Design methods in the Department class to calculate the number of courses offered and the total number of credits. Design methods in the Course class to set and get its credit.

Course Outcome 4 (CO4):
1. List any 4 methods of Data Input stream class.
2. Discuss the advantages of Random AccessFiles using a sample program.
3. Write a program that uses a structure to store the following student information in a file. The program should have a menu that allows the user to perform the following tasks i) Add new records to the file ii) Display any record in the file
4. Consider a class called **UsedCar** which uses an interface called secsalesItem. The UsedCar class has the following fields: vehicleNumber, model, year, kmTravelled, price and the following methods: getVehicleNumber, getModel and getRetailPrice. The interface secsalesItem has only one method called getRetailPrice which calculates price based on the year of manufacture and kilometers travelled. Create 5 usedCar objects and serialize them into a file

Course Outcome 5 (CO5):
1. Write a program to create a class named BirthDay that has date, month and year as members. Write a program to create BirthDay objects of 5 students. Write object oriented exception handling code to validate the month, day and year of thecreated BirthDay objects.
2. Illustrate the various exception handling mechanisms available in Java
3. Create a class named Account having Account number, Customer Name and balance as member variables and deposit and withdraw as member functions. Write the exception handling code when the balance of an account drops below Rs.1000.

Course Outcome6(CO6):
1. What is event driven programming?
2. Illustrate concurrent programming using threads.
3. What is a socket?
4. Implement a Tic-Tac-Toe game using grid layout and mouse click events

Concept Map



Syllabus

Basics of Object oriented Programming Object oriented programming and its benefits - Object oriented programming concepts: Encapsulation, Information hiding and Abstraction – Generalization/Specialization and Polymorphism - Object oriented design: finding the Classes and their Responsibilities – Object oriented programming language: Java- **Classes and Objects** Instance fields and Methods-Constructors–Passing Arguments to a Method – Returning Value from a Method – Method overloading –Constructor overloading- Passing Arrays As Arguments to Methods – Passing Objects to Methods- Returning Objects from Methods –**Class collaborations and Polymorphism** Object oriented Design: Class Collaborations – Aggregation –Composition –Chains of Inheritance – Overriding Super class methods – Abstract Classes and Abstract Methods – Interfaces**I/O Handling and Exception Handling –**Binary files – Random-Access files- Object serialization – Exception handling **Event-Driven Programming Concurrent Programming Network programming** – Text-related GUI components – other GUI components – Handling mouse events and button events – Thread life cycle and methods – Runnable interface – Thread Synchronization – Basics of network programming

Learning Resources

1. Tony Gaddis, “Starting Out with Java: From Control Structures through Objects”, Sixth edition, Pearson Education Limited, 2016.
2. Bart Baesens, Aimee Backiel, SeppevandenBroucke, “Beginning Java Programming:The Object-Oriented Approach”, John Wiley & Sons, 2015.
3. Herbert Schildt: “Java : The Complete Reference”, Tenth Edition, McGraw-Hill, 2017.
4. Kenneth L. Calvert and Michael J. Donahoo, “TCP/IP Sockets in Java: Practical Guide for Programmers”, 2^{nd} Edition. Elsevier, 2011.
5. Grady Booch, Robert Maksimchuk, Michael Engel, Bobbi Young, Jim Conallen, Kelli Houston“ Object Oriented Analysis and Design with Applications”, Third Edition, 2012.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1	**Basics of Object oriented Programming (6)**		
1.1	Object oriented programming and its benefits	1	CO1
1.2	Object oriented programming concepts: Encapsulation, Information hiding and Abstraction, Generalization/Specialization and Polymorphism	1	CO1, CO2, CO3
1.3	Object oriented design: finding the Classes and their Responsibilities	2	CO1
1.4	Object oriented programming language: Java	1	CO1
1.5	Object oriented programming language: C++	1	CO1
2	**Classes and Objects(7)**		
2.1	Instance fields and Methods-Constructors	1	CO1
2.2	Passing Arguments to a Method – Returning Value from a Method - Method overloading	2	CO2
2.3	Constructor overloading	1	CO2
2.4	Passing Arrays As Arguments to Methods	1	CO1
2.5	Passing Objects to Methods, Returning Objects from Methods	2	CO1
3	**Class collaborations and Polymorphism(6)**		
3.1	Object oriented Design: Class Collaborations	1	CO3
3.2	Aggregation –Composition	1	CO3
3.3	Chains of Inheritance	1	CO3
3.4	Overriding Super class methods	1	CO2,CO3
3.5	Abstract Classes and Abstract Methods	1	CO2,CO3
3.6	Interfaces	1	CO2,CO3
4	**I/O Handling and Exception Handling (8)**		
4.1	Binary files	1	CO4
4.2	Random-Access files	2	CO4
4.3	Object serialization	1	CO4
4.4	Exception handling	4	CO5
5	**Event-Driven Programming Concurrent Programming Network programming (9)**		

5.1	Frameworks	1	CO6
5.2	Text-related GUI components, other GUI components	1	CO6
5.3	Handling mouse events and button events	1	CO6
5.4	Thread life cycle and methods	1	CO6
5.5	Runnable interface	1	CO6
5.6	Thread Synchronization	2	CO6
5.7	Basics of network programming	2	CO6

Course Designers:

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2. Mr.S.Prasanna sprcse@tce.edu

18CS340	DATA STRUCTURES AND ALGORITHMS

Category	L	T	P	Credit
PC	3	0	0	3

Preamble

This course will cover various data structures and their operations for manipulating them. Students will learn how to organize the data so that, the data can be accessed and updated efficiently using computer programs.

Prerequisite

Problem Solving methods and Programming Fundamentals

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Apply the concepts of stack and queue for suitable applications in trade off with time and space complexity.	15
CO2	Illustrate the operations like insertion, deletion, traversing on the nonlinear tree data structure	15
CO3	Choose appropriate binary and multiway search tree for performing searching operations, with an understanding of the trade-off between the time and space complexity.	30
CO4	Manipulate disjoint sets by performing union, iterative find-set operations	10
CO5	Demonstrate the concepts of advanced data structures including heap in various applications	15
CO6	Show the avoidance of collisions in the hash tables using collision resolution techniques including open and closed hashing techniques.	15

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value	Guided Response	1.2, 2.1.2, 4.5.3
CO2	TPS3	Apply	Value	Guided Response	1.2, 2.1.2, 4.5.3
CO3	TPS3	Apply	Value	Guided Response	1.2, 2.1.2, 4.5.3
CO4	TPS3	Apply	Value	Guided Response	1.2, 2.1.2, 4.5.3
CO5	TPS3	Apply	Value	Guided Response	1.2, 2.1.2, 4.5.3
CO6	TPS3	Apply	Value	Guided Response	1.2, 2.1.2, 4.5.3

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	S	S	M										S		
CO 2	S	S	M										S		
CO 3	S	S	M										S		
CO 4	S	S	M										S		
CO 5	S	S	M										S		
CO 6	S	S	M										S		

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Assignment			Terminal Examination
	1	2	3	1	2	3	
Remember	10	10	10	-	-	-	10
Understand	30	30	10	-	-	-	10
Apply	60	60	80	100	100	100	80
Analyse							
Evaluate							
Create							

Assessment Pattern: Psychomotor

Psychomotor Skill	Assignments
Perception	
Set	
Guided Response	100
Mechanism	
Complex Overt Responses	
Adaptation	
Origination	

Sample Questions for Course Outcome Assessment**

Course Outcome 1 (CO1):

1. Suppose a circular queue of capacity (n – 1) elements is implemented with an array of n elements. Assume that the insertion and deletion operation are carried out using REAR and FRONT as array index variables, respectively. Initially, REAR = FRONT = 0. Give the conditions to detect queue full and queue empty?
2. Given a 5 element stack S (from top to bottom: 2, 4, 6, 8, 10), and an empty queue Q, remove the elements one-by-one from S and insert them into Q, then remove them one-by-one from Q and re-insert them into S. List the elements in S (from top to bottom).

3. Given an array and a singly linked list. Which of these data structures uses more memory space to store the same number of elements? Justify your answer.

Course Outcome 2 (CO2):

1. Perform the AVL algorithm for non AVL trees. In each case, count the number of updated links required by the AVL rotation.Given a simple expression tree, consisting of basic binary operators i.e., + , – ,* and / and some integers, write an algorithm to evaluate the expression tree.
2. Suppose inorder and preorder traversal of a binary tree:
   Inorder D, B, H, E, A, I, F, J, C, G
   Preorder A, B, D, E, H, C, F, I, J, G
3. Construct binary tree. Show the step by step process with suitable algorithm.Given a red-black tree with n elements, how fast can you sort them using the tree?

Course Outcome 3(CO3)

1. Given a B-Tree with H=5, M=10 and L=10, what is the Maximum and Minimum number of values that can be contained in the leafs of the B-Tree. Remember, all internal nodes and leafs must be at least half full.
2. Given a red-black tree and a key. Check the given key exist or not without recursion.
3. Create a trie for the set of words S = {ab, ba, ca, caa, caaa, baaa} over the alphabet Σ = {a, b, c}.

Course Outcome 4 (CO4)

1. Given a Boolean 2D matrix, find the number of islands using disjoint set.
2. Write pseudocode for make-set,find-set, union usingsingly linked lists and the weighted union rule.Each object x, has:
   a) fieldrepr[x] pointing to the representative of theset containing x,
   b) field last[x] pointing to the last objectin the list containing x,
   c) field size[x] giving the size of the listcontaining x.
   Size[x] and Last[x] are correct only when x is a representative
3. Suppose you have an implementation of union that is “by-size” and an implementation of find that does not use path compression. Give the parent map (or array) that results from the following sequence: union(1,2), union(3,4), union(3,5), union(1,7), union(3, 12), union(0,9), union(8,10), union(8,9), union(7,4), union(2,9) where the unions are: a) by size b) by height c) by size, but now with path compression

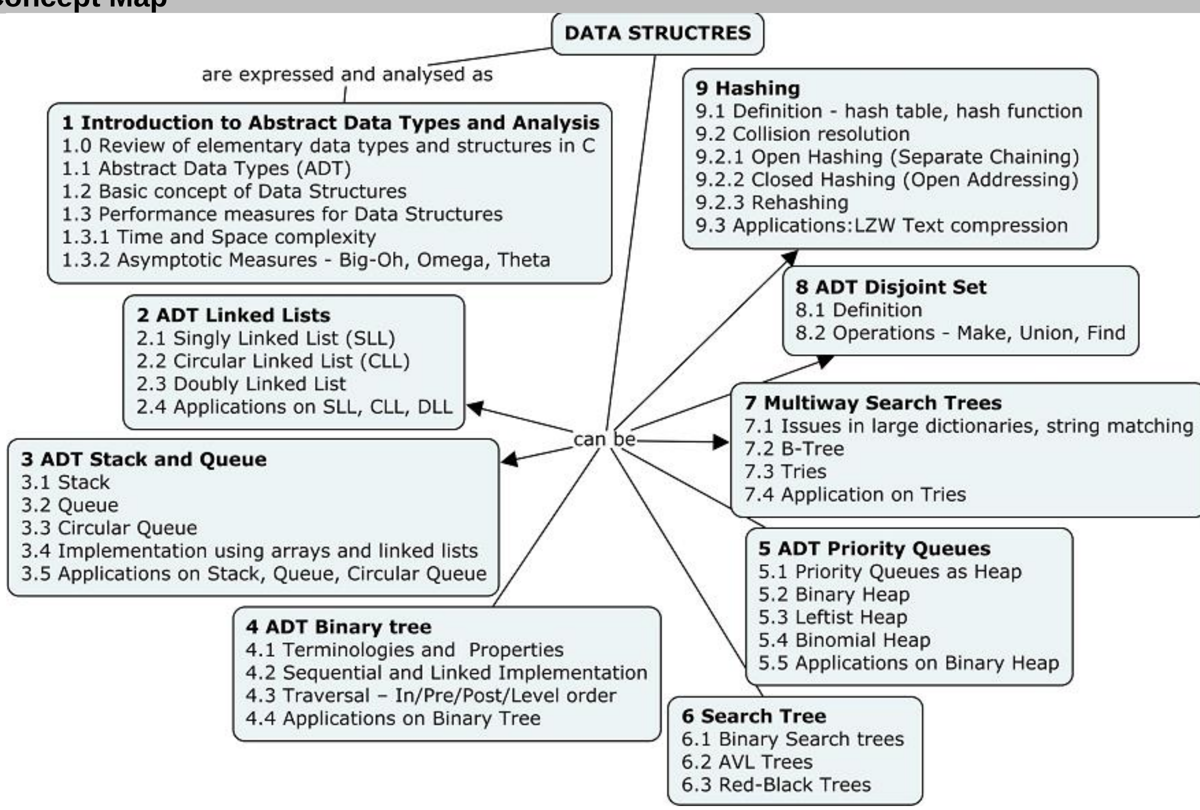
Course Outcome 5 (CO5)

1. For a binary heap stored in an array, the root is stored in position 1, the parent of node i is stored in position floor(i/2), the left child is in position 2i, and the right child is in position 2i+1. What about a d-heap stored in an array? In what positions are the children and parent of node i stored? [Hint: to start, assume that the root is at position 0. Then modify your results to work with the root at position 1]
2. Show the result of inserting keys 1 to 15 in order (i.e. 1 first, then 2 second, then 3 third, etc.) into an initially empty leftist heap. Use the leftist heap insert (i.e. merge) algorithm at each step. Show each step for this process.
3. Prove or disprove: A perfectly balanced tree forms if keys 1 to 2k − 1 are inserted in order (again this means 1 first, then 2 etc) into an initially empty leftist heap. k is a positive integer.

Course Outcome 6(CO6):

1. Given input {4371, 1323, 6173, 4199, 4344, 9679, 1989} and a hash function h(x) = x (mod () 10), show the resulting
   a. separate chaining hash table
   b. hash table using linear probing, quadratic probing
2. Consider implementing a hash table for an application in which we will build an initial hash table by inserting asubstantial collection of records. After this, we expect that the number of insertions and the number of deletions performed to be roughly the same, although there may be long runs of consecutive insertions or consecutive deletions. Furthermore, the table will use a probe strategy to resolve any collisions that occur during insertion, and therefore we will "tombstone" cells from which a record has been deleted. If we implement the hash table described above, then when we search for a record, we cannot conclude the record is not in the table until we have found an empty cell in the table, not just a tombstone. (We will ensurethat the table never reaches the state that there are no empty cells.) Explain carefully why the search cannot stopwhen a tombstone is encountered.
3. Let m = 17, h1(x) = (k+15)%m, h2(x) = (4k+11)%m, and h3(x) = (7k+2)%m.Insert the keys 23, 7, 50, and 91 into the bit vector, and show the resulting vectors content. Then,find a key that is a false positive; that is, find a key that appears to have been inserted, but wasn't.

Concept Map



Syllabus

Introduction to Abstract Data Types and Analysis: Review of elementary data types and structures in C - Abstract Data Types (ADT) - Basic concept of Data Structures - Performance measures for Data Structures - Time and Space Complexity Asymptotic Measures - Big-Oh, Omega, Theta. **Linked Lists:** Singly Linked List (SLL) – Definition and Operations (Create, Insert, Delete, Search, Reverse) - Circular Linked List (CLL) – Definition and Operations (Create, Insert, Delete, Search) - Doubly Linked List – Definition and Operations (Create, Insert, Delete, Search) - Applications on Lists - SLL: Representing univariate polynomial and adding two univariate polynomial - CLL: Josephus Problem - DLL: Checking Palindrome, Quick Sort. **Stack and Queue:**Stack – Definition and Operations (Create, Push, Pop), Queue – Definition and Operations (Create, Enqueue, Dequeue), Circular Queue – Definition and Operations (Create, Enqueue, Dequeue), Implementation using arrays and linked listsApplications - Stack: Arithmetic Expression Evaluation - Queue: First Come First Serve (FCFS) Scheduling - Circular Queue: – Round Robin Scheduling. **Binary tree:** Terminologies and Properties - Sequential and Linked Implementation - Traversal – Inorder, Preorder, Postorder, Level order - Application - Huffman coding and expression trees. **Priority Queues:** Priority Queues as Heap, Heap Implementation, Binary Heap - Definition and Operations (Create, Insert, Delete), Leftist Heap - Definition and Operations (Create, Insert, Delete), Binomial Heap - Definition and Operations (Create, Insert, Delete), Applications on Binary Heap: Heap Sort, use of winner trees in mergesort as an external sorting algorithm. **Search Tree:** Binary Search trees – Definition, Properties and Operations (Create, Insert, Delete, Search), AVL Trees – Definition, Importance of Balancing, Properties and Operations (Create, Insert, Delete, Search), Red-Black Trees – Definition, compare with AVL, Properties and Operations (Create, Insert, Delete, Search). **Multiway Search Trees:** Issues in large dictionaries, string matching, B-Tree – Definition, Properties and Operations (Create, Insert, Delete, Search), Tries - Definition and Operations (Create, Insert, Delete, Search), Application on Tries: Pattern Searching. **Disjoint Set:** Definition and Operations (Make, Union, Find). **Hashing:** Definition - hash table, hash function, Collision resolution and overflow handling techniques, Open Hashing (Separate Chaining), Closed Hashing (Open Addressing) – Linear, Quadratic, Double, Rehashing, Applications – LZW Text compression algorithm.

Learning Resources

1. Mark Allen Weiss , “Data Structures and Algorithm Analysis in C++”, Pearson, 2007
2. Adam Drozdek, “Data structures and Algorithms in C++”, Cengage Learning; 4th edition, 4th Edition, 2012.
3. Y. Langsam, M. J. Augenstein and A. N. Tanenbaum, “Data Structure Using C and C++”, Pearson Education, 2nd Edition, 2015.

Course Contents and Lecture Schedule

No.	**Topic**	**No. of Lectures**	Course Outcome
1	**Introduction to Abstract Data Types and Analysis**		
1.0	Review of elementary data types and structures in C	1	CO1
1.1	Abstract Data Types (ADT) - Basic concept of Data Structures	1	CO1
1.3	Performance measures for Data Structures: Time and Space complexity - Asymptotic Measures: Big-Oh, Omega, Theta	1	CO1
2	**Linked Lists**		
2.1	Singly Linked List (SLL) – Definition and Operations (Create, Insert, Delete, Search, Reverse)	1	CO2
2.2	Circular Linked List (CLL) – Definition and Operations (Create, Insert, Delete, Search)	1	CO2
2.3	Doubly Linked List – Definition and Operations	1	CO2

No.	Topic	No. of Lectures	Course Outcome
	(Create, Insert, Delete, Search)		
2.4	Applications on Lists		
2.4.1	SLL: Representing univariate polynomial and adding two univariate polynomial	1	CO2
2.4.2	CLL: Josephus Problem	1	CO2
2.4.3	DLL: Checking Palindrome, Quick Sort	1	CO2
3	**Stack and Queue**		
3.1	Stack, Queue, Circular Queue – Definition and Operations (Create, Insert, Delete)	1	CO1
3.2	Implementation using arrays and linked lists	1	CO1
3.3	Applications		
3.3.1	Stack: Arithmetic Expression Evaluation	1	CO1
3.3.2	Queue: First Come First Serve (FCFS) Scheduling	1	CO1
3.3.3	Circular Queue: – Round Robin Scheduling	1	CO1
4	**Binary tree**		
4.1	Terminologies and Properties - Sequential and Linked Implementation	1	CO3
4.2	Traversal – Inorder, Preorder, Post order, Level order	1	CO3
4.3	Application - Huffman coding and expression trees	1	CO3
5	**Priority Queue**		
5.1	Priority Queue as Heap, Heap Implementation	1	CO5
5.2	Binary Heap - Definition and Operations (Create, Insert, Delete)	1	CO5
5.3	Leftist Heap - Definition and Operations (Create, Insert, Delete)	1	CO5
5.4	Binomial Heap - Definition and Operations (Create, Insert, Delete)	1	CO5
5.5	Applications on Binary Heap: Heap Sort, use of winner trees in merge sort as an external sorting algorithm	1	CO5
6	**Search Tree**		
6.1	Binary Search trees – Definition, Properties and Operations (Create, Insert, Delete, Search)	1	CO3
6.2	AVL Trees – Definition, Importance of Balancing, Properties and Operations (Create, Insert, Delete, Search)	1	CO3
6.3	Red-Black Trees – Definition, Compare with AVL , Properties and Operations (Create, Insert, Delete, Search)	1	CO3
7	**Multiway Search Trees**		
7.1	Issues in large dictionaries, string matching	1	CO3
7.2	B-Tree – Definition, Properties and Operations (Create, Insert, Delete, Search)	1	CO3
7.3	Tries - Definition and Operations (Create, Insert, Delete, Search)	1	CO3
7.4	Application on Tries: Pattern Searching	1	CO3
8	**Disjoint Set**		

No.	Topic	No. of Lectures	Course Outcome
8.1	Definition and Operations (Make, Union, Find)	1	CO4
9	**Hashing**		
9.1	Definition - hash table, hash function	1	CO6
9.2	Collision resolution and overflow handling techniques	1	CO6
9.2.1	Open Hashing (Separate Chaining)	1	CO6
9.2.2	Closed Hashing (Open Addressing) – Linear, Quadratic, Double	1	CO6
9.2.3	Rehashing	1	CO6
9.3	Applications – LZW Text compression algorithm.	1	CO6
Total		36	

Course Designers:

1. Dr. M.K.Kavitha Devi mkkdit@tce.edu

18CS360	**ASSEMBLY LANGUAGE PROGRAMMING**	

Category	L	T	P	Credit
PC	2	0	2	3

Preamble

The architecture of Intel x86, its addressing modes, instruction set and elements of assembly language programming are illustrated, leading to development of simple assembly language programs.

Prerequisite

Digital circuits

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Explain the architecture of 8086/8088(Understand)	15
CO2	Illustrate the memory and I/O organisation of 8086/8088 (Understand)	15
CO3	Implement the ALP programs for Arithmetic Operations (Apply)	20
CO4	Solve Packed and Unpacked BCD numbers and Code conversions (Apply)	15
CO5	Develop ALP programs for Sorting and Matrix Operations (Apply)	15
CO6	Perform the IOT Interfacing with Peripherals and BIOS and DOS Interrupts (Apply)	20

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	Guided Response	1.2
CO2	TPS2	Understand	Respond	Guided Response	1.2
CO3	TPS3	Apply	Value	Mechanism	1.2,2.1.1
CO4	TPS3	Apply	Value	Mechanism	1.2,2.1.1
CO5	TPS3	Apply	Value	Mechanism	1.2,2.1.1
CO6	TPS3	Apply	Value	Mechanism	1.2,2.1.1

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S											S		
CO2	S	S											S		

CO 3	S	S	M						M			M	S		L
CO 4	S	S	M						M			M	S		L
CO 5	S	S	M						M			M	S		L
CO 6	S	S	M		L				M			M	S	L	L

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Assignment			Terminal Examination
	1	**2**	**3**	1	2	3	
Remember	20	10	15	-	-	-	15
Understand	50	30	40	-	-	-	40
Apply	30	60	45				45
Analyse							
Evaluate							
Create							

Assessment Pattern: Psychomotor

Psychomotor Skill	Miniproject /Assignment/Practical Component
Perception	
Set	
Guided Response	50
Mechanism	50
Complex Overt Responses	
Adaptation	
Origination	

Sample Questions for Course Outcome Assessment**

Course Outcome 1(CO1):

1. Explain the architecture of 8086/8088.
2. List the components of BIU and EU.
3. State the difference between Minimum mode and Maximum mode.

Course Outcome 2(CO2):

1. List the types of Addressing modes.
2. State the difference between memory and I/O mapping.
3. Explain about the Register organization.

Course Outcome 3(CO3):

1. Develop an assembly language program to perform addition of 16 or 32-bit numbers. (Apply)
2. Develop an assembly language program to perform arithmetic Operations (add/sub/mul) of 16-bit numbers. (Apply)

3. Develop an assembly language program to perform arithmetic Operations (add/sub/mul) of 32-bit numbers. (Apply)

Course Outcome 4 (CO4):

1. Develop an assembly language program to perform packed BCD numbers. (Apply)
2. Develop an assembly language program to perform unpacked BCD numbers. (Apply)
3. Develop an assembly language program to perform code conversions. (Apply)

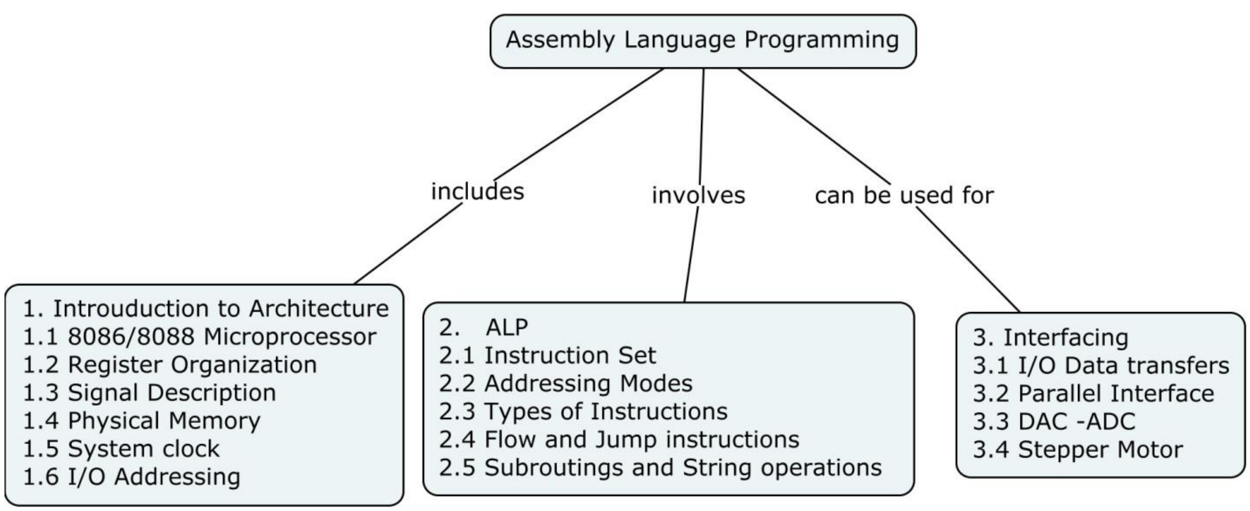
Course Outcome 5 (CO5):

1. Develop an assembly language program to perform Sorting numbers. (Apply)
2. Develop an assembly language program to perform Matrix addition. (Apply)
3. Develop an assembly language program to perform Matrix multiplication. (Apply)

Course Outcome 6(CO6):

1. Perform the BIOS interrupts
2. Perform the DOS interrupts
3. Perform the Interface with peripherals

Concept Map



Syllabus

INTRODUCTION TO 8086/8088: Architecture - Register Organization - Signal Description – Physical Memory Organization - Electrical Characteristics – System Clock – Bus Cycles – I/O Addressing Capability – Minimum Mode and Maximum Mode.

ASSEMBLY LANGUAGE PROGRAMMING: Assembly Language Program Development On The PC - The Instruction Set - Addressing Modes - Assembler Directives - Types of Instructions: Data Transfer – Arithmetic – Logical - Shift and Rotate - Flag Control – Compare - Control Flow And Jump Instructions – Subroutine - Loop And String Handling Instructions.

INTERFACING: Types of Input/output - I/O Interface - I/O Data Transfers and Instructions - Core and Special Purpose I/O Interfaces - Parallel Interface - Interfacing with DAC – ADC - Stepper Motor.

Learning Resources

TEXT BOOK:

1. Ray A K, Bhurchandi K M, ―Advanced Microprocessors and Peripherals, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2012.

REFERENCES:

1. Barry B Brey, ―Intel Microprocessors: 8086/8088, 80286, 80386, 80486, Pentium, Pentium Pro Processors, Pentium II, Pentium III and Pentium 4 : Architecture, Programming and Interfacing, Pearson Education , New Delhi, 2009.
2. Douglas V Hall, ―Microprocessors and Interfacing‖, Tata Mcgraw Hill, New Delhi, 2009.
3. Steve Furber, ―ARM System-On-Chip Architecture, Pearson Education Limited, USA, 2010

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1	**Introduction: CO and PO**		
1.1	Introduction to 8086/8088: Architecture	2	CO1
1.2	Register Organization	2	CO1
1.3	Signal Description	2	CO1
1.4	Physical Memory Organization	1	CO2
1.5	Electrical Characteristics – System Clock	2	CO2
1.6	Bus Cycles – I/O Addressing Capability – Minimum Mode and Maximum Mode.	2	CO2
2	**ASSEMBLY LANGUAGE PROGRAMMING**		
2.1	Assembly Language Program Development On The PC - The Instruction Set	2	CO3
2.2	Addressing Modes - Assembler Directives	3	CO3
2.3	Types Of Instructions: Data Transfer – Arithmetic – Logical - Shift And Rotate - Flag Control –	2	CO4
2.4	Compare - Control Flow And Jump Instructions –	2	CO5
2.5	Subroutine - Loop and String Handling Instructions.	2	CO5
3	**INTERFACING**		
3.1	Types of Input/output - I/O Interface I/O Data Transfers and Instructions - Core and Special Purpose I/O Interfaces -	1	CO6
3.2	Parallel Interface -	1	CO6
3.3	Interfacing with DAC – ADC	1	CO6
3.4	Stepper Motor	2	CO6
Total		**24**	

Course Contents and Lecture Schedule for Laboratory

Module No.	Topic	No. of Sessions	Course Outcome
	Introduction		
1	Study on Instruction Set	2	CO1
2	Study on Instruction Set and Addressing Modes	2	CO2
3	Arithmetic on 16 bit and 32 bit numbers	4	CO3
4	Arithmetic on Packed and Unpacked BCD numbers	4	CO4
5	Programs on code conversion	2	CO4
6	Programs on Sorting	2	CO5

Module No.	Topic	No. of Sessions	Course Outcome
7	Programs on Matrix Operations	2	CO5
8	Programs using BIOS and DOS Interrupts	2	CO6
9	Interfacing Peripherals	2	CO6
Total		**24**	

Course Designers:

1.Mr.R.Chellamani (rcmcse@tce.edu)
2.Dr.T.Manikandan (tmcse@tce.edu)

18CS370	DATA STRUCTURES LAB

Category	L	T	P	Credit
PC	0	0	2	1

Preamble

With a dynamic learn-by-doing focus, this laboratory course encourages students to explore data structures by implementing them, a process through which students discover how data structures work and their applicability for toy problems. This course challenges students to exercise their creativity in both programming and analysis.

Prerequisite

Computer Programming

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Construct and Implement the stack and queue functionality for suitable applications.	25
CO2	Implement the operations in linked list data structure for suitable applications	25
CO3	Implement appropriate binary and multiway search tree for performing searching operations, with an understanding of the trade-off between the time and space complexity.	25
CO4	Manipulate disjoint sets by performing union, iterative find-set operations	10
CO5	Implement heap tree for various applications	10
CO6	Show the avoidance of collisions in the hash tables using collision resolution techniques including open and closed hashing techniques.	10

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value	Mechanism	1.2, 2.1.2, 4.5.3
CO2	TPS3	Apply	Value	Mechanism	1.2, 2.1.2, 4.5.3
CO3	TPS3	Apply	Value	Mechanism	1.2, 2.1.2, 4.5.3
CO4	TPS3	Apply	Value	Mechanism	1.2, 2.1.2, 4.5.3
CO5	TPS3	Apply	Value	Mechanism	1.2, 2.1.2, 4.5.3
CO6	TPS3	Apply	Value	Mechanism	1.2, 2.1.2, 4.5.3

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L		L				M	L			M	L	L

CO 2	S	M	L		L				M	L			M	L	L
CO 3	S	M	L		L				M	L			M	L	L
CO 4	S	M	L		L				M	L			M	L	L
CO 5	S	M	L		L				M	L			M	L	L
CO 6	S	M	L		L				M	L			M	L	L

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Model Examination	Terminal Examination
Remember		
Understand		
Apply	100	100
Analyse		
Evaluate		
Create		

Assessment Pattern: Psychomotor

Psychomotor Skill	Practical Component/Observation
Perception	
Set	
Guided Response	
Mechanism	100
Complex Overt Responses	
Adaptation	
Origination	

List of Experiments/Activities with CO Mapping

Stack and its application using arrays and/or linked list	CO1
Queue and its application using arrays and/or linked list	CO1
Circular Queue and its application using arrays and/or linked list	CO1
Singly Linked List and its application	CO2
Circular Linked List and its application	CO2
Doubly Linked List and its application	CO2
Binary Search Tree operations and Traversals	CO3
AVL Tree operations and Traversals	CO3
Disjoint Set	CO4
Binary Heap operations and their application	CO5
Implementation of B Tree	CO3
Open and Closed Hashing	CO6

Learning Resources

1. Mark Allen Weiss , "Data Structures and Algorithm Analysis in C++", Pearson, 2007
2. Adam Drozdek, "Data structures and Algorithms in C++", Cengage Learning; 4th edition, 4th Edition, 2012.
3. Y. Langsam, M. J. Augenstein and A. N. Tanenbaum, "Data Structure Using C and C++", Pearson Education, 2nd Edition, 2015.

Course Designers:

1. Dr. M.K.Kavitha Devi mkkdit@tce.edu

18CS380	OBJECT ORIENTED PROGRAMMING LAB

Category	L	T	P	Credit
PC	0	0	2	1

Preamble

This syllabus is intended for the Computer science students and enables them to learn Object Oriented Programming and the design of computer solutions in a precise manner. The experiments emphasize on OOP concepts, Functions, Polymorphism, Inheritance, I/O, event-driven, concurrent and network programming. The intention is to provide sufficient depth in these topics to enable candidates to apply Object Oriented Programming approach to programming.

Prerequisite

C programming

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Construct Object oriented programs using methods and passing arrays, objects, and array of objects to them	15
CO2	Demonstrate Compile-time and Run-time polymorphism using object oriented programs	15
CO3	Illustrate the relationships between objects using inheritance hierarchies and aggregation	25
CO4	Develop Object Oriented programs to handle data using Files and Object Serialization and Exception handling	10
CO5	Develop Object Oriented programs to handle exceptions using Exception handling	10
CO6	Develop Object Oriented programs to demonstrate event driven programming, concurrent programming and network programming.	25

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value	Mechanism	1.2, 4.5.3
CO2	TPS3	Apply	Value	Mechanism	1.2, 4.5.3
CO3	TPS3	Apply	Value	Mechanism	1.2, 4.5.3
CO4	TPS3	Apply	Value	Mechanism	1.2, 4.5.3
CO5	TPS3	Apply	Value	Mechanism	1.2, 4.5.3
CO6	TPS3	Apply	Value	Mechanism	1.2, 4.5.3

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	S	M	M	M		M	M	M	M	M	S	M	M

CO 2	S	S	S	M	M	M		M	M	M	M	M	S	M	M
CO 3	S	S	S	M	M	M		M	M	M	M	M	S	M	M
CO 4	S	S	S	M	M	M		M	M	M	M	M	S	M	M
CO 5	S	S	S	M	M	M		M	M	M	M	M	S	M	M
CO 6	S	S	S	M	M	M		M	M	M	M	M	S	M	M

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Model Examination	Terminal Examination
Remember		
Understand		
Apply	20	100
Analyse		
Evaluate		
Create		

Assessment Pattern: Psychomotor

Psychomotor Skill	Miniproject/Practical Component/Observation
Perception	-
Set	-
Guided Response	25
Mechanism	50
Complex Overt Responses	25
Adaptation	-
Origination	-

List of Experiments/Activities with CO Mapping

Ex.No	Experiment	CO
1.	Develop Object Oriented Program for passing arguments to a method and returning value from a method	CO1
2.	Construct Object Oriented Program for method overloading and constructor overloading	CO2
3.	Develop Object Oriented Program for passing arrays and objects as arguments to method and returning objects from methods	CO1
4.	Demonstrate aggregation and composition using object oriented program	CO3
5.	Develop Object Oriented Program to demonstrate inheritance and overriding super class methods	CO2, CO3
6.	Develop Object Oriented Program to demonstrate abstract base classes abstract methods	CO3
7.	Construct Object Oriented Program to demonstrate File handling and Object Serialization	CO4
8.	Construct Object Oriented Program to demonstrate exception handling	CO5

9.	Develop event-driven programs using Java's delegation-based event model	CO6
10.	Develop concurrent programs using Java threads	CO6
11.	Develop network applications using Java sockets	CO6

Learning Resources

1. Tony Gaddis, “Starting Out with Java: From Control Structures through Objects”, Sixth edition, Pearson Education Limited, 2016.
2. Bart Baesens, Aimee Backiel, SeppevandenBroucke, “Beginning Java Programming:The Object-Oriented Approach”, John Wiley & Sons, 2015.
3. Herbert Schildt: “Java : The Complete Reference”, Tenth Edition, McGraw-Hill, 2017.
4. Kenneth L. Calvert and Michael J. Donahoo, “TCP/IP Sockets in Java: Practical Guide for Programmers”, 2nd Edition. Elsevier, 2011.
5. Grady Booch, Robert Maksimchuk, Michael Engel, Bobbi Young, Jim Conallen, Kelli Houston“Object Oriented Analysis and Design with Applications”, Third Edition, 2012

Course Designers:

1. Mrs. J. Jane Rubel Angelina janerubel@tce.edu
2. Mr.S.Prasanna sprcse@tce.edu

18ES390	DESIGN THINKING	Category	L	T	P	Credit
		ES	1	-	2	2

Preamble

Design has been defined as a “systematic, intelligent process in which designers generate, evaluate, and specify concepts for devices, systems, or processes whose form and function achieve clients’ objectives or users’ needs while satisfying a specified set of constraints”. Human-centered design is defined as a process and a set of techniques used to create new solutions for the world. Solutions include products, services, environments, organizations, and modes of interaction. The reason this process is called “human-centered” is because it starts with the people we are designing for. This course facilitates the development of students’ professional skills through their team engagement in developing conceptual design for a local community problem.

Prerequisite

Nil

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage in %
CO1	Identify a specific social need to be addressed	20
CO2	Identify stakeholder’s requirements for the societal project	20
CO3	Develop measurable criteria in which design concepts can be evaluated	10
CO4	Develop prototypes of multiple concepts using user’s feedback	30
CO5	Select the best design solution among the potential solutions with its functional decomposition	20

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value	Mechanism	1.1, 1.2, 2.1.1, 3.1.2, 3.2.3, 3.2.6, 4.1.2
CO2	TPS3	Apply	Value	Mechanism	1.1, 1.2, 2.1.2, 2.5.1, 2.5.2, 3.1.2, 3.2.3, 3.2.6, 4.1.2
CO3	TPS3	Apply	Value	Mechanism	1.1, 1.2, 2.1.3, 3.1.2, 3.2.3, 3.2.6, 4.1.2, 4.3.1
CO4	TPS3	Apply	Value	Mechanism	1.1, 1.2, 2.1.4, 3.1.2, 3.2.3, 3.2.6, 4.1.2, 4.4.1
CO5	TPS5	Evaluate	Organise	Adaptation	1.1, 1.2, 2.1.5, 3.1.2, 3.2.3, 3.2.6, 4.1.2, 4.4.1

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	L	-	-	M	M	M	L	M	M	S
CO2	S	M	L	-	-	M	M	M	L	M	M	S
CO3	S	M	L	-	-	M	M	M	L	M	M	S
CO4	S	M	L	-	M	M	M	M	L	M	M	S
CO5	S	S	M	L	M	M	M	M	L	M	M	S

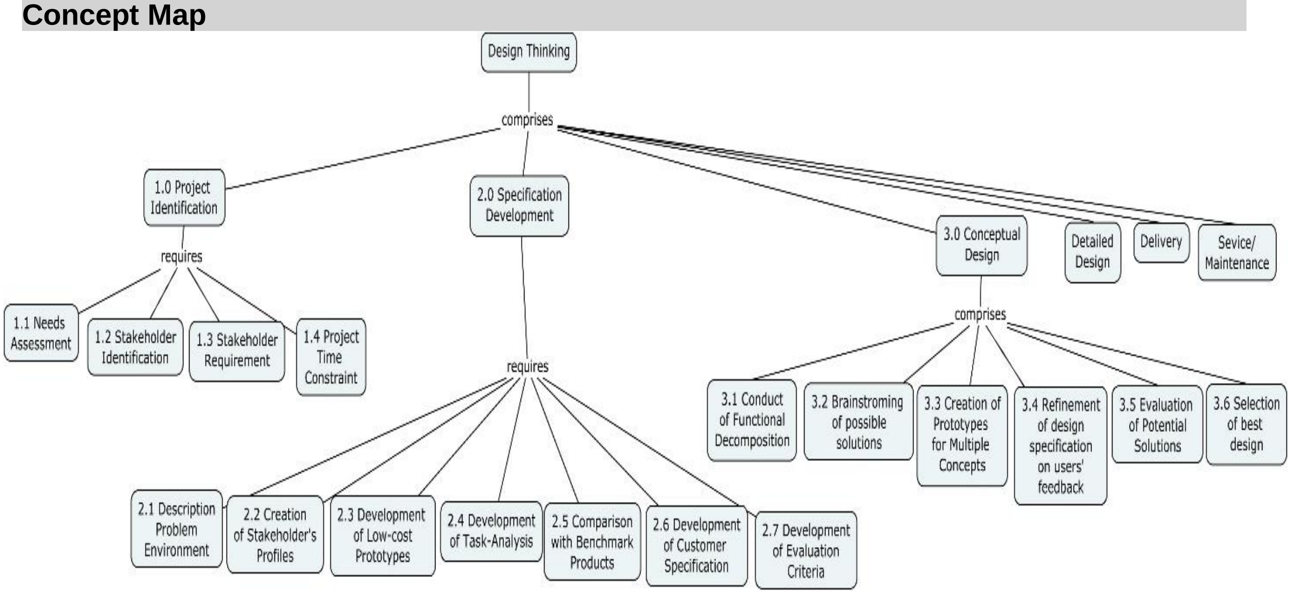
S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Phases	Deliverables	Marks	Course Outcomes
Continuous Assessment			
Review 1 – Problem Identification	Technical Report	10	CO1 and CO2
Review 2 – Specification Development	Technical Report	20	CO3
Review 3 -Conceptual Design	Technical Report	20	CO4 and CO5
End-Semester Examination			
Demonstration	Prototype	60	CO1, CO2, CO3, CO4 and CO5
Poster Presentation	Poster	40	

- Reports are to be submitted at each review. The report and presentation will be evaluated based on Rubrics
- Demonstration and Poster presentation will be evaluated by two faculty members nominated by their respective Head of the Department.

Concept Map



Syllabus

1.0 Project Identification: Needs Assessment, Stakeholder Identification, Stakeholder Requirement Project Time Constraint.

2.0 Specification Development: Description Problem Environment, Creation of Stakeholder's Profiles Development of Low-cost Prototypes, Development of Task-Analysis, Comparison with Benchmark Products, Development of Customer Specification, Development of Evaluation Criteria,

3.0 Conceptual Design: Conduct of Functional Decomposition, Brainstroming of possible solutions, Creation of Prototypes for Multiple Concepts, Refinement of Design Specification on users' feedback, Evaluation of Potential Solutions, Selection of best design

Learning Resources

1. Learning Material prepared by TCE faculty members
2. https://www.ideo.com/
3. https://engineering.purdue.edu/EPICS

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours		Course Outcome
		In-Class	Hands-on	
1.	**Project Identification**: Introduction to Human-Centered Design	1	-	CO1
1.1	Needs Assessment	1	2	CO1
1.2	Identification of Stakeholders	1	2	CO2
1.3	Identification of Stakeholder Requirements		2	CO2
1.4	Project Time Constraint	1	2	CO2
2.	**Specification Development**			
2.1	Description Problem Environment	1	2	CO3
2.2	Creation of Stakeholder's Profiles		2	CO3
2.3	Development of Low-cost Prototypes	1	2	CO3
2.4	Development of Task-Analysis	1	2	CO3
2.5	Comparison with Benchmark Products	1	2	CO3
2.6	Development of Customer Specification		2	CO3
2.7	Development of Evaluation Criteria	1	2	CO3
3.	**Conceptual Design**			
3.1	Conduct of Functional Decomposition	1	2	CO4
3.2	Brainstroming of possible solutions	1	2	CO5
3.3	Creation of Prototypes for Multiple Concepts	1	2	CO5
3.4	Refinement of design Specification on users' feedback		2	CO6
3.5	Evaluation of Potential Solutions	1	2	CO6
3.6	Selection of best design		2	CO6
	Total	12	34	

Course Designers:

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2. Dr.S.Saravana Perumaal sspmech@tce.edu

CURRICULUM AND DETAILED SYLLABI

FOR

B.E DEGREE (Computer Science and Engineering) PROGRAMME

FOURTH SEMESTER

FOR THE STUDENTS ADMITTED FROM THE

ACADEMIC YEAR 2018 - 2019 ONWARDS

THIAGARAJAR COLLEGE OF ENGINEERING
(A Government Aided ISO 9001-2008 certified
Autonomous Institution affiliated to Anna University)

MADURAI – 625 015, TAMILNADU

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THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015
B.E Degree (Computer Science and Engineering) Programme
COURSES OF STUDY
(For the candidates admitted from 2018 -19 onwards)

FOURTH SEMESTER

Course Code	Name of the Course	Category	No. of Hours / Week			Credits
			L	T	P	
THEORY						
18CS410	Discrete Mathematics	BS	2	1	-	3
18CS420	Design and Analysis of Algorithms	PC	3	-	-	3
18CS430	System Software and Operating Systems	PC	3	-	-	3
18CS440	Database Management Systems	PC	2	1	-	3
18XXFX0	Foundation Elective - I	FE	3	-	-	3
19CS490	Project Management	HSS	3	-	-	3
THEORY CUM PRACTICAL						
18EG460	Professional Communication	HSS	1	-	2	2
PRACTICAL						
18CS470	System software and Operating Systems Lab	PC	-	-	2	1
18CS480	Algorithms Lab	PC	-	-	2	1
18CHAB0	Constitution of India	AC	2	-	-	-
Total			**18**	**3**	**6**	**22**

AC : Audit Course
BS : Basic Science
HSS : Humanities and Social Science
ES : Engineering Science
PC : Program Core
L : Lecture
T : Tutorial
P : Practical

Note:

1 Hour Lecture is equivalent to 1 credit

1 Hour Tutorial is equivalent to 1 credit

2 Hours Practical is equivalent to 1 credit

THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015
B.E Degree (Computer Science and Engineering) Programme
SCHEME OF EXAMINATIONS
(For the candidates admitted from 2018-19 onwards)

FOURTH SEMESTER

S.No.	Course Code	Name of the Course	Duration of Terminal Exam. in Hrs.	Marks			Minimum Marks for Pass	
				Continuous Assessment	Terminal Exam *	Max. Marks	Terminal Exam	Total
THEORY								
1	18CS410	Discrete Mathematics	3	50	50	100	25	50
2	18CS420	Design and Analysis of Algorithms	3	50	50	100	25	50
3	18CS430	System Software and Operating Systems	3	50	50	100	25	50
4	18CS440	Database Management Systems	3	50	50	100	25	50
5	18XXFX0	Foundation Elective - I	3	50	50	100	25	50
6	19CS490	Project Management	3	50	50	100	25	50
THEORY CUM PRACTICAL								
7	18EG460	Professional Communication	3	50	50	100	25	50
PRACTICAL								
8	18CS470	System Software and Operating Systems Lab	3	50	50	100	25	50
9	18CS480	Algorithms Lab	3	50	50	100	25	50
10	18CHAB0	Constitution of India	-	50	50	100	25	50

* Terminal Examination will be conducted for maximum marks of 100 and subsequently be reduced to 50 marks for the award of terminal examination marks

18CS410	DISCRETE MATHEMATICS

Category	L	T	P	Credit
BS	2	1	0	3

Preamble

A course in discrete mathematics teaches students how to work with discrete structures, which are the abstract mathematical structures used to represent discrete objects and relationships between these objects. These discrete structures include logic, predicate calculus and sets. An important problem–solving skill is the ability to count or enumerate objects. The discussion of enumeration in this course begins with basic techniques of counting. The general counting methods involve permutations and combinations. These methods are very useful in constructing computer programs and in mastering many theoretical topics of computer science. Recurrence relations are one of the simplest ways to solve counting problems. The methods for solving recurrence relations appeared originally in the development of the theory of difference equations, cousins of differential equations.

Prerequisite

Nil

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Outline an equivalent logical proposition for a real world statement by applying predicates and quantifiers and Interpret	15
CO2	Convert the given normal form into its Principle conjunctive normal forms, Principle disjunctive normal forms by applying required quantifiers	10
CO3	Apply logic rules of inference to check the validity of the predicate calculus statements and to prove theorems	25
CO4	Apply the concepts of sets, functions and relations to solve the given problem.	20
CO5	Apply basic counting techniques to solve combinatorial Problems.	10
CO6	Construct the recurrence relation for a given engineering problem and solve the recurrence relation.	20

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value		1.1.1, 2.4.4, 3.2.2
CO2	TPS3	Apply	Value		1.1.1, 2.4.4
CO3	TPS3	Apply	Value		1.1.1, 2.4.4
CO4	TPS3	Apply	Value		1.1.1, 2.4.4
CO5	TPS3	Apply	Value		1.1.1, 2.4.4
CO6	TPS3	Apply	Value		1.1.1, 2.4.4, 2.4.7

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	L	L		L							S	L	
CO2	S	M	L	L		L							M	L	
CO3	S	S	L	L		L							S	L	
CO4	S	S	L	L		L							S	L	

CO5	S	M	L	L		L							M	L	
CO6	S	S	L	L		L							S	L	

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continious Assessment Tests			Assignment			Terminal Examinations
	1	2	3	1	2	3	
Remember	10	10	10	-	-	-	-
Understand	30	30	30	-	-	-	30
Apply	60	60	60	100	100	100	70
Analyse							
Evaluate							
Create							

Assessment Pattern: Psychomotor

Psychomotor Skill	Miniproject /Assignment/Practical Component
Perception	
Set	
Guided Response	
Mechanism	
Complex Overt Responses	
Adaptation	
Origination	

Sample Questions for Course Outcome Assessment****

Course Outcome 1(CO1):

1. Express the statement “Every student in this class has studied calculus” using predicates and quantifiers.
2. Show that $\forall x(P(x) \wedge Q(x))$ and $\forall x P(x) \wedge \forall x Q(x)$ are logically equivalent
3. Translate into English the statement $\forall x \forall y((x > 0) \wedge (y < 0) \rightarrow (xy < 0))$,where the domain for both variables consists of all real numbers.

Course Outcome 2(CO2):

1. Find the principal disjunctive normal form (PDNF) of a Boolean expression $((p\wedge q)\rightarrow r)\vee((p\wedge q)\rightarrow \neg r)$.
2. Obtain the PDNF of $(\neg P \vee \neg Q)\rightarrow (P \Leftrightarrow \neg Q)$
3. Obtain PCNF for A : $(\neg P\rightarrow R) \wedge ((Q\rightarrow P) \wedge (P\rightarrow Q))$.

Course Outcome 3(CO3):

1. Show that the premises “It is not sunny this afternoon and it is colder than yesterday,” “We will go swimming only if it is sunny,” “If we do not go swimming, then we will take a canoe trip,” and “If we take a canoe trip, then we will be home by sunset” lead to the conclusion “We will be home by sunset.”
2. Prove that the sum of two rational numbers is rational. (Note that if we include the implicit quantifiers here, the theorem we want to prove is “For every real number r and every real number s, if r and s are rational numbers, then $r + s$ is rational.)
3. Formulate a conjecture about the final decimal digit of the square of an integer and prove your result.

Course Outcome 4(CO4):

1. Suppose that *R* is the relation on the set of strings of English letters such that *aRb* if and only if *l(a)* = *l(b)*, where *l(x)* is the length of the string *x*. Is *R* an equivalence relation?
2. Let *R* be the relation on the set of people such that *xRy* if *x* and *y* are people and *x* is older than *y*. Show that *R* is not a partial ordering
3. Draw the Hasse diagram for the partial ordering $\{(A,B) \mid A \subseteq B\}$ on the power set *P(S)* where $S = \{a, b, c\}$.

Course Outcome 5 (CO5):

1. Suppose that "I Love New Jersey" T-shirts come in five different sizes: S, M, L, XL, and XXL. Further suppose that each size comes in four colors, white, red, green, and black, except for XL, which comes only in red, green, and black, and XXL, which comes only in green and black. How many different shirts does a souvenir shop have to stock to have at least one of each available size and color of the T-shirt?
2. What is the least number of area codes needed to guarantee that the 25 million phones in a state can be assigned distinct 10-digit telephone numbers? (Assume that telephone numbers are of the form *NXX-NXX-XXXX*, where the first three digits form the area code, *N* represents a digit from 2 to 9 inclusive, and *X* represents any digit.)
3. How many ways are there to select four pieces of fruit from a bowl containing apples, oranges, and pears if the order in which the pieces are selected does not matter, only the type of fruit and not the individual piece matters, and there are at least four pieces of each type of fruit in the bowl?

Course Outcome 6 (CO6):

1. A computer system considers a string of decimal digits a valid codeword if it contains an even number of 0 digits. For instance, 1230407869 is valid, whereas 120987045608 is not valid. Let a^n be the number of valid *n*-digit code words. Find a recurrence relation for a^n.
2. Find an explicit formula for the Fibonacci numbers.
3. Give a big-*O* estimate for the number of comparisons used by a binary search.

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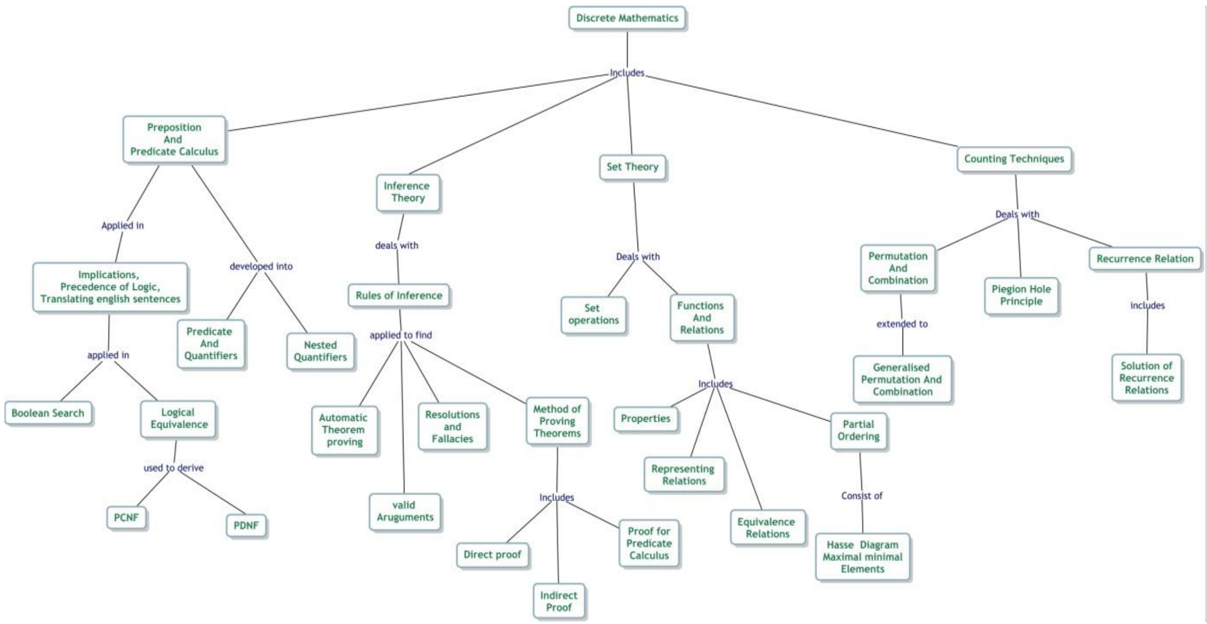
Concept Map



Syllabus

Statement and Predicate Calculus: Propositions, Implications, Precedence of logical operators, Translating English sentences, System specifications, Boolean search, Logic and bit operators, Propositional Equivalence, Logical equivalence, Principle conjunctive normal forms, Principle disjunctive normal forms, Predicates and Quantifiers, Nested Quantifiers.

Inference Theory: Rules of inference, Valid arguments, Resolution and Fallacies, Rules of Inference for quantifiers, Methods of proving theorems, Automatic Theorem proving.

Set Theory: Set operations, Functions, Relations and Properties, Representing relations, Equivalence relations, Partial orderings- Introduction - Hasse diagrams- Maximal and Minimal Elements.

Counting Techniques: The basics of counting, The Pigeonhole Principle, Permutation and Combinations, Binomial Coefficients, Generalized Permutation and Combinations, Generating Permutation and Combinations, Recurrence Relations, Solving Recurrence Relations, Generating Functions.

Learning Resources

1. Kenneth H. Rosen, “Discrete Mathematics and its Applications”, 7th edition, Tata McGraw Hill, 2012

Statement and Predicate Calculus	: Section 1.1, 1.2, 1.3, 1.4, 1.5
Inference Theory	: Section 1.6, 1.7, 1.8
Set	: Section 2.2, 2.3, 9.1, 9.3, 9.5, 9.6

Counting Techniques : Section 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 8.1, 8.2, 8.3, 8.4

2. T.P.Tremblay and R.Manohar , "Discrete Mathematical Structures with application to Computer Science",Tata McGraw Hill, 2002.
   Statement and Predicate Calculus : Section 1.3 (for PCNF and PDNF only)
   Inference Theory : Section 1.4.4 (Automatic theorem proof only)
3. Alan Tucker, "Applied Combinatorics", John Wiley & Sons, Incorporated, 2012.
4. Liu, C.L. "Introduction to Combinatorial Mathematics", McGraw Hill Book Company, New York, 1968.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Lectures	Course Outcomes
1.	**Logic**		
1.1	Propositions, Implications, Precedence of logical operators, Translating English sentences	1	CO1
	Tutorial	1	CO1
1.2	Boolean search, Logic and bit operators	1	CO1
1.3	Logical equivalence	1	CO1
1.4	Principle Conjunctive normal forms, Principle Disjunctive normal forms.	1	CO2
	Tutorial	1	CO2
1.5	Predicates and Quantifiers	1	CO1
1.6	Nested Quantifiers	1	CO1
	Tutorial	1	CO1
2	**Inference theory**		
2.1	Rules of Inference	1	CO3
2.2	Valid Arguments	1	CO3
	Tutorial	1	CO3
2.3	Resolution and Fallacies	1	CO3
2.4	Rules of Inference for Quantifiers	1	CO3
	Tutorial	1	CO3
2.5	Methods of Proving theorems	1	CO3
	Tutorial	1	CO3
2.6	Automatic proving theorem	1	CO3
3	**Set Theory**		
3.1	Set Operations	1	CO4
3.2	Functions	1	CO4
	Tutorial	1	CO4
3.3	Relations and Properties	1	CO4
3.4	Representing relations	1	CO4
	Tutorial	1	CO4
3.5	Equivalence relations	1	CO4
3.6	Partial ordering- Introduction, Hasse diagrams, Maximal minimal elements	1	CO4
	Tutorial	1	CO4
4	**Counting Techniques**		
4.1	The basics of counting, The Pigeonhole Principle	1	CO5

Module No.	Topic	No. of Lectures	Course Outcomes
4.2	Permutation and Combination, Binomial Coefficients	1	CO5
	Tutorial	1	CO5
4.3	Generalized permutation and combinations, Generating permutation and combinations	1	CO5
	Tutorial	1	CO5
4.4	Recurrence Relations,	1	CO6
4.5	Solving Recurrence relations,	1	CO6
4.6	Generating Functions	1	CO6
	Tutorial	1	CO6
	Total	**36**	

Course Designers:

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2. Ms. H.Sri Vinodhini srivinodhini@tce.edu

18CS420	DESIGN AND ANALYSIS OF ALGORITHMS

Category	L	T	P	Credit
PC	3	0	0	3

Preamble

Algorithm design and analysis provide the theoretical backbone of computer science. On completion of this course students will be able to:

i) Determine the asymptotic time complexity of algorithms
ii) Write rigorous correctness proofs for algorithms
iii) Use different paradigms of problem solving to illustrate efficient ways of solving a given problem

Prerequisite

- Problem Solving using Computers
- Data Structures and Algorithms
- Data Structures Lab

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Determine the running times of algorithms using asymptotic analysis and explain the significance of NP-completeness	15
CO2	Describe the divide-and-conquer paradigm and solve recurrences describing the performance of divide-and-conquer algorithms.	15
CO3	Construct graph-based algorithms to solve engineering problems.	20
CO4	Apply design principles for developing solutions using greedy algorithm approaches.	20
CO5	Analyse the algorithms and design techniques of dynamic programming to solve real world problems and mathematically evaluate the quality of the solutions.	15
CO6	Construct algorithms using branch and bound to solve any given problem.	15

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Understand	Respond	Guided Response	1.2
CO2	TPS3	Apply	Value	Mechanism	1.2,2.1.1

CO3	TPS3	Apply	Value	Mechanism	1.2,2.1.1
CO4	TPS3	Apply	Value	Mechanism	1.2,2.1.1
CO5	TPS3	Analyze	Organise	Complex overt Responses	1.2,2.1.1
CO6	TPS2	Apply	Value	Mechanism	1.2,2.1.1

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	S	S	M	M	M							S	S	M	S
CO 2	S	S	M	M	M							S	S	M	S
CO 3	S	S	M	M	M							S	S	M	S
CO 4	S	S	L	M	M							S	M	M	S
CO 5	S	S	L	M	M							S	M	M	S
CO 6	S	S	L	S	S	M						S	M	S	S

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Assignment			Terminal Examination
	1	**2**	**3**	1	2	3	
Remember	20	20	10	-	-	-	20
Understand	40	40	20	50	50	-	30
Apply	40	40	50	50	50		50
Analyse	-	-	20	-	-	-	-
Evaluate	-	-	-	-	-	-	-
Create	-	-	-	-	-	-	-

Assessment Pattern: Psychomotor

Psychomotor Skill	Assignment-3
Perception	-
Set	-
Guided Response	50
Mechanism	50
Complex Overt Responses	-
Adaptation	-
Origination	

Course Outcome 1 (CO1):

1. Consider the searching problem: given an array A[1…n] and a value v output an Index i such that v = A[i] or the special value ф if v does not appear in A. If the array J is sorted, we can perform a binary search: compare P with the midpoint of the array and repeat the search on one half of array, eliminating the other half from further consideration.
   (a) Construct a pseudocode for binary search as a recursive procedure.
   (b) Rewrite your binary search procedure in an iterative style.
   (c) Formally state pre- and post-conditions for your iterative procedure. Deduce a loop invariant, and illustrate that your procedure is correct.

2. Demonstrate that Bubble Sort works by proving that
   a. It terminates.
   b. It sorts the set of numbers provided as an input.

   Deduce a loop-invariant to prove the correctness of the selection sort algorithm
   Let X1, . . . ,Xn be {0, 1}-valued random variables such that Xi = 0 with probability 1 − pi and Xi = 1 with probability pi . Given probabilities p1, . . . ,pn, show how to compute probabilities of events P i Xi = m for all m ∈ [0, n], using a divide-and-conquer approach. Analyze the running time of your algorithm.

3. Let X be an NP-Complete problem. Consider a decision problem Z Є NP such that X $\leq_T^P$ Z. Then defend that Z is also NP-Complete.

Course Outcome 2 (CO2):

1. Although merge sort runs in Θ(n log2 n) worst-case time and insertion sort runs in Θ(n2) worst-case time, the constant factors in insertion sort make it faster for small n. Thus, it makes sense to use insertion sort within merge sort when sub-problems become sufficiently small. Consider a modification to merge sort in which n/k sub-lists of length k are sorted using insertion sort and then merged using the standard merging mechanism, where k is a value to be determined.
   a) Show that the n/k sub-lists, each of length k, can be sorted by insertion sort in Θ(nk) worst-case time.
   b) Show that the sub-lists can be merged in Θ(n log2 (n/k) worst-case time.
2. The following code-fragment implements Horner's rule for evaluating a polynomial $P(x) = \sum_{k=0}^{n} a_k x^k$

```
y = 0
for i = n down to 0
    y = ai + x * y
```

   a) In terms of Θ notation, calculate the running time of this code fragment for Horner's rule
   b) Construct a pseudo-code to implement the naive polynomial-evaluation algorithm that computes each term of the polynomial from scratch. Calculate the running time of this algorithm. Compare it to the Horner's rule.

Course Outcome 3(CO3)

1. Show that a depth first search of an undirected graph 'G' can be used to identify the connected components of 'G' and that the depth first forest contains as many trees as 'G' has connected components. More precisely, show how to modify depth-first-search so that each vertex v is assigned an integer label cc[v] between 1 and k, where 'k' is the

number of connected components of ‘G’ such that cc[u] = cc[v] if and only if u and v are in the same connected component.

2. We are given a directed graph G = (V, E) on which each edge (u,v) $\in$ E has an associated value r(u,v), which is a real number in the range 0 ≤ r(u,v) ≤ 1 that represents the reliability of a communication channel from vertex u to vertex v. We interpret r(u,v) as the probability that the channel from u to v will not fail, and we assume that these probabilities are independent. Construct an efficient algorithm to find the most reliable path between two given vertices.

3. Determine an algorithm to detect cycles in a directed graph G(V, E) in O(|V| + |E|) time.

Course Outcome 4 (CO4):

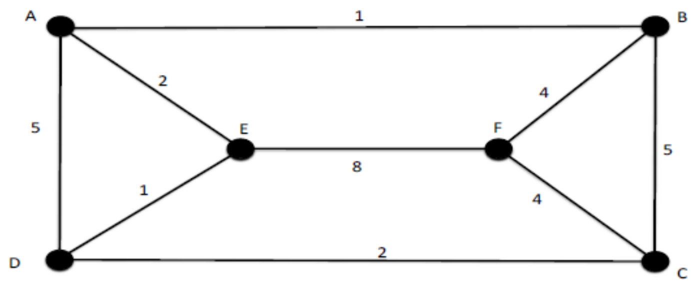
1. Defend that the greedy algorithm that solves the scheduling problem with the goal of minimizing the time spent by the customers in a system is optimal, if it adopts the following greedy strategy:
   “At each step add to the end of the schedule the customer requiring the least service time among those who remain”
2. Suppose that you have a median(S) algorithm, which finds the median element in the sequence S in O(n) time. Using this median(S) algorithm, construct a simple O(n) – linear time algorithm that solves the selection problem Select(S, k).
3. Suppose instead of running Dijkstra’s algorithm till the priority queue ‘Q’ becomes empty, we run it as long as |Q| > 1. This change will cause the ‘while’ loop in Dijkstra’s algorithm to execute |V| - 1 times instead of |V| times. Analyze whether the proposed algorithm is correct

Course Outcome 5 (CO5):

1. Write the pseudo code to find the optimal parenthesization of a matrix-chain product. Using the algorithm, find the optimal parenthesization of a matrix-chain product whose sequence of dimensions is (5,10,3,12,5)
2. Suppose we wish to find a shortest path from vertex i to vertex j. Let Ai be the vertices adjacent from vertex i. Which of the vertices in Ai should be the second vertex on the path? There is no way to make a decision at this time and guarantee that future decisions leading to an optima lsequence can be made. If on the other hand we wish to find a shortest path from vertex i to all other vertices in G ,then at each step, a correct decision can be made.
3. Deduce that backtracking algorithm solves the 2-SAT problem in polynomial time.

Course Outcome 6(CO6):

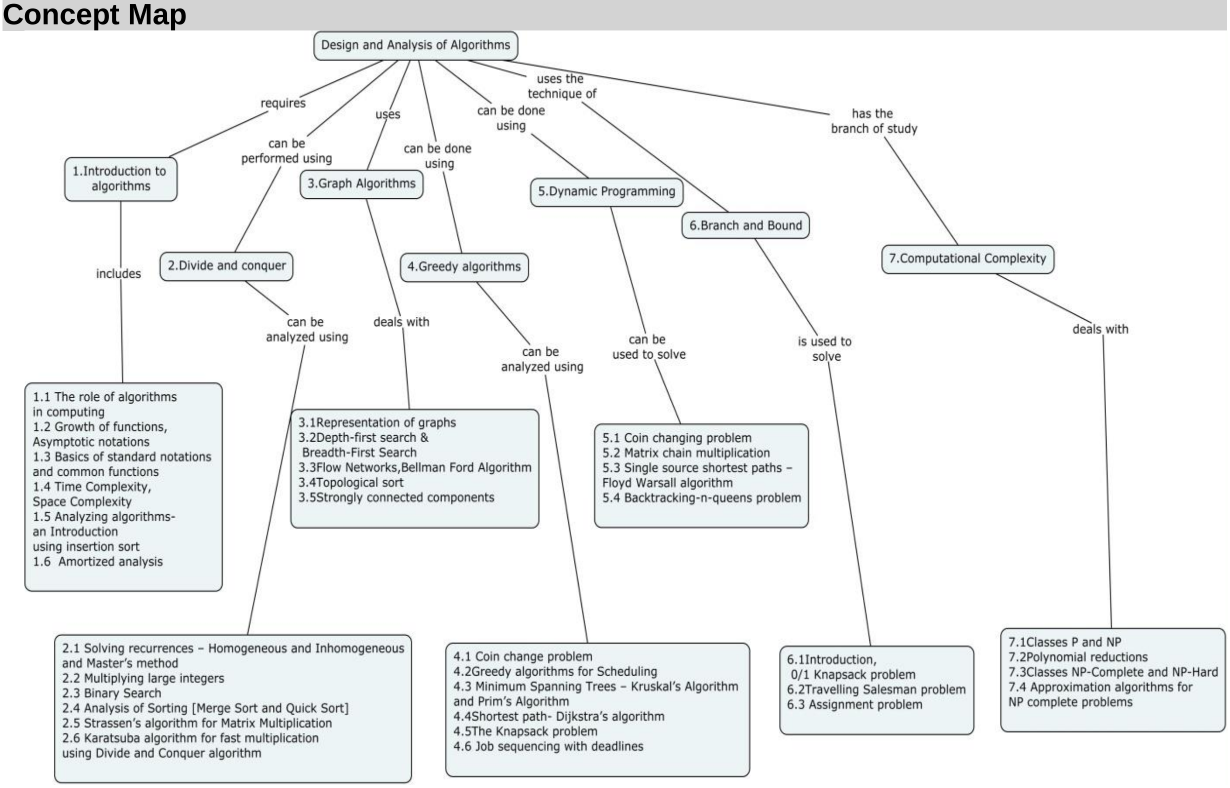
1. Apply the Branch and Bound Method (using the MST-based bounding scheme) seen in class for the TSP to solve the following instance.



2. Consider three jobs to be assigned to three machines. The cost for each combination is shown in the table below. Determine the minimal job – machine combinations

Job	Machine			
	1	2	3	a_i
1	5	7	9	1
2	14	10	12	1
3	15	13	16	1
b_j	1	1	1	

Concept Map



Syllabus

Introduction to algorithms: The role of algorithms in computing, Growth of functions, Asymptotic notations, Basics of standard notations and common functions ,Time Complexity, Space Complexity , Analyzing algorithms- an Introduction using insertion sort- Amortized analysis. **Divide and Conquer**: Solving recurrences – Homogeneous and Inhomogeneous, Master's method, Binary Search, Analysis of Sorting [Merge Sort, Quick Sort], Strassen's algorithm for Matrix Multiplication, Karatsuba algorithm for fast multiplication using Divide and Conquer algorithm. **Graph Algorithms**: Representation of graphs, Depth-first search & Breadth-First Search, Flow Networks, Bellman Ford Algorithm, Topological sort, strongly connected components. **Greedy Algorithms**: Coin change problem, Minimum Spanning Trees – Kruskal's Algorithm and Prim's Algorithm, Shortest path- Dijkstra's algorithm, The Knapsack problem ,Job sequencing with deadlines. **Dynamic Programming**: Coin changing problem, Matrix chain multiplication, Single source shortest paths – Floyd Warshall algorithm, Backtracking-n-queens problem. **Branch and Bound –** Introduction **-** 0/1 Knapsack problem**,** Travelling Salesman problem, Assignment problem. **Computational Complexity**: Classes P and NP, Polynomial reductions, Classes NP-Complete and NP-Hard, Approximation algorithms for NP complete problems.

Learning Resources

1. Charles E. Leiserson, Thomas H. Cormen, Ronald L. Rivest, Clifford Stein, Introduction to Algorithms, Third edition, PHI, 2010.
2. Gilles Brassard and Paul Bratley - Fundamentals of Algorithmics, PHI, 2009
3. Ellis Horowitz, SartajSahni and SanguthevarRajasekaran, Fundamentals of Computer Algorithms, Second Edition, Universities Press, 2011
4. Steven S. Skiena,The Algorithm Design Manual,Second Edition,Springer,2010.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Lectures	Course Outcome
1.	**Introduction to Algorithms**		
1.1	The role of algorithms in computing	1	CO1
1.2	Growth of functions, Asymptotic notations		CO1
1.3	Basics of standard notations and common functions		CO1
1.4	Time Complexity, Space Complexity	1	CO1
1.5	Analyzing algorithms- an Introduction using insertion sort	1	CO1
1.6	Amortized analysis		CO1
2.	**Divide and Conquer**		
2.1	Solving recurrences – Homogeneous and Inhomogeneous, Master's method	1	CO2
2.2	Multiplying large integers	1	CO2
2.3	Binary Search	1	CO2

Module No.	Topic	No. of Lectures	Course Outcome
2.4	Analysis of Sorting [Merge Sort and Quick Sort]		CO2
2.5	Strassen's algorithm for Matrix Multiplication	1	CO2
2.6	Karatsuba algorithm for fast multiplication using Divide and Conquer algorithm	1	
3	**Graph Algorithms**		
3.1	Representation of graphs	1	CO3
3.2	Depth-first search & Breadth-First Search	2	CO3
3.3	Flow Networks, Bellman Ford Algorithm	2	CO3
3.4	Topological sort	2	CO3
3.5	Strongly connected components	1	CO3
4	**Greedy Algorithms**		
4.1	Coin change problem	2	CO4
4.2	Greedy algorithms for Scheduling	1	CO4
4.3	Minimum Spanning Trees – Kruskal's Algorithm and Prim's Algorithm	2	CO4
4.4	Shortest path- Dijkstra's algorithm	2	CO4
4.5	The Knapsack problem	1	CO4
4.6	Job sequencing with deadlines		
5	**Dynamic programming**		
5.1	Coin changing problem	1	CO5
5.2	Matrix chain multiplication	2	CO5
5.3	Single source shortest paths – Floyd Warsall algorithm	1	CO5
5.4	Backtracking-n-queens problem	1	CO5
6	**Branch and Bound**		
6.1	Introduction, 0/1 Knapsack problem	1	CO6
6.2	Travelling Salesman problem	2	CO6
6.3	Assignment problem	2	CO6
7	**Computational Complexity**		
7.1	Classes P and NP	1	CO1
7.2	Polynomial reductions		CO1
7.3	Classes NP-Complete and NP-Hard	1	CO1
7.4	Approximation algorithms for NP complete problems.		
	Total Hours	**36**	

Course Designers:

1. Raja Lavanya rlit@tce.edu

18CS430	SYSTEM SOFTWARE AND OPERATING SYSTEMS

Category	L	T	P	Credit
PC	3	0	0	3

Preamble

To provide a basic knowledge in the concepts of system software and to understand the working principle of assemblers, functions of loaders, linkers and macro processors. Operating systems is an essential part of any computer-science education. Although this field is undergoing rapid change, as computers are now prevalent in virtually every application, the fundamental concepts remain fairly clear. It provides a clear description of the *concepts* that underlie operating systems. The fundamental concepts and algorithms are based on those used in existing commercial operating systems.

Prerequisite

Computer Organization and Microprocessor

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Describe the functions and types of assemblers, linkers and loaders.	8
CO2	Develop single-pass and multi-pass macro processors.	8
CO3	Develop programs using system-calls related to process, memory and file management	17
CO4	Construct solutions for problems related to process scheduling, deadlocks and synchronization in a multi-programmed operating system.	22
CO5	Develop appropriate solutions for memory management considering challenges due to multi-programming and virtual memory.	25
CO6	Construct solutions for problems related to secondary storage management with an understanding of file systems and disk scheduling.	20

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond		1.2,2.3.2
CO2	TPS2	Understand	Respond	Guided Response	1.2,2.3.2

CO3	TPS3	Apply	Value	Mechanism	1.2,2.3.2
CO4	TPS3	Apply	Value	Mechanism	1.2,4.5.1
CO5	TPS3	Apply	Value	Mechanism	1.2, 4.5.1
CO6	TPS3	Apply	Value	Mechanism	1.2, 4.5.1

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L		L										L		
CO2	M		M										L		
CO3	S		S										S	L	
CO4	S	M	S										S	L	
CO5	S	M	S										S		
CO6	S	M	S										L		

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Assignment			Terminal Examination
	1	**2**	**3**	1	2	3	
Remember	30	10	10	-	-	-	10
Understand	40	30	30	10	10		40
Apply	30	60	60	90	90	100	50
Analyse	-	-	-	-	-	-	-
Evaluate	-	-	-	-	-	-	-
Create	-	-	-	-	-	-	-

Assessment Pattern: Psychomotor

Psychomotor Skill	Miniproject /Assignment/Practical Component
Perception	-
Set	-
Guided Response	15
Mechanism	85
Complex Overt Responses	-
Adaptation	-
Origination	-

Sample Questions for Course Outcome Assessment**

Course Outcome 1(CO1):

1. What are called assembler directives?
2. Explain the data structures used by the assembler.
3. Differentiate the concepts of single pass and multi pass translation.
4. Distinguish absolute loaders and relocating loaders.
5. Illustrate the concept of dynamic linking.

Course Outcome 2(CO2):

1. Illustrate how nested macro calls are processed by macro processor.

2. Write the syntax for macro definition and macro call.
3. Explain the steps involved in the design of macro processor.
4. Compare and Contrast the properties of macro and subroutines.
5. Describe the data structures used by macro processor.

Course Outcome 3(CO3):

1. Using system calls, a program in either C or C++ that reads data from one file and copies it to another file.
2. List the three major activities of an operating system in regard to memory management?
3. State the purpose of system calls?
4. List the various Memory Management schemes?
5. Distinguish between logical and physical address space?
6. Explain internal and external fragmentation of main memory?

Course Outcome 4 (CO4):

1. Assume you have the following jobs to execute with one processor, with the jobs arriving in the order listed here:

i	T(pi)
0	80
1	20
2	10
3	20
4	50

   a. Suppose a system uses FCFS scheduling. Create a Gantt chart illustrating the execution of these processes?
   b. State the turnaround time for process p3?
   c. List the average wait 0time for the processes?

2. Suppose the following jobs arrive for processing at the times indicated, each job will run the listed amount of time.

Jobs	Arrival time	Burst time (in secs.)
1	0.0	8
2	0.4	4
3	1.0	1

   Give Gantt charts illustrating the execution of these jobs using the non preemptive FCFS and SJF scheduling algorithms. Compute the average turn around time and average waiting time of each job for the above algorithms and find the best alternative.

3. Give a solution to the readers-writers problem after explaining its nature?
4. Apply Dijkstra-Haberman algorithm for deadlock avoidance?
5. Implement Simulated Semaphore(Synchronized Produced Consumer Problem)
6. Discuss how file sharing semantics of unix can be implemented. Can processing of the link and unlink commands of unix lead to deadlocks .Discuss how such deadlocks can be avoided

Course Outcome 5 (CO5):

1. Given memory partitions of 100K, 500K, 200K, 300K, and 600K (in order), how would each of the First-fit, Best-fit, and Worst-fit algorithms place processes of 212K, 417K,

112K, and 426K (in order)? Which algorithm makes the most efficient use of memory?

2. Consider the following page reference string 7,0,2,0,3,0,4,2,3,0,3,2,1,2,0,1,7,0,2.
   How many page faults would occur in the case?
   a. LRU

   b. FIFO

   c. Optimal algorithms

   assuming three, five or six frames. Note that initially all frames are empty.

3.. Assume that we have a paging system with page table stored in memory

   a. If a memory reference takes 200 nanoseconds how long does a paged memory reference take?
   b. If we add associative registers and 75% of all page table references are found in the associative registers, what is the effective memory reference time? Assume that finding a page table entry in the associative registers takes zero time, if the entry is there.

4. Consider a demand-paging system with the following time-measured utilizations

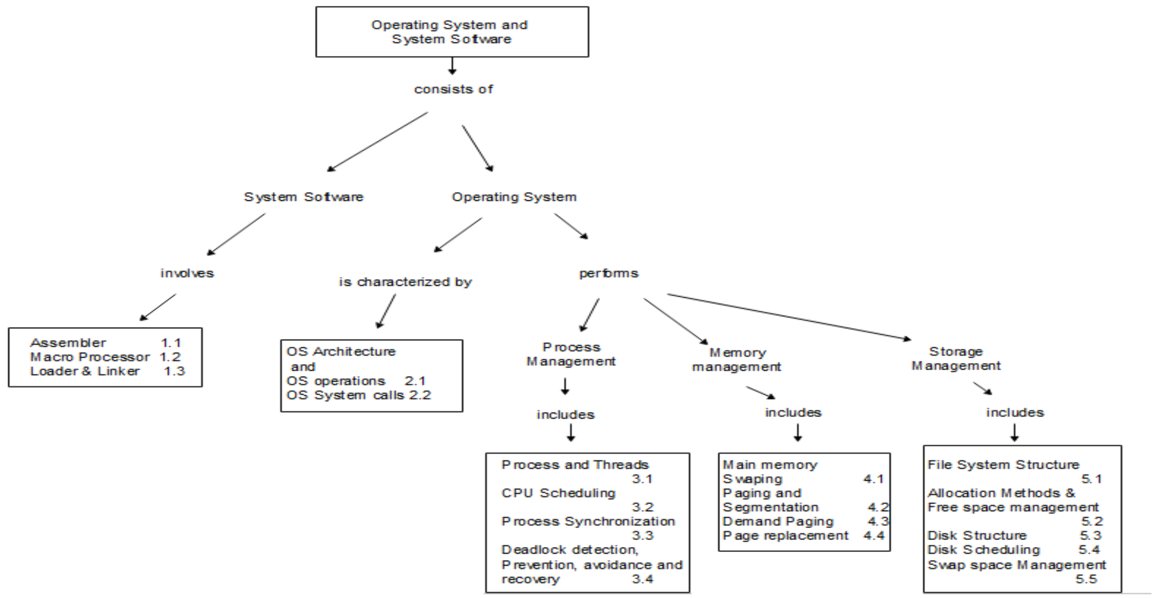
CPU utilization	20%
Paging disk	97.7%
Other I/O devices	5%

   Which (if any) of the following will (probably) improve CPU utilization? Explain your answer.
   a. Install a faster CPU.
   b. Install a bigger paging disk.
   c. Increase the degree of multiprogramming.
   d. Decrease the degree of multiprogramming.
   e. Install more main memory.
   f. Install a faster hard disk or multiple controllers with multiple hard disks.
   g. Add pre paging to the page fetch algorithms.
   h. Increase the page size.

Course Outcome 6(CO6):

1. Put the following disk scheduling policies in the order that will result in minimum amount of head movement. a. FCFS b. Circular scan c. Elevator algorithm
2. Suppose that a disk drive has 5000 cylinders, numbered from 0 to 4999. the drive is currently serving a request at cylinder 143, and the previous request was at cylinder 125. The queue of pending requests, in FIFO order is 86, 1470, 913, 1774, 948, 1509, 1022, 1750, 130. starting from the current head position, what is the total distance (in cylinders) that the disk arm moves to satisfy all the pending requests for each of the disk scheduling algorithms. a. FCFS b. SSTF c. SCAN d. LOOK e. C-SCAN f. C-LOOK.
3. Explain the different type of directories in the UNIX system
4. Explain directory paths
5. Distinguish the difference between COM and EXE program

Concept Map



Syllabus

Assemblers & Macro Processors: Simple Assembly Scheme, Pass Structure of assemblers, Macro Definition and Call, Macro Expansion, Nested Macro Calls, **Linkers and Loaders:** Introduction, Relocation and linking Concepts, Types of Loaders. **Operating System Introduction & Structure:** Basics, OS Architecture, OS Operations, System calls. **Process Management:** Processes, CPU Scheduling, Process synchronization, Deadlock Detection, Deadlock Prevention, Deadlock Avoidance, Deadlock Recovery. **Memory Management:** Main Memory – swapping, Paging, Segmentation, Virtual Memory – Demand paging, Page Replacement, **Storage Management:** File System structure, Allocation methods, free space management, Disk Structure, Disk Scheduling, Swap-Space Management.

Learning Resources

1. D.M.Dhamdhere : System Programming, Tata McGraw Hill, 2011.
2. Avi Silberschatz, Peter Baer Galvin and Greg Gagne: Operating System Concepts, Eighth edition, John Wiley and Sons, 2009.
3. Leland L.Beck, System Software – An Introduction to System Programming, Pearson Education, Third Edition, 2011.
4. Andrew S. Tanenbaum, Albert S.WoodHull: Operating Systems, Design and Implementation, Third Edition, Prentice Hall, 2006.
5. William Stallings: Operating Systems: Internals and Design Principles, Fifth Edition, Prentice Hall, 2004.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1	**System Software**	**(6)**	
1.1	Assembler -Simple Assembly Scheme Concepts	2	CO1
1.2	Macro Processors **-** Macro Definition and Call Concepts	3	CO2
1.3	Linkers and Loaders - Relocation and linking Concepts	1	CO1
2	**Operating System Introduction & Structure**	**(4)**	
2.1	OS Architecture and Operations	2	CO3
2.2	OS System Calls, OS Structure	2	CO3
3	**Process Management**	**(10)**	
3.1	Processes and Threads	2	CO3
3.2	CPU Scheduling	2	CO4
3.3	Process synchronization	2	CO4
3.4	Deadlock Detection, Prevention, Avoidance, Recovery	4	CO4
4	**Memory Management**	**(9)**	
4.1	Main Memory – swapping	2	CO5
4.2	Paging and Segmentation	3	CO5
4.3	Virtual Memory – Demand paging	2	CO5
4.4	Page Replacement	2	CO5
5	**Storage Management**	**(7)**	
5.1	File System Structure	1	CO6
5.2	Allocation methods and free space management	2	CO6
5.3	Disk Structure	1	CO6
5.4	Disk Scheduling	2	CO6
5.5	Swap-Space Management	1	CO6
	Total No of Hours	**36**	

Course Designers:

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2. Mr.K.NarasimhaMallikarjunan arjunkambaraj@tce.edu

18CS440	DATABASE MANAGEMENT SYSTEMS

Category	L	T	P	Credit
PC	2	1	0	3

Preamble

This course aims at facilitating the student to understand the various concepts and functionalities of Database Management Systems, the method and model to store data and how to manipulate the data through relational and query languages. The course also covers the effective designing of relational database and how the system manages the concurrent usage of data in a multiuser environment.

Prerequisite

Data Structures and Algorithms.

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage in %
CO1	Develop Entity Relationship (ER) and Relational models for a given application.	15
CO2	Manipulate relational database using Relational and Structured Query languages.	20
CO3	Develop a normalized database for a given application by incorporating various constraints like integrity and value constraints.	20
CO4	Demonstrate and explain how an optimized query will be build by the database system for data retrieval.	5
CO5	Illustrate different forms of transactions, concurrency control and recovery mechanisms to preserve data consistency in a multi user environment.	20
CO6	Construct data structures like indexes and hash tables for the fast retrieval of data.	20

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value	Mechanism	1.2, 2.1.1, 2.1.2, 2.1.5, 4.4.3, 4.4.4
CO2	TPS3	Apply	Value	Mechanism	1.2, 2.1.1, 2.1.2, 2.1.5, 4.4.3, 4.4.4
CO3	TPS3	Apply	Value	Mechanism	1.2, 2.1.5, 4.4.3, 4.4.4
CO4	TPS2	Understand	Respond	Guided Response	1.2, 2.1.1
CO5	TPS3	Apply	Value	Mechanism	1.2, 2.1.1, 2.1.2, 2.1.5, 4.4.3, 4.4.4
CO6	TPS3	Apply	Value	Mechanism	1.2, 2.1.1, 2.1.5, 4.4.3, 4.4.4

Mapping with Programme Outcomes and Programme Specific Outcome

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	S	L	S	M	M	M	M	M		M	S	M	M
CO2	S	M	M	L	S	M	M	M	M	M		M	M	M	M
CO3	S	S	S	L	S	M	M	M	M	M		M	S	M	M
CO4	M	L	L												
CO5	S	M	M	L		M	M	M	M	M		L	M	L	M
CO6	S	M	M	L		M	M	M	M	M		L	M	L	M

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Assignment			Terminal Examination
	1	**2**	**3**	1	2	3	
Remember	10	10	10	-	-	-	10
Understand	30	40	30	-	-	-	30
Apply	60	50	60	100	100	100	60
Analyse	-	-	-	-	-	-	-
Evaluate	-	-	-	-	-	-	-
Create	-	-	-	-	-	-	-

Assessment Pattern: Psychomotor

Psychomotor Skill	Miniproject /Assignment/Practical Component
Perception	-
Set	-
Guided Response	10
Mechanism	90
Complex Overt Responses	-
Adaptation	-
Origination	-

Sample Questions for Course Outcome Assessment

Course Outcome1 (CO1):

1. What are mapping cardinalities? State their uses with examples. (Remember)
2. Explain the concepts of generalization – specialization in E-R Model with suitable examples. (Understand)
3. For the following employee database

    employee(employee-name, street, city)
    works(employee-name, company-name, salary)
    company(company-name, city)
    manages(employee-name, manager-name)

    Construct the ER and relational models with all possible cardinalities. (Apply)

Course Outcome2 (CO2):

1. Recall the use of CHECK constraint. (Remember)
2. Distinguish between relational algebra and relational calculus with suitable example. (Understand)
3. Considering the schema structure given below

   CUSTOMER(custno, custname, city, phone)
   ITEM (Itemno, Itemname, Itemprice, QtyOnhand)
   INVOICE (Invno , Invdate , Custno)
   INVITEM (Invno , Itemno , Qty)

   Answer the following queries in SQL. (Apply)
   a. Find customers from 'Chennai '.
   b. Display all item name along with the quantity sold.

Course Outcome3 (CO3):

1. Outline the desirable properties of decomposition. (Remember)
2. When a relation is said to be in 1NF? Illustrate with an example. (Understand)
3. Develop a relational database for the Banking environment by following the various design phases of normalization. (Apply)

Course Outcome4 (CO4):

1. Define the term "evaluation plan". (Remember)
2. Let relations r1(A,B,C) and r2(C,D,E) have the following properties: r1 has 20,000 tuples, r2 has 45,000 tuples, 25 tuples of r1 fit on one block, and 30 tuples of r2 fit on one block. Estimate the number of block transfers and seeks required using Hash join strategy for r1 natural joined with r2. (Understand)
3. For the query

   select T.branch_name from branch T, branch S
   where T.assests > S.assests and S.branch_city='madurai'

   write an efficient relational_algebra expression for this query. (Understand)

Course Outcome5 (CO5):

1. What is the goal of recovery systems in DBMS? (Remember)
2. When deadlock will occur in concurrent transactions? Explain with an example. (Understand)
3. Consider the following ordering Schedule - S of transactions:

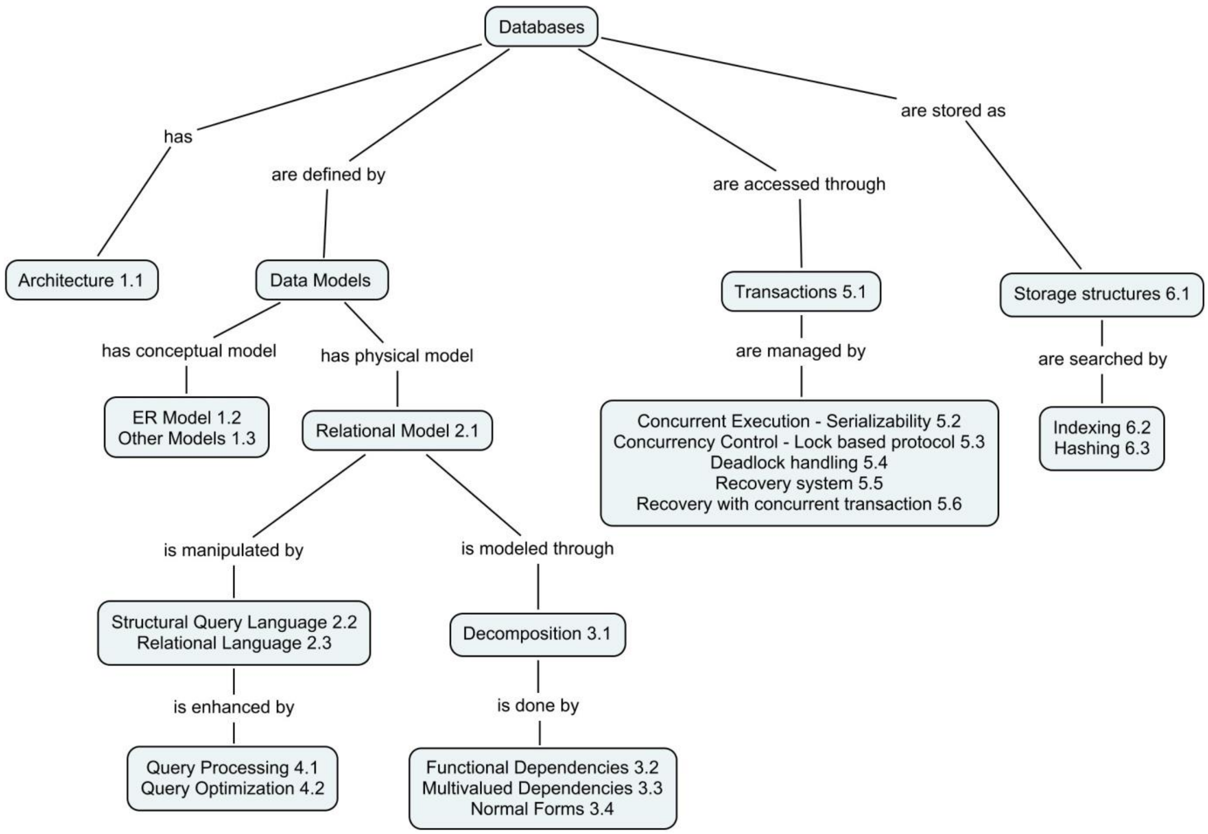
   T3: W(X); T2: R(X); T3: commit; T1: W(Y); T1: commit; T2: R(Y);
   T2: W(Z); T2: commit; T4: R(X); T4: R(Y); T4:W(Z); T4: commit.

   Identify whether given transactions are view serializable. (Apply)

Course Outcome6 (CO6):

1. When a multi-level index is required? (Remember)
2. List the advantages of dynamic hashing when compared to static hashing. (Understand)
3. Construct a B+ tree for the following set of key values { 2,3,5,7,11,17,19,23,29,31 } Suppose that we are using extendable hashing on a file that contains records with the following search key values 2,3,5,7,11,17,19,23,29,31. Show the extendable hash structure for this file, if the hash function is h(x)=x mod 8 and buckets can hold 3 records. (Apply)

Concept Map



Syllabus

Introduction to database: Purpose of database system, System Architecture, Components of DBMS, Data Models – ER model, Other models: UML model, Graph model.

Relational Databases: Relational Model – Concept of relation, Constraints, Mapping ER model to Relational Model, Structured Query Language - DDL, DML, TCL and DCL, Relational language – Relational algebra, tuple calculus.

Database design: Decomposition, Functional Dependencies - Armstrong's axioms for FD's, Closure set of FD's for key identification, Multivalved Dependencies, and Normal forms – 1NF, 2NF, 3NF, BCNF and 5NF.

Query Processing and Optimization - Measures and Evaluation of query, Estimation and Evaluation of quey, Database tuning, HBase.

Transaction and Concurrency control - Transaction concepts, Concurrent Execution, Serializability, Concurrency Control - Lock based protocol, Deadlock handling. Recovery System - Failure Classification, Backup, Log-based Recovery, Recovery with Concurrent Transaction.

Data Storage and structures: RAID levels, Database Compression, De-Duplication, File Structure - Indexing – Ordered Index - B+ tree, Hashing - Static and dynamic hashing.

Learning Resources

1. Avi Silberschatz, Henry F.Korth, S.Sudarshan: "Database System Concepts", 6th Edition, Tata McGrawHill, 2010.
2. Sharad Maheshwari, Ruchin Jain: "Database Management System-Complete practical Approach", Firewall Media, Second Edition, 2006.
3. Ramez Elmasri and Shamkant B.Navathe, " Fundamentals of Database System", 7th edition, Pearson Education, 2017.
4. Raghu Ramakrishnan, Johannes Gehrke, "Database Management Systems", 3rd Edition, Tata McGraw Hill, 2002.
5. https://onlinecourses.nptel.ac.in/noc18_cs15/preview
6. https://courses.tce.edu/

Course Contents and Lecture Schedule

Module No.	Topic	No. of Lectures	Course Outcome
1	**Introduction to database (3)**		
1.1	Purpose of database system, System Architecture, Components of DBMS	1	CO1
1.2	Data Models – ER Model - Tutorial	1	CO1
1.3	Other Data Models - UML Model, Graph model	1	CO1
2	**Relational Databases (9)**		
2.1.1	Relational Model, Mapping ER model to Relational Model	1	CO1
2.1.2	Relational model construction - DDL – Create, Alter, Drop, Constarints - Tutorial	1	CO1
2.2.1	Structured Query Language – Introduction. DML – Set operators	1	CO2
2.2.2	Structured Query Language – DML – Joins - Tutorial	1	CO2
2.2.3	Structured Query Language – DML – Sub-queries, Nested Queries - Tutorial	1	CO2
2.2.4	Structured Query Language – DML – Complex queries, TCL and DCL	1	CO2
2.3.1	Relational language - Relational Algebra – Selection, Projection, Cross product, Join and Set operators	1	CO2
2.3.2	Relational Algebra Operations - Tutorial	1	CO2
2.3.3	Relational language - Relational calculus	1	CO2
3	**Database design (7)**		
3.1	Decomposition	1	CO3
3.2	Functional Dependencies - Armstrong's axioms for FD's, Closure set of FD's for key identification	1	CO3
3.3	Functional Dependencies, Closure set - Tutorial	1	CO3
3.4	Multivalved Dependencies	1	CO3
3.5	Normal forms - 1NF, 2NF, 3NF, BCNF and 5NF	2	CO3
	Normalization - Tutorial	1	CO3
4	**Query Processing and Optimization (3)**		
4.1	Query Processing - Measures and Evaluation of query	1	CO4
4.2.1	Query Optimization - Estimation and Evaluation of quey	1	CO4
4.2.2	Query Optimization - Database tuning, HBase	1	CO4

Module No.	Topic	No. of Lectures	Course Outcome
5	**Transaction and Concurrency control (8)**		
5.1	Transaction concepts	1	CO5
5.2	Concurrent Execution – Serializability - Tutorial	1	CO5
5.3	Concurrency Control - Lock based protocol	1	CO5
5.4	Deadlock handling - Tutorial	1	CO5
5.5	Recovery – Backup, Log based recovery	1	CO5
5.6	Tutorial on Recovery	1	CO5
5.7	Recovery with concurrent transaction	2	CO5
6	**Data Storage and stuctures (6)**		
6.1	Storage structures – RAID levels, Database Compression, De-Duplication, File Structure	2	CO6
6.2	Indexing - Ordered Index – B+ tree	1	CO6
6.3	Tutorial on B+ indexing	1	CO6
6.4	Hashing - Static and dynamic hashing	1	CO6
6.5	Tutorial on hashing	1	CO6
	Total	**36**	

Course Designers:

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2. Mrs.B.Subbulakshmi bscse@tce.edu

18EG460	PROFESSIONAL COMMUNICATION

Category	L	T	P	Credit
HSS	1	0	2	2

Preamble

This course helps the students to achieve effective language proficiency for their professional, social and interpersonal communication skills, hence increasing their employability and career skills.

Prerequisite

Basic English Knowledge

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Listen, watch, understand and respond to talks, conversations, etc by native and neutral speakers on science, general context, and from ETS test samples with confidence.	22%
CO2	Present ideas, express opinions/comments, practice presentation, and converse in discussions on a variety of technical and non-technical domains without fear	39%
CO3	Read and comprehend passages/texts from various topics – general and reasoning, to respond precisely through reading techniques, besides getting awareness on competitive exam lexicon/verbal exercises for career prospects	17%
CO4	Write journal abstracts/projects and business correspondences with clarity, accuracy, intelligibility, and precision.	22%

*** Weightage depends on Bloom's Level, number of contact hours

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	Guided Response	2.4.2, 2.4.6, 3.2.1, 3.2.2,
CO2	TPS3	Apply	Value	Mechanism	3.1.3, 3.1.2, 3.2.4, 3.2.5,3.2.6
CO3	TPS2	Understand	Respond	Guided Response	2.4.6, 2.4.5, 3.2.1,
CO4	TPS3	Apply	Value	Mechanism	2.4.3, 3.2.1, 3.2.3, 3.2.5

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1									L	S		M			L
CO2									S	S		M			M
CO3									M	S		M			L
CO4									M	S		M			L

S- Strong; M-Medium; L-Low

Assessment Pattern:

Internal: No Continuous Assessment Test(CAT) will be conducted. Students' performance will be continuously assessed in various classroom activities in Listening, Speaking, Reading and Writing for 50 marks as detailed below:

Listening Test - 10
Speaking Test (Group Discussion and Technical Presentation) - 20
Written Test(Objective/Descriptive to be tested for 40 marks and converted to 20 marks)- 20

External (Practical):

Group Discussion - 20
Personal Interview / Situational Conversation (BEC speaking based) - 20
Listening Test - 20
Reading / Writing – Computerised or Paper-based Test / General Aptitude Test – Objective type - 40

List of Experiments/Activities with CO Mapping

S.No	Activities	Hours		CO Mapping			
		T	P				
1	Listening, Reading and Writing based on Extensive Reading	2		CO1		CO3	CO4
2	Listening exercises at lab - online resources		2	CO1			
3	Developing Listening skills (BEC / IELTS / TOEIC / TOEFL)		2	CO1			
4	GD/Mock interview/Presentation Intro at lab through online		2	CO1			
5	GD Practice at classroom in groups		4	CO1	CO2		
6	Presentation on Technical / general topics – from dailies &	1	4		CO2		
7	Mock interview practice at classroom	1	4	CO1	CO2		
8	Comprehension Descriptive and Reasoning	2	2			CO3	
9	General Aptitude Practice – Vocabulary Development / Sentence completion / Error spotting /Analogy / Reasoning	3	2			CO3	CO4
10	Business Correspondence - BEC Writing Task II	2					CO4
11	Basics of Technical Writing/ Project Reports		2		CO2		
12	Preparation of Resume	1					CO4

Learning Resources

Reference Books:

1. Cappel, Annette and Sharp, Wendy, Cambridge English: Objective First, 4th Ed., CUP, New Delhi, 2013.
2. Cusack, Barry. Improve Your IELTS Listening and Speaking Skills (With CD) Paperback, Mcmillan, 2007.
3. Bates, Susan TOEFL iBT Exam Paperback – Oxford, 2012.
4. Hart, Guy Brook. Cambridge English Business Benchmark: 2 Ed., CUP 2014

Websites:

1. https://ielts-up.com (IELTS – LSRW – Practice Tests)
2. www.cambridgeenglish.org (BEC - LSRW)
3. www.etsglobal.org (TOEIC Preparation)

4. www.examenglish.com (Online Exams for international ESL Exams)
5. www.testpreppractice.net (GRE Tests -Vocabulary /Analogy / Sentence Completion / Reading)
6. https://www.freshersworld.com (Placement Papers)

Extensive Reading:

Coelho, Paulo. The Alchemist, Harper Publication, 2018.

Course Designers:

1. Dr.A.Tamilselvi , Convenor
2. Dr S.Rajaram
3. Mr.Vinoth.R
4. Dr.G.Jeya Jeevakani
5. Ms.R.Manibala

18CS470	SYSTEM SOFTWARE AND OPERATING SYSTEMS LAB

Category	L	T	P	Credit
PC	0	0	2	1

Preamble

This laboratory enables the students clearly understand the concepts of system software. Also students can implement the scheduling, process and memory management techniques.

Prerequisite

Computer Organization and Microprocessor
Problem Solving using Computers

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Implement system software components like symbol table generator, single-pass and multi-pass assemblers (Apply)	25
CO2	Implement and demonstrate the function of system software like loaders, linkers in program execution (Apply)	8
CO3	Implement page replacement algorithms and dynamic storage allocation algorithms. utilize the first fit and best fit algorithms for allocating and managing memory (Apply)	18
CO4	Implement scheduling algorithms such as FCFS, SJFS and Round Robin to schedule a given set of processes. (Apply)	17
CO5	Implement Banker's algorithm for deadlock avoidance (Apply)	8
CO6	Implement disk scheduling algorithms like FCFS, SSTF, SCAN and C-SCAN. (Apply)	8
C07	Construct programs to demonstrate inter-process communication using shared memory, pipes and message queues. (Apply)	8
C08	Implement solutions to the critical section problem using semaphores. (Apply)	8

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value	Mechanism	1.2, 4.5.1
CO2	TPS3	Apply	Value	Mechanism	1.2, 4.5.1
CO3	TPS3	Apply	Value	Mechanism	1.2, 4.5.1
CO4	TPS3	Apply	Value	Mechanism	1.2, 4.5.1
CO5	TPS3	Apply	Value	Mechanism	1.2, 4.5.1
CO6	TPS3	Apply	Value	Mechanism	1.2, 4.5.1
CO7	TPS3	Apply	Value	Mechanism	1.2, 4.5.1
CO8	TPS3	Apply	Value	Mechanism	1.2, 4.5.1

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S		M		M				M	L			L	M	
CO2	S		M		M				M	L			L	M	
CO3	S		M		M				M	L				S	
CO4	S		M		M				M	L				S	
CO5	S		M		M				M	L				S	
CO6	S		M		M				M	L				S	
CO7	S		M		M				M	L				M	
CO8	S		M		M				M	L				S	

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Model Examination	Terminal Examination
Remember		
Understand		
Apply	100	100
Analyse		
Evaluate		
Create		

Assessment Pattern: Psychomotor

Psychomotor Skill	Miniproject /Practical Component/Observation
Perception	
Set	
Guided Response	15
Mechanism	85
Complex Overt Responses	
Adaptation	
Origination	

List of Experiments/Activities with CO Mapping

Sl.No	Experiments	CO
1.	Implementation of symbol table.	CO1
2.	Implementation of Single pass assembler.	CO1
3.	Implementations of Multi pass assembler.	CO1
4.	Implementation of Linker, absolute and relocatable Loader.	CO2
5.	Given the list of processes, their CPU burst times and arrival times, display/print the Gantt chart for FCFS and SJF. For each of the scheduling policies, compute and print the average waiting time and average turnaround time.	CO4
6.	Given the list of processes, their CPU burst times and arrival times, display/print the Gantt chart for Priority and Round robin. For each of	CO4

	the scheduling policies, compute and print the average waiting time and average turnaround time.	
7.	Developing Application using Inter Process Communication (using shared memory, pipes or message queues)	CO7
8.	Implement Bankers Algorithm for Deadlock Avoidance	CO5
9.	Implement the Producer – Consumer problem using semaphores (using UNIX system calls).	CO8
10.	Implement First fit and Best fit memory management schemes	CO3
11.	Implement First come first serve and LRU Page replacement Algorithms	CO3
12.	Implement Disk management using Algorithms such as FCFS,SSTF,SCAN and C-SCAN	CO6

Learning Resources

1. Avi Silberschatz, Peter Baer Galvin and Greg Gagne: Operating System Concepts, Seventh edition, John Wiley and Sons, 2006.

Course Designers

1. Dr. P.Chitra pccse@tce.edu

2. Mr. K.Narasimha Mallikarjunan arjunkambaraj@tce.edu

18CS480	ALGORITHMS LAB

Category	L	T	P	Credit
PC	0	0	2	1

Preamble

The objective of this laboratory course is to enable students to solve algorithmic problems by choosing and/or designing efficient data structures and algorithms to meet the problem constraints and implementing the algorithm in C/C++ and Python.

Prerequisite

Problem Solving using Computers

Data Structures and Algorithms

Data Structures Lab

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Determine the time complexity of various sorting and searching techniques.	15
CO2	Apply design techniques like divide and conquer to solve the recursive problems.	15
CO3	Identify the problem and design the algorithm using greedy dynamic programming techniques.	15
CO4	Implement various graph traversal algorithm and analyse their performance.	15
CO5	Develop efficient algorithms using branch and bound techniques for solving real world, scientific and engineering problems.	15
CO6	Design, implement and evaluate the algorithms designed using a high-level programming language.	25

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value	Mechanism	1.2,2.1.1,2.4.3
CO2	TPS3	Apply	Value	Mechanism	1.2,2.1.1,2.4.3
CO3	TPS4	Analyse	Organise	Complex Overt Responses	1.2,2.1.1,2.4.3
CO4	TPS3	Apply	Value	Mechanism	1.2,2.1.1,2.4.3
CO5	TPS3	Apply	Value	Mechanism	1.2,2.1.1,2.4.3
CO6	TPS5	Evaluate	Organise	Adaptation	1.2,2.1.1,3.1.1,4.5.1

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	S	M	M			M	S	M	M	M	S	M	M
CO2	S	S	S	M	M			M	S	M	M	M	S	M	M

CO3	S	S	S	M	M			M	S	M	M	M	S	M	M
CO4	S	S	S	M	M			M	S	M	M	M	S	M	M
CO5	S	S	S	M	M			M	S	M	M	M	S	M	M
CO6	S	S	S	M	M			M	S	M	M	M	S	M	M

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Model Examination	Terminal Examination
Remember		
Understand		
Apply	20	30
Analyse	20	30
Evaluate	10	20
Create		

Assessment Pattern: Psychomotor

Psychomotor Skill	Miniproject /Practical Component/Observation
Perception	
Set	
Guided Response	
Mechanism	
Complex Overt Responses	60
Adaptation	40
Origination	

List of Experiments/Activities with CO Mapping

Students will be expected to understand and model the problem, design efficient algorithms, implement the algorithms designed using C/C++

1. Analysis of searching (Linear/Binary search)and sorting algorithm(O(n^2)/O(nlogn)
2. Analysis of divide & conquer algorithms – Merge sort/Quick sort
3. Implementation of greedy algorithm- Prim's / Kruskal /Knapsack problem
4. Implementation of dynamic programming – matrix multiplication
5. Application of DFS – Topological sort/Strongly connected components
6. Implementation of maximum flow algorithm – Ford Fulkerson algorithm
7. Implementation of branch and bound techniques – Travelling salesman problem
8. Mini Project - Identifying an appropriate data structure and implement it using relevant algorithms and analyse the time complexity to solve problems like :
   - Huffman coding and decoding
   - Maximum flow in a dynamic network
   - Graph colouring
   - Drunken Donuts, a new wine-and-donuts restaurant chain, wants to build restaurants on many street corners with the goal of maximizing their total profit. The street network is described as an undirected graph G = (V, E), where the potential restaurant sites are the vertices of the graph. Each vertex u has a nonnegative integer value pu, which describes the potential profit of site u. Two restaurants cannot be built on adjacent vertices (to avoid

selfcompetition). You are supposed to design an algorithm that outputs the chosen set U ⊆ V of sites that maximizes the total profit u∈U pu.

Module No.	Topic	No. of Lectures	Course Outcome
1	Analysis of searching (Linear/Binary search)and sorting algorithm(O(n^2)/O(nlogn)	3	CO1
2	Analysis of divide & conquer algorithms – Merge sort/Quick sort	3	CO2
3	Implementation of greedy algorithm- Prim's / Kruskal /Knapsack problem	3	CO3
4	Implementation of dynamic programming – matrix multiplication	3	CO3
5	Application of DFS – Topological sort/Strongly connected components	3	CO4
6	Implementation of maximum flow algorithm – Ford Fulkerson algorithm	3	CO4
7	Implementation of branch and bound techniques – Travelling salesman problem	3	CO5
8	Mini Project	4	CO6
	Total	**24**	

Learning Resources

1. https://www.geeksforgeeks.org/fundamentals-of-algorithms/
2. https://www.hackerrank.com/domains/algorithms
3. https://www.codechef.com/wiki/tutorials
4. Steven S. Skiena, The Algorithm Design Manual, Second Edition, Springer,2010.

19CS490	PROJECT MANAGEMENT

Category	L	T	P	Credit
HSS	3	0	0	3

Preamble

This course develops the competencies and skills for planning, organizing and controlling projects and understanding interpersonal issues that leads to successful project outcomes. Discusses the activities for the prospective project managers to manage their teams, schedules, risks and resources to produce the desired outcome. The course is based on references from Project Management Institute's (PMI®) Project Management Body of Knowledge (PMBOK® Guide).

Prerequisite

Nil

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Suggest an organizational structure for managing projects to develop a product with a given specification	10
CO2	Develop a project communication plan by defining its scope, priorities and responsibility matrices	20
CO3	Construct a work breakdown structure for a given business cases	20
CO4	Identify the critical path in scheduling a set of project-activities by using the Activity-On-Node method.	20
CO5	Outline the importance and various activities performed for resource management, risk assessment and project closure.	15
CO6	Plan and implement a team-project for developing a product.	20

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value	Mechanism	1.2,2.5
CO2	TPS3	Apply	Value	Mechanism	1.2,2.5
CO3	TPS3	Apply	Value	Mechanism	1.2,2.2.1,2.2.3
CO4	TPS3	Apply	Value	Mechanism	1.2,2.2.1,2.2.3,3.1.1
CO5	TPS2	Understand	Respond	Guided Response	1.2,4.1.1, 4.1.2
CO6	TPS3	Apply	Value	Mechanism	1.2, 2.2.1,3.1.1,3.1.2,3.1.4, 4.4.2

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L			M	L	M	L		L	M	M	L	L
CO2	S	M	L			M	L	M	L			M	M	L	L
CO3	S	M	L	L	M	M	L	M	L		M	M	M	M	M

CO4	S	M	L	L	M	M	L	M	L		M	M	M	M	M
CO5	M	L			M	L		L			M	M	L	L	L
CO6	S	M	L	L	M	M	L	M	S	M	M	M	M	M	M

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Assignment			Terminal Examination
	1	**2**	**3**	1	2	3	
Remember	20	20	20	-	-	-	20
Understand	40	40	40	-	-	-	50
Apply	40	40	40	100	100	100	30
Analyse							
Evaluate							
Create							

Assessment Pattern: Psychomotor

Psychomotor Skill	Mini project /Assignment/Practical Component
Perception	
Set	
Guided Response	30
Mechanism	70
Complex Overt Responses	
Adaptation	
Origination	

Sample Questions for Course Outcome Assessment**

Course Outcome 1 (CO1):

1. Suggest a suitable organisational structure for a Central Engineering Systems, Inc.
2. You work for LL Company, which manufactures high-end optical scopes for hunting rifles. LL Company has been the market leader for the past 20 years and has decided to diversify by applying its technology to develop a top-quality binocular. What kind of project management structure would you recommend they use for this project? What information would you like to have to make this recommendation, and why?
3. Explain how organizing projects are deployed within the dedicated project teams. State its pros and cons.

Course Outcome 2 (CO2):

1. Estimate the cost associated with the project using bottom up technique
2. Why is the implementation of projects important to strategic planning and the project Manager ?
3. Explain the guidelines for estimating times, costs and resources and explain the methods for estimating the project costs by Top Down Approach

Course Outcome 3 (CO3):

1. Develop a work breakdown structure for a wedding

2 How does the WBS differ from the project network
3. Develop a WBS for a project in which you are going to build a bicycle. Try to identify all of the major components and provide three levels of detail.

Course Outcome 4 (CO4):

1. Draw a project network from the following information. What activity(s) is a burst activity? What activity(s) is a merge activity?

ID	Description	Predecessor	Time
A	Survey	None	5
B	Soils report	A	20
C	Traffic design	A	30
D	Lot layout	A	5
E	Approve design	B,C,D	80
F	Illumination	E	15
G	Drainage	E	30
H	Landscape	E	25
I	Signing	E	20
J	Bid proposal	F,G,H,I	10

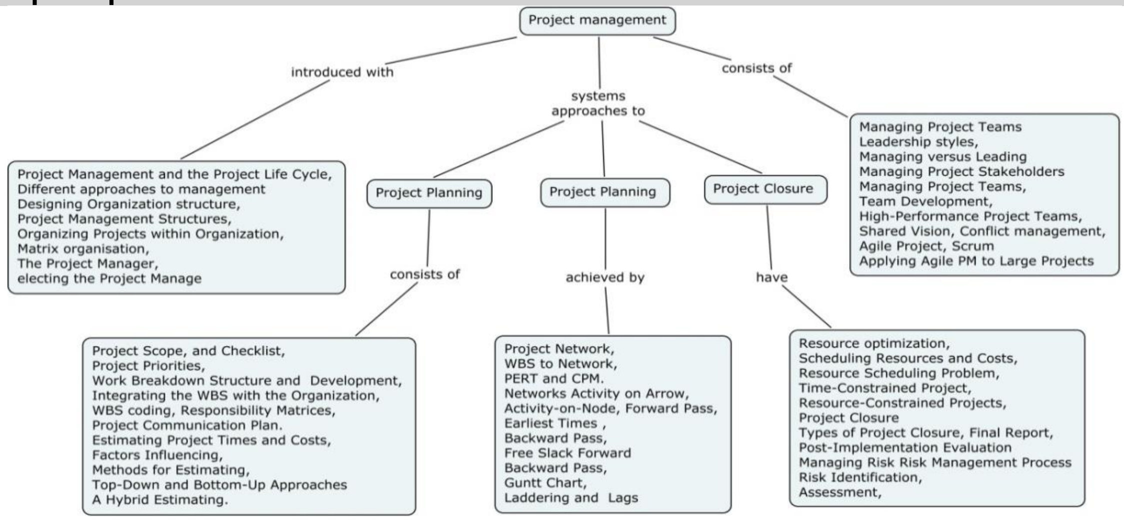
2. Create a customer database for the Modesto league baseball team. Draw a project network Complete the forward and backward pass, compute activity slack, and identify the critical path. How long will this project take? How sensitive is the network schedule? Calculate the free slack and total slack for all noncritical activities.
3. Your roommate is about to submit a scope statement for a spring concert sponsored by the entertainment council at Western Evergreen State University (WESU). WESU is a residential university with over 22,000 students. This will be the first time in six years since WESU sponsored a spring concert. The entertainment council has budgeted $40,000 for the project. The event is to occur on June 5th. Since your roommate knows you are taking a class on project management she has asked you to review her scope statement and make suggestions for improvement. She considers the concert a resume-building experience and wants to be as professional as possible. Below is a draft of her scope statement. What suggestions would you make and why?

Course Outcome 5 (CO5):

1 What is the difference between avoiding a risk and accepting a risk?
2 What is the difference between mitigating a risk and contingency planning?
3 Develop a risk breakdown structure and describe the process involved in Risk management.

*Note: **CO6** will be attained through Mini Projects / Assignments.

Concept Map



Syllabus

Modern Project Management

Project Management and its importance, The Project Life Cycle, Different approaches to management, Organization structure and Project Management, Organizing Projects within the Functional Organization, Matrix organisation and Projectized organisation, The Project Manager, and Project Management

Project Initiation

Project Scope, and Checklist, Project Priorities, Software Project Planning, Work Breakdown Structure Development, WBS coding, Responsibility Matrices in WBS, Project Communication Plan, Project Estimation and Methods for Estimation, Software project estimation.

Project Planning

Selection of appropriate project management approaches, spiral model, Agile, Extreme programming, Iterative planning, WBS to Project Network, Networks Activity on Arrow, Activity-on-Node, Forward Pass, Earliest Times , Backward Pass—Latest Times, Laddering and Lags,Gantt Chart

Resource optimization, Scheduling Resources and Costs, Resource Scheduling Problem, Time-Constrained Project, Resource-Constrained Projects. **Managing Risk,** Risk Management Process, Risk Identification, Assessment, and Response Development Managing people in software projects

Leadership, Leadership styles, managing versus Leading a Project, Managing Project Stakeholders **Managing Project Teams**, Team Development, High-Performance Project Teams, Shared Vision, Conflict management, Project Closure Types of Project Closure, Final Report, Post-Implementation Evaluation

Learning Resources

1. By Bob Hughes, Mike Cotterell, “Software Project Management”, Tata McGraw-Hill Education.
2. Erik W. Larson, Clifford F. Gray, “Project Management The Managerial Process”, McGraw-Hill/Irwin, Fifth Edition, 2011.

3. Jack R. Meredith, Samuel J. Mantel, Jr., "Project management A Managerial Approach"., John Wiley & Sons, Inc. Seventh Edition,2009
4. Harold kerzner , "Project Management A systems approach to Planning, scheduling, And controlling", Tenth edition, John Wiley & Sons, Inc.2009
5. Harold kerzner , "Project management best practices achieving global excellence", Second edition, John Wiley & Sons, Inc.2010
6. A Guide to the Project Management Body of Knowledge (PMBOK® Guide)—Fifth Edition, Project Management Institute.
7. Harold Koontz, Heinz weihrich "Essentials of Management", Tata McGraw-Hill Education, 2006 - Management

Course Contents and Lecture Schedule

Module No.	Topic	No. of Lectures	Course Outcome
1	**Modern Project Management**		
1.1	Project Management and its importance	1	CO1
1.2	The Project Life Cycle	1	CO1
1.3	Different approaches to management,	1	CO1
1.4	Organization structure and Project Management	2	CO1
1.5	Organizing Projects within the Functional Organization, Matrix organisation and Projectized organisation	1	CO1
1.6	The Project Manager, and Project Management	1	CO1
2	**Project Initiation**		
2.1	Project Scope, and Checklist, Project Priorities,	1	CO2
2.2	Software Project Planning	2	CO2
2.3	Work Breakdown Structure Development, WBS coding.	1	CO3
2.4	Responsibility Matrices in WBS, Project Communication Plan.	2	CO2
2.5	Project Estimation and Methods for Estimation Software project estimation	2	CO2
3.1	**Project Planning**		
3.2	Selection of appropriate project management approaches, spiral model,	2	CO4
3.3	Agile, Extreme programming, Iterative planning	1	CO4
3.4	WBS to Project Network	2	CO4
3.5	Networks Activity on Arrow, Activity-on-Node	2	CO4
3.6	Forward Pass, Earliest Times , Backward Pass—Latest Times, Laddering and Lags, Gantt Chart	2	CO4
4	**Resource optimization**,		
4.1	Scheduling Resources and Costs, Resource Scheduling Problem,	2	CO5
4.2	Time-Constrained Project,	1	CO5
4.3	Resource-Constrained Projects,	1	CO5
4.4	Managing Risk, Risk Management Process Risk Identification, Assessment, Response Development,	1	CO5
	Managing people in software projects		

Module No.	Topic	No. of Lectures	Course Outcome
5	**Software project management**		
5.1	Leadership styles, Managing versus Leading a Project, Managing Project Stakeholders	1	CO6
5.2	Managing Project Teams, Team Development, High-Performance Project Teams, Shared Vision	2	CO6
5.3	Conflict management.	1	CO5
5.4	Project Closure Types of Project Closure, Final Report, Post-Implementation Evaluation	2	CO5
	Total	36	

Course Designers:

1. Dr.N.Shivakumar shiva@tce.edu
2. Mr.V.Vignaraj Ananth vignaraj@tce.edu

18CHAB0	CONSTITUTION OF INDIA	Category	L	T	P	Credit
		AC	2	0	0	0

Preamble

On the successful completion of the course, the students will be able to explain the basic features and fundamental principles of Constitution of India. The Constitution of India is the supreme law of India. Parliament of India cannot make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the "basic structure" of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of "Constitutionalism" – a modern and progressive concept historically developed by the thinkers of "liberalism" – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of "constitutionalism" in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America.

The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India's legacy of "diversity". It has been said that Indian constitution reflects ideals of its freedom movement; however, few critics have argued that it does not truly incorporate our own AICTE Model Curriculum for Mandatory Courses & Activities (Non-Credit) for Undergraduate Degree in Engineering & Technology ancient legal heritage and cultural values. No law can be "static" and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950. The Indian judiciary and particularly the Supreme Court of India has played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution but also strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court of India and its historic contributions has been recognized throughout the world and it gradually made it "as one of the strongest court in the world"

Course Outcome:

On the successful completion of the course students will be able to

CO1	Explain the meaning of the constitution law and constitutionalism and Historical perspective of the Constitution of India	Understand
CO2	Explain the salient features and characteristics of the Constitution of India, scheme of the fundamental rights and the scheme of the Fundamental Duties and its legal status	Understand
CO3	Explain the Directive Principles of State Policy, Federal structure and distribution of legislative and financial powers between the Union and the States, and Parliamentary Form of Government in India	Understand
CO4	Explain the amendment of the Constitutional Powers and Procedure, the historical perspectives of the constitutional amendments in India, and Emergency Provisions.	Understand
CO5	Explain the Local Self Government – Constitutional Scheme in India, Scheme of the Fundamental Right to Equality,	Understand
CO6	Explain the scheme of the Fundamental Right to certain Freedom under Article 19, and Scope of the Right to Life and Personal Liberty under Article 21	Understand

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	-	-	-	M	-	M	-	L	-	-
CO2	M	L	-	-	-	M	-	M	-	L	-	-
CO3	M	L	-	-	-	M	-	M	-	L	-	-
CO4	M	L	-	-	-	M	-	M	-	L	-	-
CO5	M	L	-	-	-	M	-	M	-	L	-	-
CO6	M	L	-	-	-	M	-	M	-	L	-	-

S- Strong; M-Medium; L-Low

Syllabus

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the fundamental rights
5. The scheme of the Fundamental Duties and its legal status
6. The Directive Principles of State Policy – Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Union and the States
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India
9. Amendment of the Constitutional Powers and Procedure
10. The historical perspectives of the constitutional amendments in India
11. Emergency Provisions : National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme in India
13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19
15. Scope of the Right to Life and Personal Liberty under Article 21

Assessment Pattern

Bloom's category	Continuous Assessment Tests		Seminar
	1	2	-
Remember	40	40	0
Understand	60	60	100
Apply	0	0	0
Analyze	0	0	0
Evaluate	0	0	0
Create	0	0	0

References

1. Durga Das Basu, 'Introduction to The Constitution of India', LexisNexis Butterworths Wadhwa, 20th Edition, Reprint 2011.
2. Constitution of India, National Portal of India, Web link: https://www.india.gov.in/my-government/constitution-india

Course Designers:

1. Adapted from AICTE Model Curriculum for Undergraduate Degree Courses in Engineering & Technology, Volume-II, January 2018.

CURRICULUM AND DETAILED SYLLABI

FOR

B.E DEGREE (Computer Science and Engineering) PROGRAMME

FIFTH SEMESTER

FOR THE STUDENTS ADMITTED FROM THE

ACADEMIC YEAR 2018 - 2019 ONWARDS

THIAGARAJAR COLLEGE OF ENGINEERING

(A Government Aided ISO 9001-2008 certified
Autonomous Institution affiliated to Anna University)

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THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015
B.E Degree (Computer Science and Engineering) Programme

COURSES OF STUDY
(For the candidates admitted from 2018- 19 onwards)

FIFTH SEMESTER

Course Code	Name of the Course	Category	No. of Hours / Week			Credits
			L	T	P	
THEORY						
18CS510	Numerical Methods	ES	2	1	-	3
18CS520	Theory of Computation	PC	3	-	-	3
18CS530	Data Communication and Networks	PC	3	-	-	3
18CSPX0	Program Elective – I	PE	3	-	-	3
18CSGX0	General Elective – I	GE	3	-	-	3
THEORY CUM PRACTICAL						
18CS560	Software Engineering: Theory and Practice	PC	2	-	2	3
PRACTICAL						
18CS570	Databases Lab	PC	-	-	2	1
18CS580	Network Programming Lab	PC	-	-	2	1
18ES590	System Thinking	ES	1	-	2	2
18CHAC0	Essence of Indian Knowledge	AC	2	-	-	-
Total			**19**	**1**	**8**	**22**

BS : Basic Science
HSS : Humanities and Social Science
ES : Engineering Science
PC : Program Core
PE : Program Elective
OE : Open Elective

L : Lecture
T : Tutorial
P : Practical

Note:

1 Hour Lecture is equivalent to 1 credit
1 Hour Tutorial is equivalent to 1 credit
2 Hours Practical is equivalent to 1 credit

THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015
B.E Degree (Computer Science and Engineering) Programme

SCHEME OF EXAMINATIONS
(For the candidates admitted from 2018-19 onwards)

FIFTH SEMESTER

S.No.	Course Code	Name of the Course	Duration of Terminal Exam. in Hrs.	Marks			Minimum Marks for Pass	
				Continuous Assessment	Terminal Exam *	Max. Marks	Terminal Exam	Total
THEORY								
1	18CS510	Numerical Methods	3	50	50	100	25	50
2	18CS520	Theory of Computation	3	50	50	100	25	50
3	18CS530	Data Communication and Networks	3	50	50	100	25	50
4	18CSPX0	Program Elective – I	3	50	50	100	25	50
5	18CSGX0	General Elective – I	3	50	50	100	25	50
THEORY CUM PRACTICAL								
6	18CS560	Software Engineering: Theory and Practice	3	50	50	100	25	50
PRACTICAL								
7	18CS570	Databases Lab	3	50	50	100	25	50
8	18CS580	Network Programming Lab	3	50	50	100	25	50
9	18ES590	System Thinking	3	50	50	100	25	50
10	18CHAC0	Essence of Indian Knowledge	-	50	50	100	25	50

* Terminal Examination will be conducted for maximum marks of 100 and subsequently be reduced to 50 marks for the award of terminal examination marks

		Category	L	T	P	Credit
18CS510	**NUMERICAL METHODS**	ES	2	1	0	3

Preamble

Numerical method deals with finding approximate solutions of polynomial, simultaneous algebraic equations, Interpolation, Differentiation and Integration, ODEs and PDEs by various Numerical techniques. The course is designed to impart the knowledge and understanding of the above concepts to computer science engineering students and apply them in their areas of specializations.

Prerequisite

Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Apply appropriate numerical methods to solve algebraic, transcendental equations and polynomial equations.	10
CO2	Compute an approximate solution for simultaneous linear algebraic equations and the inverse of a non-singular matrix.	15
CO3	Calculate the approximate solutions for problems related to interpolation, differentiation and integration	25
CO4	Apply various predictor corrector methods for finding approximate solutions of Ordinary Differential Equations	20
CO5	Apply finite difference method to solve Boundary value problems.	10
CO6	Classify PDE and Apply various computational methods for finding approximate solutions of Partial Differential Equations of different types	20

*** Weightage depends on Bloom's Level, number of contact hours

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value		1.1.1, 2.1.1
CO2	TPS3	Apply	Value		1.1.1, 2.1.1
CO3	TPS3	Apply	Value		1.1.1, 2.1.1
CO4	TPS3	Apply	Value		1.1.1, 2.1.1
CO5	TPS3	Apply	Value		1.1.1, 2.1.1
CO6	TPS3	Apply	Value		1.1.1, 2.1.1

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L		L	L		L	L	L		L	M		L
CO2	S	M	L		L	L		L	L	L		L	M		L

CO3	S	M	L		L	L		L	L	L		L	M		L
CO4	S	M	L		L	L		L	L	L		L	M		L
CO5	S	M	L		L	L		L	L	L		L	M		L
CO6	S	M	L		L	L		L	L	L		L	M		L

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continious Assessment Tests			Assignment			Terminal Examinations
	1	2	3	1	2	3	
Remember	10	10	10	-	-	-	-
Understand	30	30	30	-	-	-	30
Apply	60	60	60	100	100	100	70
Analyse							
Evaluate							
Create							

Assessment Pattern: Psychomotor

Psychomotor Skill	Miniproject /Assignment/Practical Component
Perception	
Set	
Guided Response	
Mechanism	
Complex Overt Responses	
Adaptation	
Origination	

Sample Questions for Course Outcome Assessment**

** (2 to 3 at the cognitive level of course outcome)

Course Outcome 1 (CO1)

1 Predict the positive root of $3x-\sqrt{1+Sin\,x}=0.$ by fixed point method.

2 Compute the negative roots of $2x^3-7x^2+7x-2=0.$ by Bisection method

3 Compute the positive root of $x-Cos\,x=0.$ using Newton's Raphson method.

Course Outcome 2 (CO2)

1 Calculate the approximate solution to the system of equations by Gauss Seidel method. $x+3y+10z=24\,;2x+17y+4z=35\,;28x+4y-z=32.$

2 Calculate the approximate solution to the system of equations by Gauss Jacobi method. $8x+y+z=8\,;2x+4y+z=4\,;x+3y+3z=5.$

3 Calculate the inverse of the matrix $\begin{pmatrix} 1 & 6 & 1 \\ 1 & 2 & 0 \\ 0 & -0 & 3 \end{pmatrix}$ by Gauss Elimination method.

Course Outcome 3 (CO3)

1 Evaluate the integral $\int_1^2 \frac{dx}{1+x^2}$ using Trapezoidal rule with two subintervals

2 Use Runge Kutta method to compute y for x =0.1, given $y^1 = \frac{xy}{1+x^2}$, y(0)=1, take h = 0.1

3 For the following data, calculate the differences and obtain the forward and backward differene polynomials. Interpolate at x=0.25 and x=0.35

x	0.1	0.2	0.3	0.4	0.5
f(x)	1.40	1.56	1.76	2.00	2.28

Course Outcome 4 (CO4)

1 Calculate $y(0.8)$ using Milne's predictor corrector method given that $y' = y - x^2$; $y(0)=1$; $y(0.2)=1.12$; $y(0.3)=1.46$; $y(0.6)=1.73$

2 Calculate $y(0.8)$ using Adam's predictor corrector method given that $y' = xy + y^2$; $y(0)=1$; $y(0.2)=1.12$; $y(0.3)=1.46$; $y(0.6)=1.73$

3 Using Milne's method, find y(2) if y(x) is the solution of $y^1 = \frac{1}{2}(x+y)$, given y(0)=2, y(0.5)= 2.636, y(1)= 3.595 and y(1.5)= 4.968

Course Outcome 5 (CO5)

1 Solve the boundary value problem $x^2 y'' = 2y - x,\ 2 < x < 3, y(2) = 0, y(3) = 0$ using the Numerov method with h=1/3

2 Solve y″ + y = 2 with condition y (0) = 0, y (1) = 1, using Hermitian Method

3 Using Finite difference method Solve y″ - 64y + 10 = 0, $x \in (0,1)$,y (0) = y(1) = 0 by sub dividing the internals into i) Four equal parts ii) Two equal parts

Course Outcome 6 (CO6)

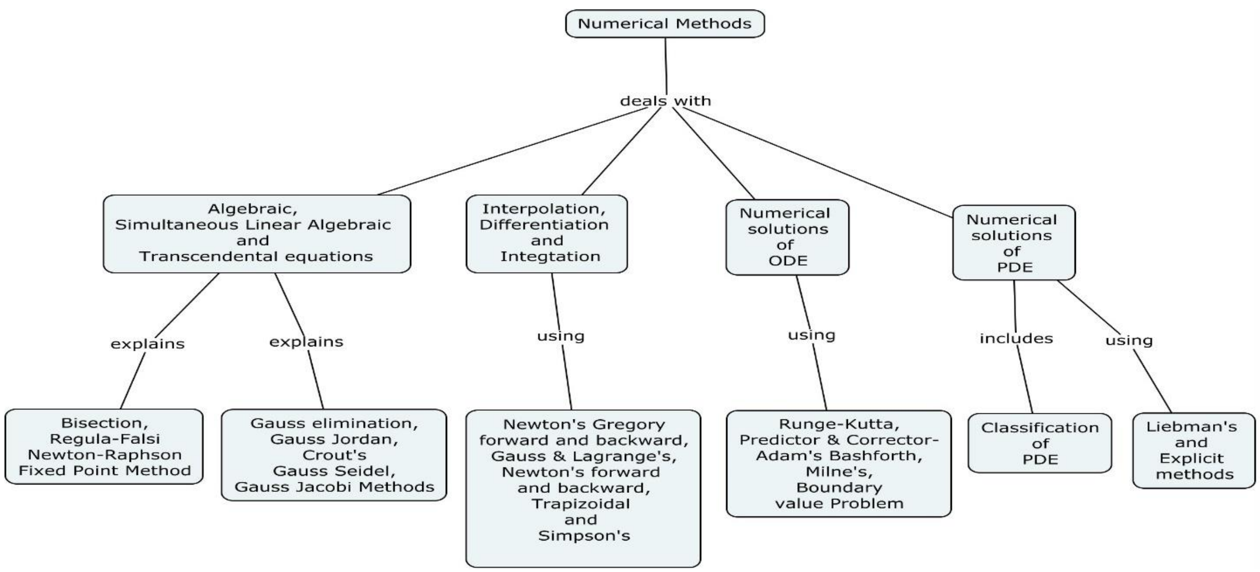
1 Solve: $u_{xx} + u_{yy} = 0$; over the square mesh of side 4 satisfying the following boundary conditions:

$$u(0,y) = 0 \ ;\ 0 \le y \le 4 \ ;\ u(4,y) = 12 + y;\ 0 \le y \le 4 \ ;\ u(x,0) = 3x \ ;\ 0 \le x \le 4 \ ;$$
$$u(x,4) = x^2 \ ;\ 0 \le x \le 4 \ .$$

2 Using Bender Schmidt method find the solution of the parabolic equation $\frac{\partial^2 u}{\partial x^2} - 2\frac{\partial u}{\partial t} = 0$; *where* $u(0,t) = 0 = u(4,t)$; $u(x,0) = x(4-x)$. Assume h=1.Calculate the values up to t=5.

3 Solve numerically, $4u_{xx} = u_{tt}$ with boundary conditions u (0,t)=0, u(4,t)=0 and the initial conditions u_t(x,0)=0 and u(x,0)= x(4-x), taking h =1. (for 4 time steps)

Concept Map



Syllabus

Algebraic, Simultaneous linear Algebraic and Transcendental Equations: Bisection, Regula falsi, Newton-Raphson, Fixed point Method, Gauss Elimination, Gauss Jordan method, Crout's method ,Gauss Seidel and Gauss Jacobi methods, Inversion by Gauss Jordan method.

Interpolation, Differentiation and Integration: Newton Gregory's forward and backward difference interpolation formulae, Gauss's and Lagrange's interpolation formulae, Newton's forward and backward formulae for derivatives, Trapezoidal, Simpson's 1/3rd and 3/8th rules.

Numerical solutions of ODE: Runge Kutta Method of fourth order, Predictor-Corrector Method-Adams Bashforth, Milne's Method, Boundary Value Problem- Solution by Finite difference method.

Numerical solutions of PDE: Classification of PDE, Solution of Elliptic equations by Leibmann's method, Solution of parabolic and Hyperbolic equations by explicit methods.

Learning Resources

1. Sastry S.S "Introductory Methods of Numerical Analysis" Fifth edition Prentice Hall of India , New Delhi -2006
2. Iyengar.S.R.K, Jain.R.K., "Numerical Methods for Scientific and Engineering Computation"-Fifth edition, New Age International Publishers, New Delhi-2009
3. B.S.Grewal," Numerical Methods",- Nineth Edition- Khanna Publishing Company-New Delhi -2010.
4. Steven C. Capra, "Applied Numerical Methods with Matlab for Engineers and Scientists" –third edition, The McGraw-Hill Companies- 2012.
5. Steven C. Capra, Raymond P.Canale, "Numerical Methods for Engineers"- fifth edition, The McGraw-Hill Companies- 2006.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Lectures	Course Outcomes
1	**Algebraic, simultaneous linear algebraic and Transcendental equations**		
1.1	Bisection , Regula-falsi method	2	CO1
1.2	Newton- Raphson method	1	CO1
	Tutorial	1	CO1
1.3	Fixed point method	1	CO1
1.4	Gauss elimination and Gauss Jordan methods	2	CO2
	Tutorial	1	
1.5	Crout's method, Gauss Jacobi and Gauss Siedal methods	2	CO2
1.6	Inversion by Gauss Jordan method	1	CO2
	Tutorial	1	
2	**Interpolation, Differentiation and Integration**		
2.1	Newton Gregory's forward and backward difference interpolation formulae	2	CO3
2.2	Gauss's and Lagrange's interpolation formulae	1	CO3
	Tutorial	1	
2.3	Newton's forward and backward formulae for derivatives	1	CO3
2.4	Trapezoidal, Simpson's $1/3^{rd}$ and $3/8^{th}$ rules	1	CO3
	Tutorial	2	
3	**Numerical Solution of ODE**		
3.1	Runge Kutta Method of fourth order	1	CO4
3.2	Predictor-Corrector Method- Adams Bash forth, Milne's Method	2	CO4
	Tutorial	2	
3.3	Boundary value problem – Solution by finite difference method	2	CO5
	Tutorial	1	
4	**Numerical Solution of PDE**		
4.1	Classification of PDE	1	CO6
4.2	solution of elliptic equations by Leibmann's Method	2	CO6
	Tutorial	1	
4.3	Solution of parabolic and Hyperbolic equations by explicit methods	2	CO6
	Tutorial	2	
	TOTAL	36	

Course Designers:

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18CS520	**THEORY OF COMPUTATION**	Category	L	T	P	Credit
		PC	3	0	0	3

Preamble

This course will introduce students to three foundational areas of computer science namely the basic mathematical models of computation, problems that can be solved by computers and problems that are computationally hard. It also introduces basic computation models, their properties and the necessary mathematical techniques to prove more advanced attributes of these models. The students will be able to express computer science problems as mathematical statements and formulate proofs.

Prerequisite

Nil

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Construct the abstract machines including finite automata, pushdown automata, and Turing machines from their associated languages	15
CO2	Make use of pumping lemma to show that a language is not regular / not context-free	15
CO3	Construct finite automata, pushdown automata, Turing machines for the given grammar	20
CO4	Construct the grammar for any given finite automata, pushdown automata or Turing machines	20
CO5	Outline the characteristics of P, NP and NP Complete problems in the context of Turing machines	15
CO6	Illustrate the unconventional model of computation associated with a new computing paradigms including DNA and Membrane Computing	15

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value	Mechanism	1.2,2.3.2,3.2.3,4.4.3
CO2	TPS3	Apply	Value	Mechanism	1.2,2.3.2, 3.2.3,4.4.3

CO3	TPS3	Apply	Value	Mechanism	1.2,2.3.2, 3.2.3,4.4.3
CO4	TPS3	Apply	Value	Mechanism	1.2,2.3.2, 3.2.3,4.4.3
CO5	TPS2	Understand	Respond	Guided Response	1.2,2.3.2, 3.2.3,4.4.3
CO6	TPS2	Understand	Respond	Guided Response	1.2,2.3.2, 3.2.3,4.4.3

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO 1	S	M	L					M	L	M		L	M		L
CO 2	S	M	L					M	L	M		L	M		L
CO 3	S	M	L					M	L	M		L	M		L
CO 4	S	M	L					M	L	M		L	M		L
CO 5	M	L						L		L			L		
CO 6	M	L			L	L		L		L			L	L	

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Assignment			Terminal Examination
	1	2	3	1	2	3	
Remember	20	20	20	-	-	-	20
Understand	30	40	30	30	30	30	30
Apply	50	40	50	70	70	70	50
Analyse	0	0	0	-	-	-	-
Evaluate	0	0	0	-	-	-	-
Create	0	0	0	-	-	-	-

Course Outcomes Assessment Pattern: Psychomotor

Psychomotor Skill	Miniproject /Assignment/Practical Component
Perception	-
Set	-

Guided Response	30
Mechanism	70
Complex Overt Responses	-
Adaptation	-
Origination	-

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Demonstrate the closure properties of CFLs.
2. Draw a deterministic and non-deterministic finite automate which accept 00 and 11 at the end of a string containing 0, 1 in it, e.g., 01010100 but not 000111010.
3. State the difference between recursive and recursively enumerable language.
4. State the difference between PDA and TM.
5. Explain any two properties of recursive language in detail.

Course Outcome 2 (CO2)

1. Prove that the following languages are not regular using the pumping lemma.
   $L = \{0^n 1^m 0^n | m, n \geq 0\}$
2. Prove that the following languages are not regular using the pumping lemma.
   $L = \{wtw | w, t \in \{0,1\}^+\}$
3. Use the Pumping Lemma for context-free languages to show that the language is not context-free. $L = \{a^i b^j c^k | i < j < k\}$

Course Outcome 3 (CO3)

1. Implement a PDA accepting the language L ={ equal number of X‘s and Y‘s }by empty store.
2. Construct a PDA that accepts the language generated by grammar with productions S->aSbb | a.
3. Construct a TM for a language L ={an bn, n≥1}
4. Construct finite automata that accepting {11, 110}*{0}
5. Explain DFA with set of all strings such that that 10th symbol from the right end is ‘1‘.

Course Outcome 4 (CO4)

1. Construct CFG for the given PDA run for the string 000111
2. Construct CFG for the PDA that accepts the Dyck Language

3. Apply appropriate strength reduction techniques to eliminate unreachable non terminals in the produced CFG

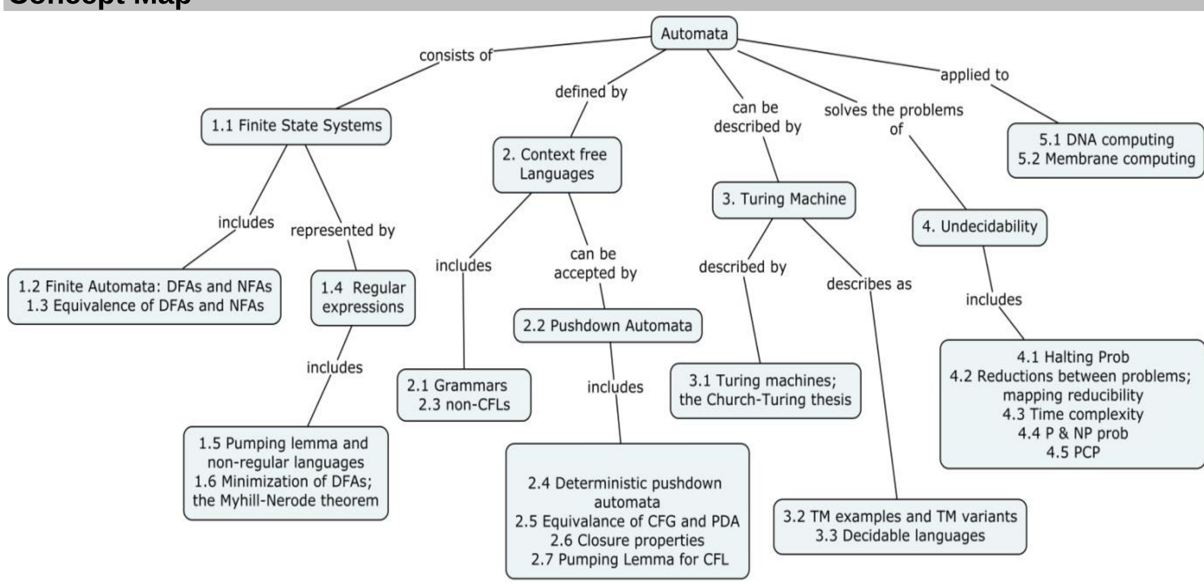
Course Outcome 5 (CO5):

1. Define Class P.
2. Define Class NP.
3. P belongs NP. Why?
4. Describe two classes of decision problem P and NP.
5. Explain that minimum spanning tree is in NP.

Course Outcome 6 (CO6):

1. Define Membrane Computing
2. List the various types of Membrane systems
3. Explain the intuition behind Membrane
4. How does DNA computation solve the seven –point Hamiltonian path problem

Concept Map



Syllabus

Introduction to Finite Automata -Introduction, Methods of Proofs- Finite Automata: DFAs and NFAs- Equivalence of DFAs and NFAs, closure of regular operations- Regular expressions and equivalence with finite automata- Pumping lemma and non-regular languages- Minimization of DFAs; the Myhill-Nerode theorem- Closure property of regular languages/Decision properties of CFLA or regular languages- **Context Free Languages-**Context-free languages: introduction-Pushdown automata; equivalence with CFL- Examples of non-CFLs; Context-sensitive languages; the Chomsky hierarchy- Deterministic pushdown automata- Equivalence to CFG and Deterministic PDA- Non Deterministic PDA- Equivalence between PDA accepting by null and final state- Equivalence between PDA and CFG- Closure properties of CFL- Pumping lemma for CFL – problems - Recursive, Recursively Enumerable language, Grammar Reduction- **Turing Machines-** Turing machines; the Church-Turing thesis-TM examples and TM variants- Decidable languages-**Undecidability-**Diagonalization; The Halting Problem- Greibach NF and DCFLS- Reductions between problems; mapping reducibility- Time complexity; The class P- The classes NP and co-NP; Examples; Polynomial-time reductions- Post Correspondence Problem- Godel's incompleteness theorem - **Case Study: New Models of Computation-** DNA Computing-Membrane Computing- Quantum Computing

Learning Resources

1. Kamala Krithivasan, R Rama, Introduction to Formal Languages, Automata Theory and Computation, Pearson India, 2009
2. Peter Linz, An Introduction to Formal Languages and Automata, Fifth Edition, Jones & Bartlett Learning, 2012.
3. J.E. Hopcroft, R. Motwani and J.D. Ullman, —Introduction to Automata Theory, Languages and Computations, second Edition, Pearson Education, 2007.
4. MichealSipser, —Introduction of the Theory and Computation, Thomson, second Edition 2005.
5. H.R. Lewis and C.H. Papadimitriou, —Elements of the theory of Computation, Second Edition, Pearson Education, 2003.
6. Thomas A. Sudkamp, An Introduction to the Theory of Computer Science, Languages and Machines, Third Edition, Pearson Education, 2007.
7. Raymond Greenlaw an H.James Hoover, —Fundamentals of Theory of Computation, Principles and Practice, Morgan Kaufmann Publishers, 1998.
8. J. Martin, —Introduction to Languages and the Theory of computation, Third Edition, Tata Mc Graw Hill, 2007.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Lectures	Course Outcomes
1	**Introduction to Finite Automata(7)**		
1.1	Introduction, Methods of Proofs	1	CO1
1.2	Finite Automata: DFAs and NFAs	1	CO1
1.3	Equivalence of DFAs and NFAs, closure of regular operations	1	CO1
1.4	Regular expressions and equivalence with finite automata	1	CO1
1.5	Pumping lemma and non-regular languages	1	CO2
1.6	Minimization of DFAs; the Myhill-Nerode theorem	2	CO2
2	**Context Free Languages(10)**		
2.1	Context-free languages: introduction	1	CO2
2.2	Pushdown automata; equivalence with CFL	1	CO2
2.3	Examples of non-CFLs; Context-sensitive languages; the Chomsky hierarchy	3	CO2
2.4	Deterministic Pushdown Automata, Non Deterministic PDA	1	CO3

2.5	Equivalence to CFG and Deterministic PDA- Non Deterministic PDA- Equivalence between PDA accepting by null and final state- Equivalence between PDA and CFG	2	CO3
2.6	Closure properties of CFL	1	CO3
2.7	Pumping lemma for CFL – problems- Recursive, Recursively Enumerable language, Grammar Reduction-	1	CO3
3	**Turing Machines(7)**		
3.1	Turing machines; the Church-Turing thesis	1	CO4
3.2	TM examples and TM variants	3	CO4
3.3	Decidable languages	3	CO4
4	**Undecidability(8)**		
4.1	Diagonalization; The Halting Problem - Greibach NF and I	3	CO5
4.2	Reductions between problems; mapping reducibility	1	CO5
4.3	Time complexity; The class P	1	CO5
4.4	The classes NP and co-NP; Examples; Polynomial-time reductions	2	CO5
4.5	Post Correspondence Problem - Godel's incompleteness theorem	1	CO5
5	**New Models of Computation(4)**		
5.1	DNA Computing	2	CO6
5.2	Membrane Computing, Quantum Computing	2	CO6
	Total	36	

Course Designer

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18CS530	DATA COMMUNICATION AND NETWORKS

Category	L	T	P	Credit
PC	3	0	0	3

Preamble

This course on Computer Network provides an introduction to the basic concepts in networks, OSI and TCP/IP reference models, layers, protocols, switching, routing and various applications that use Computer Networks. The objective of this course is to introduce the concepts in Computer Networks. Emphasis will be given to different layers and functionality of the TCP/IP protocol suite. At the end of the course, the students should have an understanding of the basic principles and practice of Computer Networking.

Prerequisite

Digital Circuits

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Explain the operation of network applications with an understanding of the network models, switching techniques and layered architecture.	20
CO2	Illustrate the concepts for encoding, multiplexing and different modulation techniques.	10
CO3	Solve flow and error control issues in the data link layer, using appropriate techniques.	20
CO4	Identify the performance implications of random access protocols like ALOHA, slotted ALOHA , CSMA/CD and CSMA/CA.	10
CO5	Construct routing and forwarding solutions for packet switching networks, with an understanding of the router architectures, algorithms and protocols.	25
CO6	Identify the performance of transport layer protocols under given scenario.	15

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	Guided Response	1.2
CO2	TPS2	Understand	Respond	Guided Response	1.2
CO3	TPS3	Apply	Value	Mechanism	1.2,2.1.1,3.1.1
CO4	TPS3	Apply	Value	Mechanism	1.2,2.1.1,3.1.1

CO5	TPS3	Apply	Value	Mechanism	1.2,2.1.1,3.1.1,4.4.1
CO6	TPS3	Apply	Value	Mechanism	1.2,2.1.1,3.1.1

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	-										M		
CO2	M	L	-										M		
CO3	S	M	L		L			L	L	L		M	M		L
CO4	S	M	L		L			L	L	L		M	M		L
CO5	S	M	L		L			L	L	L		M	M		L
CO6	S	M	L		L			L	L	L		M	M		L

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Assignment			Terminal Examination
	1	**2**	**3**	1	2	3	
Remember	30	20	20		-	-	20
Understand	50	40	20	30	30	30	20
Apply	20	40	60	70	70	70	60
Analyse							
Evaluate							
Create							

Assessment Pattern: Psychomotor

Psychomotor Skill	~~Miniproject~~/Assignment/~~Practical Component~~
Perception	
Set	
Guided Response	30
Mechanism	70
Complex Overt Responses	
Adaptation	
Origination	

Sample Questions for Course Outcome Assessment**

** (2 to 3 at the cognitive level of course outcome)

Course Outcome 1(CO1):

1. Why is it said that FTP sends control information “out-of-band”?(Understand)
2. Describe the general format of HTTP request message. (Understand)
3. Explain the operation of domain name resolution. (Understand)

Course Outcome 2(CO2):

1. State the different types of Encoding. (Remember)
2. What is the difference between AM and FM. (Understand)

3. Explain the different types of multiplexing. (Understand)

Course Outcome 3 (CO3):

1. Sixteen-bit messages are transmitted using a Hamming code, using even parity. Determine the number of check bits needed to ensure that the receiver can detect and correct single bit errors? Show the bit pattern transmitted for the message1101001100110101. (Apply)
2. A 12-bit Hamming code whose hexadecimal value is 0xE4F arrives at a receiver. Determine the original transmitted value in hexadecimal, assuming not more than 1 bit is in error. (Apply)
3. A bit stream 10011101 is transmitted using the standard CRC method, with the generator 1001. Show the actual bit string transmitted. Suppose the third bit from the left and the second bit from the right of the transmitted message are inverted during transmission. Show that this error is detected (Apply)

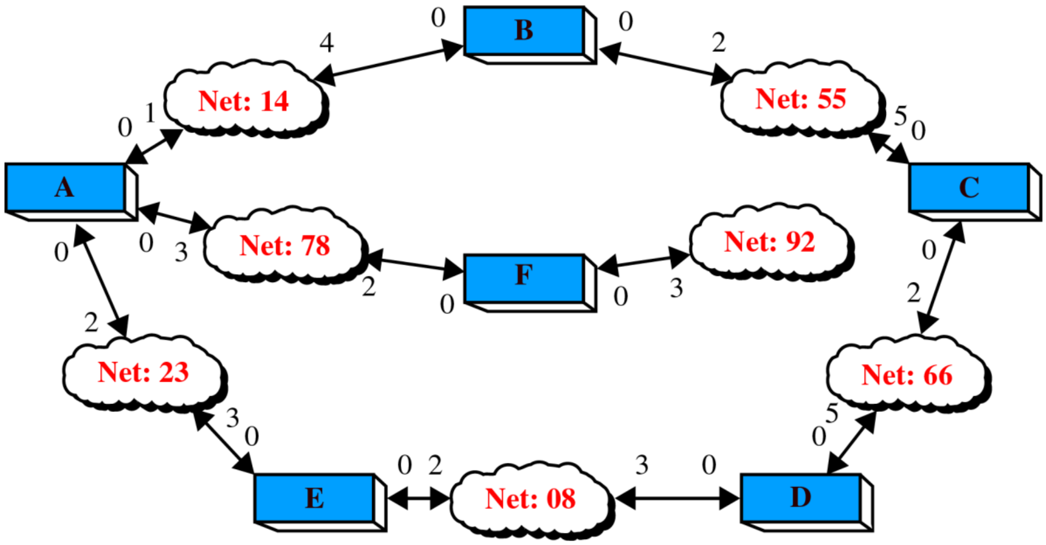
Course Outcome 4(CO4):

1. Suppose nodes A and B are on the same 10 Mbps broadcast channel, and the propagation delay between the two nodes is 245 bit times. Suppose A and B send Ethernet frames at the same time, the frames collide, and then A and B choose different values of *K* in the CSMA/CD algorithm. Assuming no other nodes are active, can the retransmissions from A and B collide? For our purposes, it suffices to work out the following example. Suppose A and B begin transmission at t = 0 bit times. They both detect collisions at t = 245 bit times. Suppose KA = 0 and KB = 1. At what time does B schedule its retransmission? At what time does A begin transmission? At what time does A's signal reach B? Does B refrain from transmitting at its scheduled time? (Apply)

2. Suppose four active nodes—nodes A, B, C and D—are competing for access to a channel using slotted ALOHA. Assume each node has an infinite number of packets to send. Each node attempts to transmit in each slot with probability p. The first slot is numbered slot 1, the second slot is numbered slot 2, and so on.
   a) What is the probability that node A succeeds for the first time in slot 5?
   b) What is the probability that some node (A, B, C or D) succeeds in slot 4?
   c) What is the probability that the first success occurs in slot 3?(Apply)

Course Outcome 5 (CO5):

1. Consider the following datagram network. Show the forwarding table in router A, such that all traffic destined to host H3 is forwarded through interface 3.Also write down a forwarding table in router A, such that all traffic from H1 destined to host H3 is forwarded through interface 3, while all traffic from H2 destined to host H3 is forwarded through interface 4. (Apply)
2. An organization has granted a block of address with the beginning address 25.24.74.0/24.The organization need to have 3 subblocks to be used in 3 subnets: one subblock of 10 addresses, one subblock of 50 addresses and one subblock of 125 addresses. Design the subblocks.

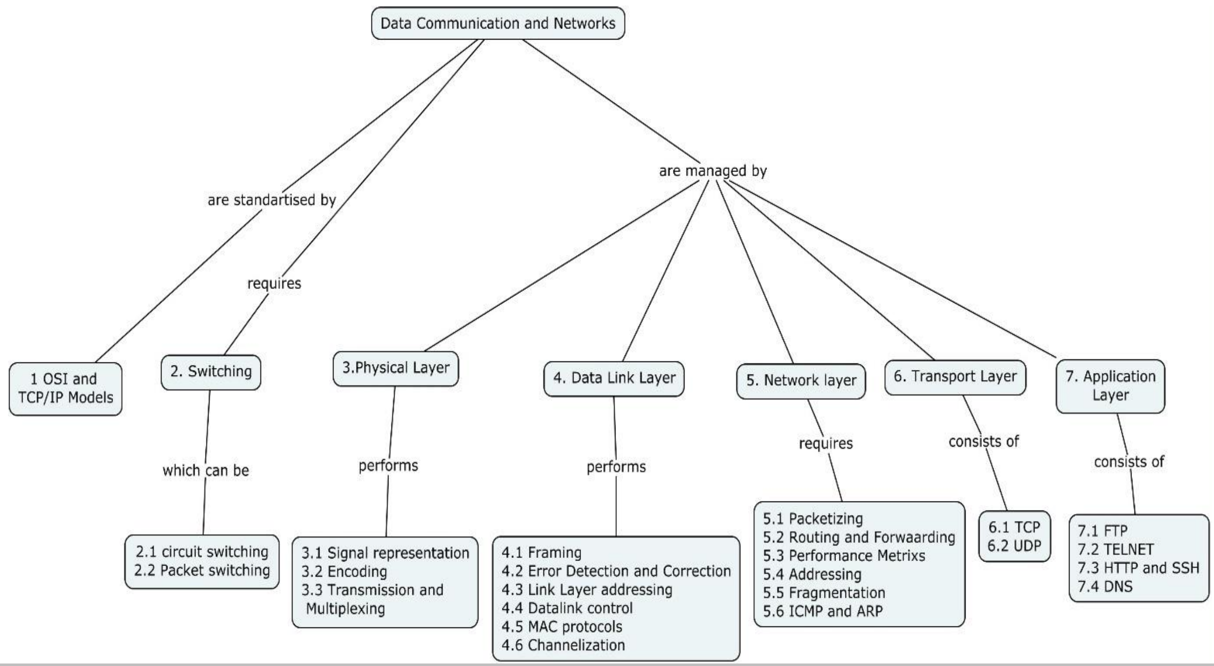


For the subnet shown in the figure calculate the shortest path for all the networks form **Router A** by using Dijkstra algorithm (Show intermediate steps) and build the routing table for **Router A.**

Course Outcome 6 (CO6):

1. Consider transferring an enormous file of *L* bytes from Host A to Host B. Assume an MSS of 536 bytes. What is the maximum value of *L* such that TCP sequence numbers are not exhausted? For the calculated value of L, find how long it takes to transmit the file. Assume that a total of 66 bytes of transport, network, and link header are added to each segment before the resulting packet is sent out over a 155 Mbps link. Ignore flow control and congestion control so A can pump out the segments back to back and continuously. (Apply)
2. Suppose Host A sends two TCP segments to Host B over a TCP connection. The first segment has a sequence number 90; the second has a sequence number 110. How much data is in the first segment? If the first segment is lost but the second segment arrives at B. What will be the acknowledgment number in the acknowledgment that Host B sends to Host A.(Apply)

Concept Map



Syllabus

Network Models - The OSI Model - TCP/IP Protocol Suite - OSI versus TCP/IP – **Switching** - Circuit-Switched Networks - Packet Switching, Structure of a Switch, Switching and TCP/IP Layers -**Physical Layer**– Signal representation, Encoding ,Transmission and Multiplexing-**Data link Layer**: Framing, Error Detection and Correction: Types of Errors - Error Detection, Cyclic Redundancy Check, Checksum, Forward Error Correction, Link-Layer Addressing - Data link Control - Media Access Control (MAC): CSMA/CD, CSMA/CA, Controlled Access – Channelization: FDMA, TDMA, CDMA -**Network Layer** - Connecting Devices: Hubs, Link-Layer Switches, Routers – Packetizing - Routing and Forwarding: Distance-Vector Routing, Link-State Routing - Performance Metrics: Delay, Throughput, Packet Loss, Congestion Control - Addressing: Internet Protocol, IPV6,IPV4 Addresses: Classful Addressing, Classless Addressing - Fragmentation – Internet Control Message Protocol (ICMP) - Address Resolution Protocol (ARP)- RARP -**Transport Layer**: Transmission Control Protocol, User Datagram Protocol-**Application Layer:** FTP - TELNET HTTP- Secure Shell (SSH) - Domain Name System (DNS)

Learning Resources

1. Data Communications and Networking, 5th Edition, BehrouzForouzan, Mc Graw Hill, 2017
2. Computer Networks: A Systems Approach, Larry L. Peterson, Bruce S. Davie, Elsevier, Mar 2011
3. Computer Networking: A Top-Down Approach featuring the Internet, 6th edition, James F. Kurose, Pearson Education India, 2013.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1.	**Network Models** - The OSI Model - TCP/IP Protocol Suite - OSI versus TCP/IP	1	CO1
2	**Switching**		
2.1	Circuit-Switched Networks	1	CO1

2,2	Packet Switching, Structure of a Switch, Switching and TCP/IP Layers	1	CO1
3	**Physical Layer**		
3.1	Signal representation	1	CO2
3.2	Encoding	2	CO2
3.3	Transmission and Multiplexing	2	CO2
4	**Data link Layer**		
4.1	Framing	1	CO3
4.2	Error Detection and Correction - Types of Errors, Error Detection, Cyclic Redundancy Check, Checksum, Forward Error Correction	3	CO3
4.3	Link-Layer Addressing	1	CO4
4.4	Data link Control	1	CO4
4.5	Media Access Control (MAC): CSMA/CD(Ethernet), CSMA/CA, Controlled Access	2	CO4
4.6	Channelization: FDMA, TDMA, CDMA	1	CO4
5	**Network Layer** - Connecting Devices: Hubs, Link-Layer Switches, Routers	2	CO5
5.1	Packetizing	1	CO5
5.2	Routing and Forwarding-Distance-Vector and Link-State Routing	2	CO5
5.3	Performance Metrics : Delay, Throughput, Packet Loss, Congestion Control	1	CO5
5.4	Addressing: Internet Protocol –IPV6, IPV4 Addresses: Classful Addressing, Classless Addressing	2	CO5
5.5	Fragmentation	1	CO5
5.6	Internet Control Message Protocol(ICMP), Address Resolution Protocol (ARP), RARP	1	CO5
6	**Transport Layer**	1	CO6
6.1	Transmission Control Protocol	3	CO6
6.2	User Datagram Protocol	1	CO6
7	**Application Layer**		
7.1	FTP	1	CO1
7.2	TELNET	1	CO1
7.3	HTTP,Secure Shell (SSH)	1	CO1
7.4	Domain Name System (DNS)	1	CO1
	Total	36	

Course Designers:

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18CS560	SOFTWARE ENGINEERING: THEORY AND PRACTICE	Category	L	T	P	Credit
		PC	2	0	2	3

Preamble

The main purpose of this course is to impart knowledge on various models (interaction, context models etc.) and processes that are used by professionals in the field of software engineering. This course focuses on architecture patterns and various software engineering methodologies for designing and developing the software. Consequently, student's take up a group project, working through a number of stages for the development of software.

Prerequisite

Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Explain various software development process and management techniques	10
CO2	Understand various types of software like client server, fault tolerant etc.	20
CO3	Design the model for the given software requirements using Context, Interaction models etc	20
CO4	Analyze the key techniques involved in testing the software based on the requirements.	20
CO5	Develop the system partially through Test Driven Development.	10
CO6	Build a project report as a team which contains the requirement specification, plan, schedule and design documents	20

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	Guided Response	1.2, 4.1.1, 4.1.2
CO2	TPS2	Understand	Respond	Guided Response	1.2, 4.1.1, 4.1.2
CO3	TPS3	Apply	Value	Mechanism	1.2, 2.1.1, 2.1.5, 4.1.1, 4.1.2, 4.4.1, 4.4.3
CO4	TPS3	Apply	Value	Mechanism	1.2, 2.1.1, 4.1.1, 4.1.2
CO5	TPS3	Apply	Value	Mechanism	1.2, 2.1.1, 3.1.1, 4.1.1, 4.1.2
CO6	TPS3	Apply	Value	Mechanism	1.2, 2.1.1, 3.1.1, 4.1.1, 4.1.2

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L									L		L		L
CO2	M	L									L		L		L
CO3	S	M	L	L	S	S	M	M			L	M	M	S	M
CO4	S	M	L	L	S	S	M	M			L	M	M	S	M
CO5	S	M	L	L	S	S	S	S	S	M	M	M	M	S	M
CO6	S	M	L	L	S	S	S	S	S	M	M	M	M	S	M

S- Strong; M-Medium; L-Low

Assessment Pattern

Bloom's Category	Continuous Assessment Tests				Terminal Examination
	1	2	3	3(Practical)	Theory
Remember	20	20	20	-	20
Understand	30	30	30	-	30
Apply	50	50	50	100(Team work)	50
Analyse	-	-	-	-	-
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Assessment Pattern: Psychomotor

Psychomotor Skill	Miniproject/Assignment/Practical Component
Perception	
Set	
Guided Response	30
Mechanism	70
Complex Overt Responses	
Adaptation	
Origination	

Sample Questions for Course Outcome Assessment**

** (2 to 3 at the cognitive level of course outcome)

Course Outcome 1 (CO1):

1. Explain how electronic connectivity between various development teams can support software engineering activities. (Understand)
2. Why it is important to make a distinction between developing the user requirements and developing system requirements in the requirements engineering process. (Understand)

3. Explain how the principles underlying agile methods lead to the accelerated development and deployment of software. (Understand)

Course Outcome 2 (CO2):

1. What are the essential differences between CBSE with reuse and software processes for original software development? (Understand)
2. Your customer wants to develop a system for stock information where dealers can access information about companies and evaluate various investment scenarios using a simulation system. Each dealer uses this simulation in a different way, according to his or her experience and the type of stocks in question. Suggest a client–server architecture for this system that shows where functionality is located. Justify the client–server system model that you have chosen. (Understand)
3. Giving reasons for your answer, suggest two important types of application where you would not recommend the use of service-oriented architecture. (Understand)

Course Outcome 3 (CO3):

1. Suggest how an engineer responsible for drawing up a system requirements specification might keep track of the relationships between functional and non-functional requirements. (Apply)
2. Draw a sequence diagram for the same system. Explain why you might want to develop both activity and sequence diagrams when modeling the behavior of a system. (Apply)
3. Suggest an architecture for a system (such as iTunes) that is used to sell and distribute music on the Internet. What Architectural patterns are the basis for your proposed architecture? (Apply)

Course Outcome 4 (CO4):

1. What are the benefits of involving users in release testing at an early stage in the testing process? Are there disadvantages in user involvement? (Understand)
2. Explain why legacy systems should be thought of as socio technical systems rather than simply software systems that were developed using old technology. (Understand)
3. The reuse of software raises a number of copyright and intellectual property issues. If a customer pays a software contractor to develop a system, who has the right to reuse the developed code? Does the software contractor have the right to use that code as a basis for a generic component? What payment mechanisms might be used to reimburse providers of reusable components? Discuss these issues and other ethical issues associated with the reuse of software. (Apply)

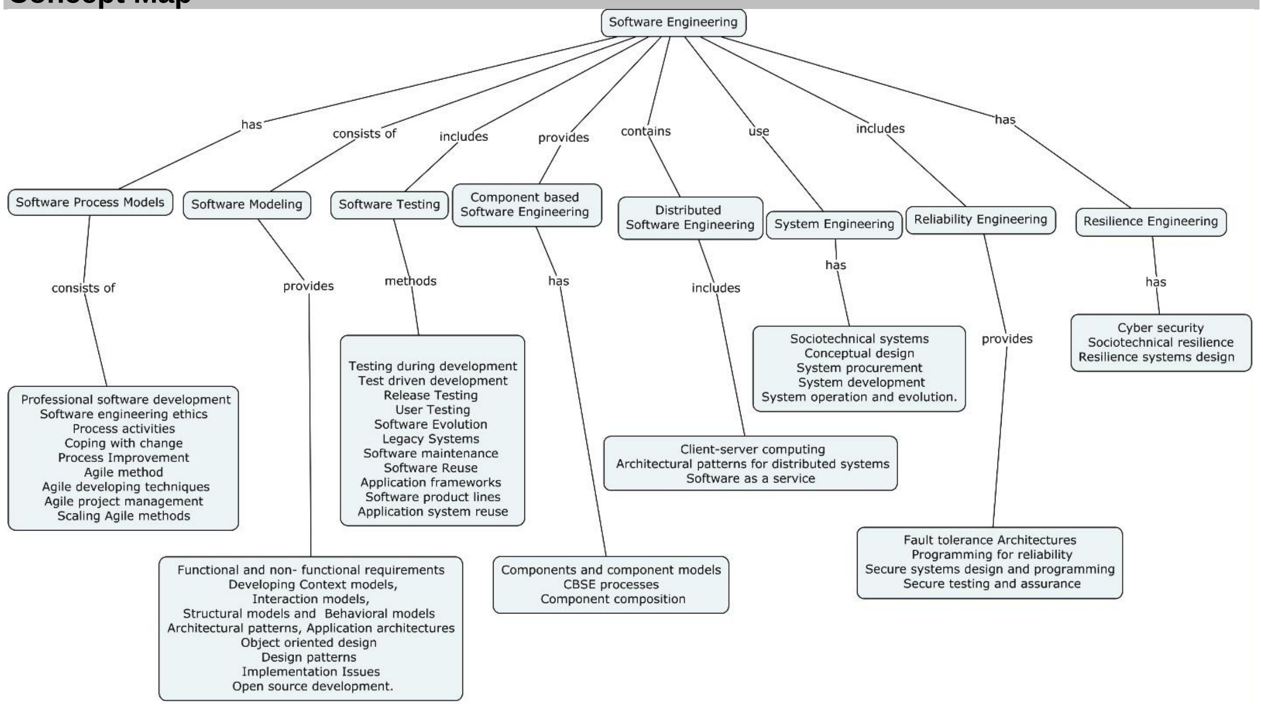
Course Outcome 5 (CO5):

1. Design Graphical user interface for taken case study (Apply)
2. Develop acceptance test cases for selected case study. (Apply)
3. Develop the code for selected case study (Apply)

Course Outcome 6 (CO6):

1. Select software life cycle model suitable for case study and justify your answer. (Apply)
2. Develop user stories and story map for case study. (Apply)
3. Construct a design diagrams for case study. (Apply)

Concept Map



Syllabus

Software process models

Professional software development- Software engineering ethics- Process activities- Coping with change- Process Improvement- Software Life cycle- Iterative, Spiral, Prototyping-Agile method- Agile developing techniques- Agile project management- Scaling Agile methods.

System Modelling

Functional and non- functional requirements- Software Requirement Specification - Developing Context models, Interaction models, Structural models and Behavioural models- Architectural patterns, Application architectures- -Object oriented design- Design patterns- Implementation Issues- Open source development.

Software Testing

Testing during development- Test Driven Development- Release Testing- User Testing- Software Evolution- Legacy Systems- Software maintenance- Software Reuse- Risk Management

Component based Software Engineering

Components and component models- CBSE processes- Component composition

Distributed Software Engineering

Distributed systems- Client-server computing- Architectural patterns for distributed systems- Software as a service

System Engineering

Socio technical systems- Conceptual design- System procurement- System development- System operation and evolution.

Reliability Engineering

Fault tolerance Architectures- Programming for reliability- Secure systems design and programming- Secure testing and assurance-.

Resilience Engineering

Cyber security- Socio technical resilience- Resilience systems design.

Lab Content:

Develop a mini project for a real world problem in which a software solution can be obtained (a team of 3 members) and do the following.

- Collect requirements for the chosen problem
- Model the system through interaction, structural diagrams and develop software architecture.
- Develop the system partially through Test Driven Development with unit test.

Sample case-studies:

- An embedded control system for a personal insulin pump

This case study discusses the control software for a personal insulin pump, which is used by diabetics to mimic the function of the pancreas and hence control the level of glucose (sugar) in their blood.

- The iLearn digital learning environment

The iLearn system is a digital learning environment used to support learning in schools with students from age 4 to 18. It is intended to replace an existing system (Glow) that was specially built for the purpose and which includes its own applications for e-mail, etc.

- The Mentcare system

This case study focuses on the requirements for a system that I have called the Mentcare system, which is a real system (although that is not its real name) which was used in a number of UK hospitals, including hospitals in Scotland.

- Wilderness weather station

This case study is based on the software for a wilderness weather station that collects weather information in remote areas that do not have local infrastructure (power, communications, roads, etc.).

Reference Books

1. Ian Sommerville , "Software Engineering" , 10th Edition,John Wiley and sons,2015.
2. Orit Hazzan, Yael Dubinsky, "Agile software engineering", Springer,2014
3. The Unified Modeling Language Reference Manual, James Rumbaugh, Ivar Jacobson, Grady Booch, 2nd Edition, Addison Wesley,2005.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Lectures	Course Outcome
1	**Software process models**		
1.1	Professional software development- Software engineering ethics- Process activities- Coping with change- Process Improvement	1	CO1
1.2	Software Life cycle models- Iterative, Spiral and Prototyping models	1	CO1
1.3	Agile method- Agile developing techniques- Agile project management- Scaling Agile methods	1	CO1
2	**System Modelling**		
2.1	Functional and non- functional requirements- SRS	1	CO3
2.2	Developing Context models, Interaction models	1	CO3
2.3	Architectural patterns, Application architectures	1	CO3
2.4	Structural models and Behavioural models	1	CO3
2.5	Object oriented design	1	CO3
2.6	Design patterns- Implementation Issues- Open source development	1	CO3
3	**Software Testing**		
3.1	Testing during development- Test driven development- Release Testing- User Testing	1	CO4
3.2	Software Evolution- Legacy Systems- Software maintenance, Software Reuse- Software product lines- Application system reuse	1	CO4
3.3	Risk Management	1	CO1
4	**Component based Software Engineering**		
4.1	Components and component models	1	CO2
4.2	CBSE processes- Component composition	1	CO2
5	**Distributed Software Engineering**		
5.1	Distributed systems- Client-server computing-	1	CO2

Module No.	Topic	No. of Lectures	Course Outcome
1	**Software process models**		
5.2	Architectural patterns for distributed systems- Software as a service	1	CO2
6	**System Engineering**		
6.1	Socio technical systems- Conceptual design	1	CO2
6.2	System procurement- System development	1	CO2
6.3	System operation and evolution.	1	CO2
7	**Reliability Engineering**		
7.1	Fault tolerance Architectures- Programming for reliability	1	CO2
7.2	Secure systems design and programming	1	CO2
7.3	Secure testing and assurance	1	CO2
8	**Resilience Engineering**		
8.1	Cyber security- Socio technical resilience	1	CO2
8.2	Resilience systems design	1	CO2

Module No.	Topic	No. of Lectures		
1	Develop a mini project for a real world problem in which a software solution can be obtained (a team of 3 members) and do the following, Collect requirements for the chosen problem	4	CO6	
2	Develop context level models and software architecture.	4	CO6	
3	Model the system through structural diagrams	6	CO6	
4	Model the system through interaction diagrams	6	CO6	
5	Develop the system partially through Test Driven Development with unit test.	4	CO5	

Course Designers:

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18CS570	DATABASES LAB

Category	L	T	P	Credit
PC	0	0	2	1

Preamble

This course aims at facilitating the student to apply the effective designing of relational database for Real-world applications, perform many operations related to creating, manipulating and maintaining databases using DBMS tools and manipulate data using the higher level language - JDBC.

Prerequisite

Database Management Systems

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Analyze and construct the Entity Relationship and Relational models for the given real-world application	10
CO2	Develop normalized database for given application using various constraints.	10
CO3	Build relational database and manipulate the same using simple and complex queries in SQL	20
CO4	Construct and make use of the database objects like Index, View, Sequence, Varray and Nested table using SQL	10
CO5	Develop database objects like Procedure, Functions, Triggers and Package using Pl/SQL and manipulate the database through these objects.	25
CO6	Develop a complete database application using higher level language through JDBC	25

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value	Mechanism	1.2, 2.1.1, 2.1.2, 2.1.5, 2.2.3, 2.4.3, 3.1, 4.4.3, 4.4.4, 4.5
CO2	TPS3	Apply	Value	Mechanism	1.2, 2.1.1, 2.1.2, 2.1.5, 2.2.3, 2.4.3, 3.1, 4.4.3, 4.4.4, 4.5
CO3	TPS3	Apply	Value	Mechanism	1.2, 2.1.1, 2.1.2, 2.1.5, 2.2.3, 2.4.3, 3.1, 4.4.3, 4.4.4, 4.5
CO4	TPS3	Apply	Value	Mechanism	1.2, 2.1.1, 2.1.2, 2.1.5, 2.2.3, 2.4.3, 3.1, 4.4.3, 4.4.4, 4.5

CO5	TPS3	Apply	Value	Mechanism	1.2, 2.1.1, 2.1.2, 2.1.5, 2.2.3, 2.4.3, 3.1, 4.4.3, 4.4.4, 4.5
CO6	TPS3	Apply	Value	Mechanism	1.2, 2.1.1, 2.1.2, 2.1.5, 2.2.3, 2.4.3, 3.1, 4.4.3, 4.4.4, 4.5

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L		M	L		L	M	M		L	M	L	M
CO2	S	M	L		M	L		L	M	M		L	M	L	M
CO3	S	M	L		S	L		L	M	M		L	M	M	M
CO4	S	M	L		M			L	M	M			M	M	M
CO5	S	M	L		S	L		L	M	M			M	M	M
CO6	S	M	L		S	L		L	M	M		L	M	M	M

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Model Examination	Terminal Examination
Remember	-	-
Understand	-	-
Apply	100	100
Analyse	-	-
Evaluate	-	-
Create	-	-

Assessment Pattern: Psychomotor

Psychomotor Skill	Miniproject /Practical Component/Observation
Perception	-
Set	-
Guided Response	25
Mechanism	75
Complex Overt Responses	-
Adaptation	-
Origination	-

List of Experiments/Activities with CO Mapping

Module No.	Topic	No. of Sessions	Course Outcome
1.	Analyze and model a database application	2	CO1
2.	Creation and Modification of tables with and without normalization	2	CO1, CO2
3.	Complete database creation using Integrity Constraints and giving privilege on the database to other users	2	CO2
4.	Manipulating the database using simple SQL Queries and transaction control using COMMIT, ROLLBACK and SAVEPOINT commands	2	CO3
5.	Manipulating the database using Complex SQL Queries	2	CO3
6.	Creation and usage of database objects, complex data types such as BLOB, CLOB, NCLOB, BFILE	2	CO4
7.	Creation of Functions, Procedures with cursors and exception handling using PL/SQL	2	CO5
8.	Creation of Simple and Compound Triggers using PL/SQL	2	CO5
9.	Creation of Package using Pl/SQL	2	CO5
10.	Database application using JDBC	2	CO6
11.	Demonstration of a complete database application using PL/SQL or JDBC as front end – Report submission	4	CO1..CO6
	Total	**24**	

Learning Resources

1. https://courses.tce.edu/
2. https://apex.oracle.com/en/

Course Designers:

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18CS580	**NETWORK PROGRAMMING LAB**

Category	L	T	P	Credit
PC	0	0	2	1

Preamble

Universal connectivity is realized through Computer Networks. It is important to gain knowledge on the hardware requirements and functioning of Computer Networks. This course provides insight into the working of network protocols and their characteristics.

Prerequisite

Object oriented programming

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Perform Configuration of networking components and installing device drivers and build a Local Area Network.	10
CO2	Perform port scanning and identify IP and MAC Address.	20
CO3	Implement client server communication using socket programming and Applet.	25
CO4	Perform DNS server host name identification and resolve given host name	10
CO5	Implement File transfer and RMI.	25
C06	Simulate a network topology using NS3.	10

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value	Mechanism	1.2,3.2.3,4.5.1
CO2	TPS3	Apply	Value	Mechanism	1.2,3.2.3,4.5.1,4.5.3
CO3	TPS3	Apply	Value	Mechanism	1.2,3.2.3,4.5.1,4.5.3
CO4	TPS3	Apply	Value	Mechanism	1.2,3.2.3,4.5.1,4.5.3
CO5	TPS3	Apply	Value	Mechanism	1.2,3.2.3,4.5.1,4.5.3
C06	TPS3	Apply	Value	Mechanism	1.2,2.1.2,3.2.3,4.5.1,4.5.3

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L			L	L	M	L	L		L	M	L	L
CO2	S	M	L		L	L	L	M	L	L		L	M	L	L
CO3	S	M	L		L	L	L	M	L	L		L	M	L	L

CO4	S	M	L		L	L	L	M	L	L		L	M	L	L
CO5	S	M	L		L	L	L	M	L	L		L	M	L	L
CO6	S	M	L		L	L	L	M	L	L		L	M	L	L

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Model Examination	Terminal Examination
Remember		
Understand	20	20
Apply	80	80
Analyse		
Evaluate		
Create		

Assessment Pattern: Psychomotor

Psychomotor Skill	~~Miniproject /~~Practical Component/~~Observation~~
Perception	
Set	
Guided Response	20
Mechanism	80
Complex Overt Responses	
Adaptation	
Origination	

List of Experiments/Activities with CO Mapping

Module No.	Topic	No. of Sessions	Course Outcome
1	Establishment of a LAN: Preparation of network cables and installation and configuration of network.	2	CO1
2	Write a program to identify your machine's host name and IP address.	2	CO2
3	Write a program to locate the next hop router's IP address and MAC address.	2	CO2
4	Write a program to find which port is currently used, by scanning the port.	2	C02
5	Write a program to obtain local DNS server's host name and IP address and resolve a given host name.	2	CO3
6	Write a program to illustrate a simple client/server communication and Time server	2	CO4
7	Write a program to implement ECHO and PING commands and time server.	2	CO4
8	Develop a client server application for chat using Applets	2	C04
9	Write a program to implement a file transfer using TCP.	2	CO5

Module No.	Topic	No. of Sessions	Course Outcome
10	Write a program to implement a file transfer using UDP.	2	CO5
11	Write a program to implement Remote Method Invocation.	2	CO5
12	Simulate a network topology using NS3.	2	C06
Total		24	

Course Designers:

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18ES590	SYSTEM THINKING

Category	L	T	P	Credit
ES	1	-	2	2

Preamble

Systems thinking is the integrated paradigm for systems science and system approaches to practice. It is concerned with understanding or intervening in problem situations, based on the principles and concepts of the system model. It can help to provide a common language and an intellectual foundation and make practical system concepts, principles, patterns and tools accessible to systems engineering. System thinking considers the similarities between systems from different domains in terms of a set of common systems concepts, principles, and patterns. The scope of systems thinking is a starting point for dealing with real-world situations using a set of related systems concept. The system thinking is viewed as both a set of founding ideas for the development of systems theories and practices and also as a pervasive way of thinking need by those developing and applying them. This systems approach is a way of tackling real-world problems and making use of the concepts, principle, patterns of systems thinking to enable the systems to be engineered and used.

Prerequisite

Nil

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage in %
CO1	Explain the concepts of systems thinking, System engineering and Systems Life Cycle	10
CO2	Identify system elements, interactions, boundary and environment for the given system descriptions	20
CO3	Develop a functional architecture with appropriate primary function(s) and sub-functions of the identified system	10
CO4	Develop a physical architecture with appropriate sub-systems and components of the identified system	10
CO5	Prepare a system requirement specification review documents for the various stages of acquisition phase of the identified system	20
CO6	Develop a system model with logical and physical architecture using system modelling tool like SysML	30

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	-	1.1, 2.3.1, 2.3.2
CO2	TPS3	Apply	Value	-	1.1, 2.1.1, 2.3.1,2.3.2, 2.3.3, 2.3.4, 2.4.4, 4.3.1,
CO3	TPS3	Apply	Value	Mechanism	1.1, 2.1.1, 2.3.1,2.3.2, 2.3.3, 2.3.4, 2.4.4, 3.1.2, 3.2.3, 3.2.4, 3.2.5, 3.2.6, 4.3.1, 4.3.2, 4.3.3, 4.4.5, 4.5.1
CO4	TPS3	Apply	Value	Mechanism	1.1, 2.1.1, 2.3.1,2.3.2, 2.3.3, 2.3.4, 2.4.4, 3.1.2, 3.2.3, 3.2.4,

					3.2.5, 3.2.6, 4.3.1, 4.3.2, 4.3.3, 4.4.5, 4.5.1
CO5	TPS3	Apply	Value	Mechanism	1.1, 2.1.1, 2.3.1,2.3.2, 2.3.3, 2.3.4, 2.4.4, 3.1.2, 3.2.3, 3.2.4, 3.2.5, 3.2.6, 4.3.1, 4.3.2, 4.3.3, 4.4.5, 4.5.1
CO6	TPS3	Apply	Value	Mechanism	1.1, 2.1.1, 2.3.1,2.3.2, 2.3.3, 2.3.4, 2.4.4, 3.1.2, 3.2.3, 3.2.4, 3.2.5, 3.2.6, 4.3.1, 4.3.2, 4.3.3, 4.4.5, 4.5.1

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	-	-	-	-	-	-	-	-	-	-			
CO2	S	M	L	-	-	L	L	L	L	L	-	M			
CO3	S	M	L	-	-	M	M	M	L	M	M	S			
CO4	S	M	L	-	-	M	M	M	L	M	M	S			
CO5	S	M	L	-	-	M	M	M	L	M	M	S			
CO6	S	M	L	-	S	M	M	M	L	M	M	S			

S- Strong; M-Medium; L-Low

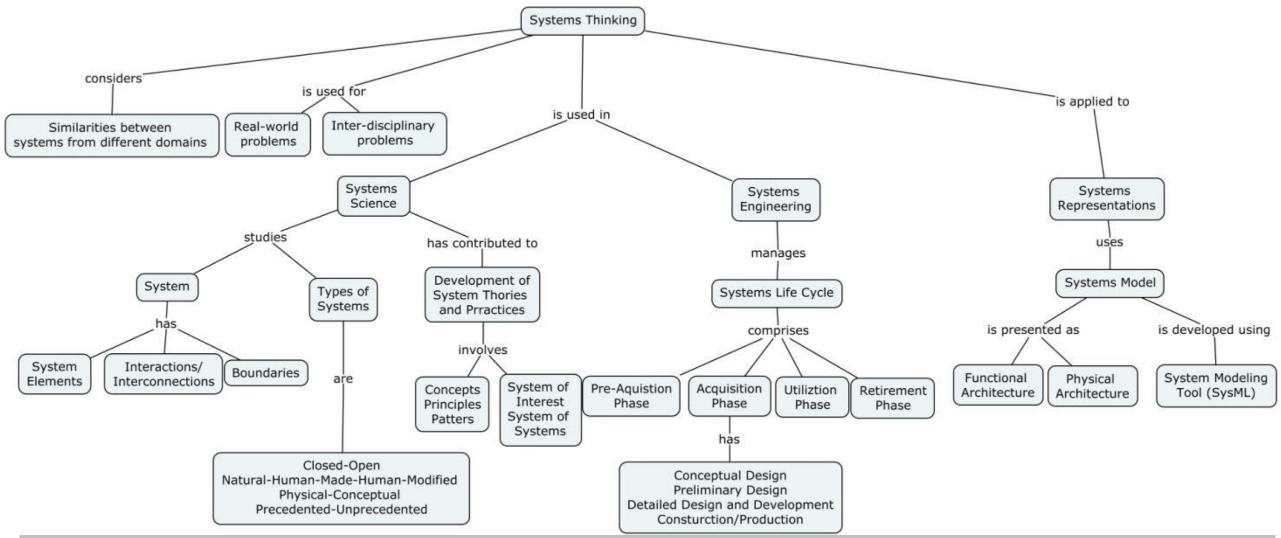
Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Test -2
Remember	20
Understand	40
Apply	40
Analyse	-
Evaluate	-
Create	-

Phases	Deliverables	Marks	Course Outcomes
Continuous Assessment			
Continuous Assessment Test-2	Summative Assessment Report	10	CO1 and CO2
Review 1 – Functional & Physical Architecture and System Requirement Specification	Technical Report	25	CO3, CO4 and CO5
Review 2 – Systems Modeling	Technical Report	15	CO6
End-Semester Examination			
Demonstration	Virtual Prototype with simulation	60	CO1, CO2, CO3, CO4 CO5 and CO6
Poster Presentation	Poster	40	

- Reports are to be submitted at each review. The report and presentation will be evaluated based on Rubrics
- Demonstration of Virtual Prototype with simulation and Poster presentation will be evaluated by two faculty members nominated by their respective Head of the Department.

Concept Map



Syllabus

1.0 Systems Fundamentals: System - Definition, System Elements, Interactions, System Boundary, - Types of Systems: Closed-Open, Natural-Human-Made-Human-Modified, Physical-Conceptual and Precedented-Unprecedented. Systems science - Systems approaches. Systems Thinking: Concepts, principles and pattens. System of Interest - Systems of System. Systems Engineering: Product, Service, Enterprise. System Life Cycle: Pre-acquisition phase, Acquisition Phase, Utilization Phase and Retirement Phase.

2.0 Acquisition Phase: Conceptual Design: Business needs and requirements, Stakeholder needs and requirements, System Requirement Specification, Functional Base Line, System Requirement Review – Functional Architecture. Preliminary Design: Configuration items, Allocated Baseline, Preliminary Design Review – Physical Architecture. Detailed Design and Development: System Modeling, Product Base Line, Critical Design Review. Construction/Production: Formal Qualification Review, Acceptance Test and Evaluation.

3.0 Systems Modeling: System Model - Types of models – System Modeling Concepts – Modeling Standards. System Architecture: Logical Architecture Model – Physical Architecture Model. Systems Life Cycle Process Model: Vee model.

Learning Resources

1. A Guide to Guide to the Systems Engineering Body of Knowledge (SEBoK), version 2.2, INCOSE Systems Engineering Research Center and IEEE Computer Society, Released 31 October 2019 – https://www.sebokwiki.org/w/images/sebokwiki-farm!w/8/8b/SEBoK_v2.1.pdf
2. Systems Engineering Handbook, A Guide for Systems Life Cycle Processes and Activities, 4th Edition, INCOSE-TP-2003-002-04, 2015.
3. R. Ian Faulconbridge, Michael Ryan, “Systems Engineering Practice”, Argos Argos Press, 2014.
4. Jon Holt and Simon Perry, “SysML for systems engineering”, The Institution of Engineering and Technology, London, United Kingdom, 2008.

5. Sanford Friedenthal, Alan Moore and Rick Steiner, "A Practical Guide To SysML: The Systems Modeling Language, Third edition, Morgan Kaufmann, an imprint of Elsevier, 2015
6. Coursera course on Introduction to Systems Engineering - R. Ian Faulconbridge, Michael Ryan of The University of New South Wales, Sydney.
7. NPTEL Course: Systems Engineering Theory and Practice – IIT Kanpur – Prof. Deepu Philip (Last offered in 2019) - https://nptel.ac.in/courses/110/104/110104074/

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours		Course Outcome
		In-Class	Hands-on	
1.	**1.0 Systems Fundamentals:** System - Definition, System Elements, Interactions, System Boundary	1	-	CO1
1.1	Types of Systems: Closed-Open, Natural-Human-Made-Human-Modified, Physical-Conceptual and Precedented-Unprecedented.	1	2	CO1
1.2	Systems science - Systems approaches.	1	-	CO1
1.3	Systems Thinking: Concepts, principles and pattens.	1	-	CO1
1.4	System of Interest - Systems of System. Systems Engineering: Product, Service, Enterprise System Life Cycle: Pre-acquisition phase, Acquisition Phase, Utilization Phase and Retirement Phase.	2	2	CO2
2.	**Acquisition Phase**			
2.1	Conceptual Design: Business needs and requirements, Stakeholder needs and requirements, System Requirement Specification, Functional Base Line, System Requirement Review – Functional Architecture.	1	4	CO3
2.2	Preliminary Design: Configuration items, Allocated Baseline, Preliminary Design Review – Physical Architecture.	1	4	CO3
2.3	Detailed Design and Development: System Modeling, Product Base Line, Critical Design Review.	1	4	CO4
2.4	Construction/Production: Formal Qualification Review, Acceptance Test and Evaluation.	1	2	CO5
3.	**Systems Modelling**			
3.1	System Model - Types of models – System Modeling Concepts – Modeling Standards.	1	2	CO6
3.2	System Architecture: Logical Architecture Model – Physical Architecture Model.	1	6	CO6
3.3	Systems Life Cycle Process Model: Vee model.	1	2	CO6
	Total	14	28	

Course Designers:

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3. Dr.C.Jeyamala jeyamala@tce.edu

18CHAC0	**ESSENCE OF INDIAN KNOWLEDGE**

Category	L	T	P	Credit
AC	2	0	0	0

Preamble

On the successful completion of the course, the students will be able to explain the concept of Indian Traditional Knowledge along with Indian Modern Knowledge. Traditional Knowledge Systems or Indigenous Knowledge Systems are a body of knowledge, which is very ancient and deep rooted. They have their origins in the remote past. Their systematisation and canonisation gave rise to the elite (the Greater Tradition) science. The nature of Traditional Knowledge System is diverse. It covers, among other things, literary, artistic and scientific works; songs, dances, medical treatments and practices; manufacturing and industry; and agricultural technologies and techniques. There is a dramatically growing national and international interest in incorporating Traditional Knowledge Systems, including Traditional Ecological Knowledge, into truly participatory approaches to development.

Course Outcome:

On the successful completion of the course students will be able to

CO1	Explain the concept of Traditional Knowledge and Modern knowledge of India.	Understand
CO2	Explain the need and importance of protecting Traditional Knowledge, Knowledge sharing, and Intellectual property rights over Traditional Knowledge.	Understand
CO3	Explain about the use of Traditional Knowledge to meet the basic needs of human being.	Understand
CO4	Explain the rich biodiversity materials and knowledge preserved for practicing traditional lifestyle.	Understand
CO5	Explain the use of Traditional Knowledge in Manufacturing and Industry.	Understand
CO6	Explain about the cultural expression and modern applications of Traditional Knowledge	Understand

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	-	-	-	S	M	M	M	M	-	L	M	-	M
CO2	M	L	-	-	-	S	M	M	M	M	-	L	M	-	M
CO3	M	L	-	-	-	S	M	M	M	M	-	L	M	-	M
CO4	M	L	-	-	-	S	M	M	M	M	-	L	M	-	M
CO5	M	L	-	-	-	S	M	M	M	M	-	L	M	-	M
CO6	M	L	-	-	-	S	M	M	M	M	-	L	M	-	M

S- Strong; M-Medium; L-Low

Syllabus

Traditional and Modern Knowledge: Two Worlds of Knowledge - Phase of Explorers, Sir Arthur Cotton and Irrigation, Smallpox Vaccination, Late Nineteenth Century, Voelcker, Howard and Agriculture, Havell and Indian Art; Indians at the Encounter - Gaekwad of Baroda and Technical Education, Science Education and Modern Industries, Hakim Ajmal Khan and Ayurveda, R. N. Chopra and Indigenous Drugs, Gauhar Jaan and Indian Classical Music; Linking Science and the Rural - Tagore's Sriniketan Experiment, Marthandam, the YMCA Model, Gandhi's Thoughts on

Development, Nehru's View of Growth; Post-Independence Era - Modernization and Traditional Knowledge, Social Roots of Traditional Knowledge Activism, Global Recognition for Traditional Knowledge. **Global Mechanisms of Protection and Sharing:** For Recognition and Protection - United Nations Educational, Scientific and Cultural Organization (UNESCO), World Health Organization (WHO), International Labour Organization (ILO), UN Working Group on Indigenous Populations, Evolution of Other Organizations; Norms of Sharing - United Nations Environment Programme (UNEP), World Intellectual Property Organization (WIPO), World Trade Organization (WTO); IPR and Traditional Knowledge - Theoretical Background, Positive Protections of TK, Defensive Strategies, IPR Facilitation for TK. **Traditional Knowledge for Basic Needs:** Indian Midwifery Tradition—The Dai System, Surface Flow Irrigation Tanks, Housing - A Human Right, Changing Priorities—Niyamgiri. **Biodiversity and Genetic Resources:** Jeevani - The Wonder Herb of Kanis, A Holistic Approach - FRLHT, Basmati - In the New Millennium, AYUSH-Based Cosmetics. **Traditional Knowledge in Manufacturing and Industry:** Drug Discovery, A Sweetener of Bengal, The Sacred Ring of Payyanur, Channapatna Toys. **Traditional Cultural Expressions:** Banarasi Saree, Music, Built and Tangible Heritage, Modern Yoga, Sanskrit and Artificial Intelligence, Climate Change and Traditional Knowledge.

Assessment Pattern

Bloom's category	Continuous Assessment Tests		Seminar
	1	2	-
Remember	40	40	0
Understand	60	60	100
Apply	0	0	0
Analyze	0	0	0
Evaluate	0	0	0
Create	0	0	0

Learning Resources:

1. Nirmal Sengupta "Traditional Knowledge in Modern India Preservation, Promotion, Ethical Access and Benefit Sharing Mechanisms" Springer, 2019.
2. Amit Jha,"Traditional Knowledge System in India", Atlantic Publishers and Distributors Pvt Ltd, 2009.
3. Basanta Kumar Mohanta, Vipin Kumar Singh "Traditional Knowledge System and Technology in India", Pratibha Prakashan, 2012.
4. Kapil Kapoor, Michel Danino "Knowledge Traditions and Practices of India", Central Board of Secondary Education, 2012.
5. NPTEL video lecture on "Ayurvedic Inheritance of India", Video link: https://nptel.ac.in/courses/121/106/121106003/#.
6. Youtube video on "Introduction to Indian Knowledge Systems", Video link: https://www.youtube.com/watch?v=LZP1StpYEPM.
7. Youtube video on "12 Great achievements of Indian Civilization", Video link: https://www.youtube.com/watch?v=xmogKGCmclE.

Course Designers:

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CURRICULUM AND DETAILED SYLLABI

FOR

B.E DEGREE (Computer Science and Engineering) PROGRAMME

SIXTH SEMESTER

FOR THE STUDENTS ADMITTED FROM THE

ACADEMIC YEAR 2018 - 2019 ONWARDS

THIAGARAJAR COLLEGE OF ENGINEERING

(A Government Aided ISO 9001-2008 certified
Autonomous Institution affiliated to Anna University)

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THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015
B.E Degree (Computer Science and Engineering) Programme

COURSES OF STUDY
(For the candidates admitted from 2018-19 onwards)

SIXTH SEMESTER

Course Code	Name of the Course	Category	No. of Hours / Week			Credits
			L	T	P	
THEORY						
18CS610	Compilers	PC	3	-	-	3
18CS620	Web Programming	PC	3	-	-	3
18CS630	Artificial Intelligence	PC	3	-	-	3
18CSPX0	Program Elective - II	PE	3	-	-	3
18CSXX0	Elective	OE	3	-	-	3
18CSEA0	Data Science using Python	ES	2	-	2	3
PRACTICAL						
18CS670	Web Programming Lab	PC	-	-	2	1
18CS680	Artificial Intelligence Lab	PC	-	-	2	1
18ES690	Engineering Design Project	Project	1	0	4	3
Total			**18**	**-**	**10**	**23**

BS : Basic Science
HSS : Humanities and Social Science
ES : Engineering Science
PC : Program Core
PE : Program Elective
OE : Open Elective

L : Lecture
T : Tutorial
P : Practical

Note:

1 Hour Lecture is equivalent to 1 credit
1 Hour Tutorial is equivalent to 1 credit
2 Hours Practical is equivalent to 1 credit

THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015
B.E Degree (Computer Science and Engineering) Programme

SCHEME OF EXAMINATIONS
(For the candidates admitted from 2018-19 onwards)

SIXTH SEMESTER

S.No.	Course Code	Name of the Course	Duration of Terminal Exam. in Hrs.	Marks			Minimum Marks for Pass	
				Continuous Assessment	Terminal Exam *	Max. Marks	Terminal Exam	Total
THEORY								
1	18CS610	Compilers	3	50	50	100	25	50
2	18CS620	Web Programming	3	50	50	100	25	50
3	18CS630	Artificial Intelligence	3	50	50	100	25	50
4	18CSPX0	Program Elective - II	3	50	50	100	25	50
5	18CSXX0	Elective	3	50	50	100	25	50
6	18CSEA0	Data Science using Python	3	50	50	100	25	50
PRACTICAL								
7	18CS670	Web Programming Lab	3	50	50	100	25	50
8	18CS680	Artificial Intelligence Lab	3	50	50	100	25	50
9	18ES690	Engineering Design Project	3	50	50	100	25	50

* Terminal Examination will be conducted for maximum marks of 100 and subsequently be reduced to 50 marks for the award of terminal examination marks

18CS610	COMPILERS

Category	L	T	P	Credit
PC	3	-	-	3

Preamble

This course provides the basic principles and techniques used for developing compilers. The objective of the course is to make students to study programming language translation and compiler design concepts; language recognition, symbol table management, syntax analysis, run time environment and code generation. This will also include the examination of intermediate code states, machine code optimization techniques and support for advanced language features.

Prerequisite

- Theory of Computation

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Explain basics of compiler design and analyze compiler phases in advanced language features	5
CO2	Illustrate a Lexical Analyzer for recognizing the tokens of a given language	10
CO3	Practice parsers like top-down, bottom-up, operator precedence ,SLR, CLR, LALR	30
CO4	Construct interference graphs and perform complete register allocation on them reflecting the design of activation records	10
CO5	Develop intermediate code generators to translate the source program into an intermediate code.	20
CO6	Construct code optimization techniques to optimize the target code generated.	25

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	Guided Response	1.2,4.3.2
CO2	TPS3	Apply	Value	Mechanism	1.2,2.1.2,3.2.3,4.5.3
CO3	TPS3	Apply	Value	Mechanism	1.2, 2.1.2,3.2.3, 4.3.2
CO4	TPS3	Apply	Value	Mechanism	1.2, 2.1.3.2.3, 4.5.3
CO5	TPS3	Apply	Value	Mechanism	1.2, 2.1.2,3.2.3,4.5.3
CO6	TPS3	Apply	Value	Mechanism	1.2, 2.1.2,3.2.3,4.5.3

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L			L	L		L				M	M	L	L

CO2	S	M	L		M	L		M	L	L		M	M	M	L
CO3	S	M	L		M	L		M	L	L		M	M	M	L
CO4	S	M	L		L			M	L	L		M	M	M	L
CO5	S	M	L		L			M	L	L		M	M	M	L
CO6	S	M	L		M	L		M	L	L		M	M	M	L

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Assignment			Terminal Examination
	1	2	3	1	2	3	
Remember	20	20	20	-	-	-	20
Understand	30	20	20	-	-	-	20
Apply	50	60	60	100	100	100	60
Analyse							
Evaluate							
Create							

Assessment Pattern: Psychomotor

Psychomotor Skill	Miniproject /Assignment/Practical Component
Perception	-
Set	-
Guided Response	25
Mechanism	75
Complex Overt Responses	-
Adaptation	-
Origination	-

Sample Questions for Course Outcome Assessment

Course Outcome 1 (CO1):
1. Define Compiler and Interpreter
2. Explain the phases of compiler with an example
3. Describe in detail about the compiler generated code

Course Outcome 2 (CO2):
1. Draw the NFA for recognizing the language (a/b) * abb.
2. Write the regular expression for the language "All strings of digits with even numbers.
3. Define the term Finite Automata. Distinguish between NFA and DFA.
4. Draw the NFA diagram for the regular expression $011(011)^*$
5. Convert the regular expression of $(a|b)^*abb$ into DFA and draw the minimized transition table.

Course Outcome 3 (CO3):

1. Convert the following operator precedence relations table into precedence graph and construct the precedence functions table.

	(	)	A	,	$
(	<	=	<	<	
)		>		>	>
A		>		>	>
,	<	>	<	>	
$	<		<		

2. Construct the predictive parsing table for the following grammar and check the given grammar is LL(1) grammar or not.

   S→iEtS | iEtSeS | a
   E→b
3. Construct the operator precedence relations table for the following grammar and show the parser movements for the given input string i) *id=id ii) id*id=id
   The grammar is S → L=R, S →R,L → *R, L →id, R →L

Course Outcome 4 (CO4)

1. Construct a quicksort algorithm for reads nine integers into an array a and sorts them by using the concepts of activation tree.
2. Write a procedure to insert an item into a linked list by passing a pointer to the head of the list. Under what parameter passing mechanisms does this procedure work.
3. Write the unification algorithm by applying the type checking concepts..

Course Outcome 5 (CO5)

1. Construct and explain the DAG for the following basic block.
```
d:= b * c
e:= a+ b
b:=b*c
a:=e-d
```

2. Generate code for the following C program using any code generation algorithm.
```
main()
{
Int I;
Int a[10];
while(i<=10)
a[i]=0;
}
```
3. Analyze and Generate code for the following assignment using the code generator algorithms

   (a-b) + (a-c) + (a-c).

Course Outcome 6 (CO6)

1. Illustrate benefits of code optimizer.
2. Construct the DAG for the following basic blocks and Write Deadcode elimination

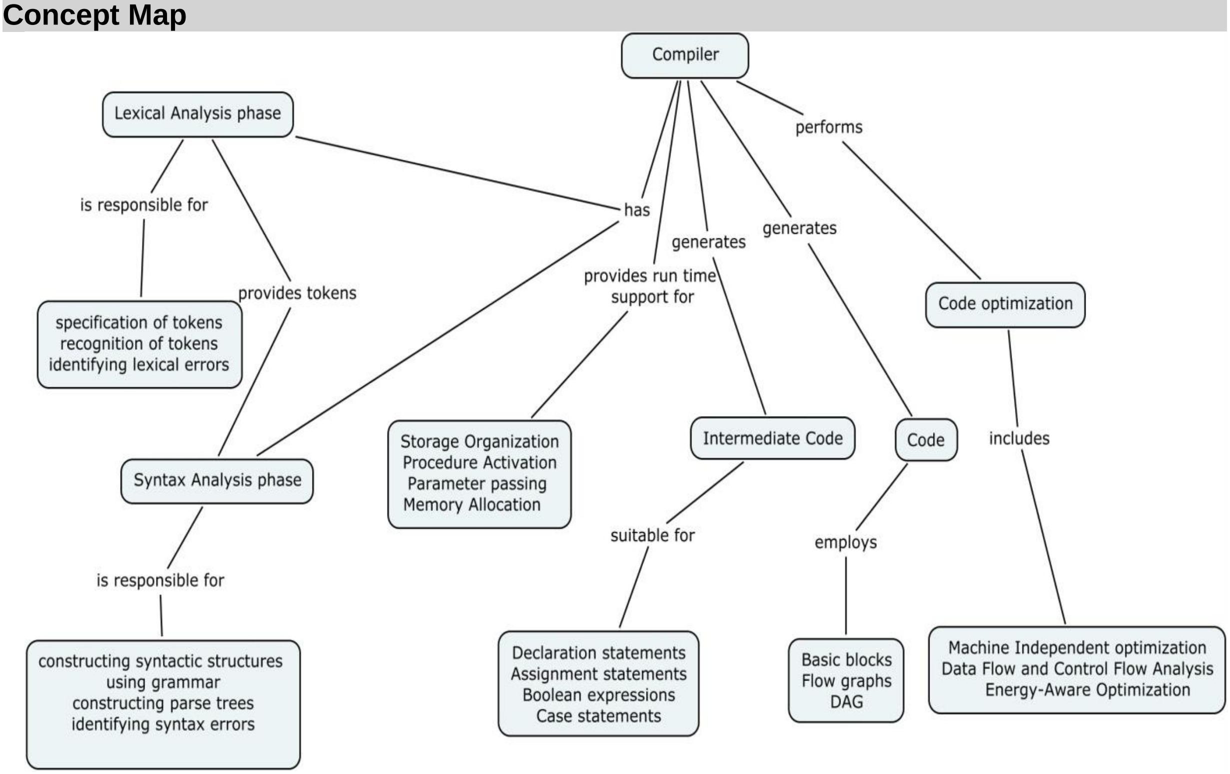
process for the following code

1.t1:=4*i
2.t2:=a[t1]
3.t3:=4*i
4.t4:=b[t3]
5.t5:=t2*t4
6.t6:=prod+t5
7.prod:=t6
8.t7:=i+1
9.i:=t7
10.if i<=20 goto 1

3. Find the constant expressions in the program. Replace all the constant expressions with their constant literals.

```
foo (int b) {
a[1] = 1; a[2] = 2; a[3] = 3;
i = 1;
if (b > 2) {
j = 2;
} else {
j = i + 1; }
k = a[j];
return k;
}
```

Concept Map



Syllabus

Introduction to compilers: Translators-Compilation and Interpretation-The phases of compiler- The grouping of phases. **Lexical Analysis (scanner):** Role of Lexical Analyzer-Input Buffering-Specification of Tokens-Finite automata- -regular expression to finite automata **Syntax**

Analysis (Parser) : The role of the parser- Top down parser - predictive parser- LL(1) grammar- Bottom-up Parsing- Shift Reduce Parser- Operator precedence parser-LR(0) automation- SLR Parser-CLR Parser-LALR Parser. **Run-time environment:** Storage Organization-Procedure activation-parameter passing-Access to Non local names -memory allocation, and scope. **Intermediate Code Generation:** Semantic Analysis-Type Checking, Types of Intermediate Codes-Declarations-Assignment statements - Boolean expressions-Case Statements-Back Patching-Procedure Calls. **Code Generation:** basic blocks and flow graphs -The DAG representation of basic blocks-Generating code from DAG- Peephole Optimization. **Code Optimization:** Machine Independent Optimization – Data Flow and Control Flow Analysis- Energy-Aware optimization

Learning Resources

1. Alfred V. Aho, Ravi Sethi, Jeffrey D Ullman – Principles of Compiler Design, Pearson Education, 2nd Edition,2012.
2. Randy Allen, Ken Kennedy-Optimizing Compilers for Modern Architectures : A Dependence-based Approach, Morgan Kauffman publishers,2001
3. Dr.O.G.Kakde-Compiler design,4th Edition,Laxmi Publications,2005
4. K.D. Cooper, and L. Torczon,Engineering a Compiler, Elsevier, 2004
5. https://www.nptel.ac.in/courses/106108052/

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
0	**Introduction of Compilers (2)**		
0.1	Translators-Compilation and Interpretation	1	CO1
0.2	The phases of compiler, The grouping of phases	1	CO1
1	**Lexical Analysis (5)**		
1.1	Role of Lexical Analyzer	1	CO2
1.2	Input Buffering	1	CO2
1.3	Specification of Tokens	1	CO2
1.4	Finite Automata (*Review the concepts of Finite Automata from Theory of Computation*)	1	CO2
1.5	Regular expression to finite automata (*Review the concepts of Conversion of Regular Expression into NFA, NFA to minimized DFA from Theory of Computation*)		CO2
2	**Syntax Analysis (10)**		
2.1	Role of Parsers	1	CO3
2.2	Top-down Parsing		
2.2.1	Predictive parser	1	CO3
2.2.2	LL(1) grammar	2	CO3
2.3	Bottom-up parsing		
2.3.1	Shift Reduce Parser	1	CO3
2.3.2	Operator-precedence parser	1	CO3
2.4	LR(0) automation-SLR Parser	2	CO3
2.5	CLR Parser –LALR Parser	3	CO3
3	**Run-time environment (4)**		
3.1	Storage Organization	1	CO4
3.2	Procedure activation-parameter passing	1	CO4
3.3	Access to Non local names	1	CO4

3.4	Memory allocation, and scope	1	CO4
4	**Intermediate Code Generation (6)**		
4.1	Semantic Analysis-Type Checking	1	CO5
4.1	Types of Intermediate Codes	1	CO5
4.2	Declarations	1	CO5
4.3	Assignment statements	1	CO5
4.4	Boolean expressions	1	CO5
4.5	Case Statements	1	CO5
4.6	Back patching	1	CO5
5	**Code Generation (3)**		
5.1	Basic blocks and flow graphs	1	CO6
5.2	DAG representation of basic blocks,	1	CO6
5.3	Generating code from DAG	1	CO6
5.4	Peephole Optimization	1	
6	**Code Optimization (6)**		
6.1	Machine Independent Optimization	1	CO6
6.2	Data Flow and Control Flow Analysis	2	CO6
6.5	Energy-Aware optimization	1	CO6
	Total	**36**	

Course Designers:

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18CS620	WEB PROGRAMMING

Category	L	T	P	Credit
PC	3	0	0	3

Preamble

This course provides the basic principles and techniques used for developing Web based application. The objective of the course is to make students to study client side and server side programming language concepts. This course provides semi structured representation of data and transport data using XML related technologies. This course provides the techniques used for creating, publishing and consuming a web service in a web based application

Prerequisite

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Model web pages using HTML and DHTML (Understand)	15
CO2	Demonstrate client side programs which interact with users (apply)	20
CO3	Illustrate three tier applications using JSP (apply)	20
CO4	Illustrate three tier applications using Servlet (Apply)	15
CO5	Develop web application using XML related technologies. (apply)	15
CO6	Develop web application using Web services. (apply)	15

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	Guided Response	1.2,
CO2	TPS3	Apply	Value	Mechanism	1.2,2.2.3,3.2.2,4.5.1,4.5.3
CO3	TPS3	Apply	Value	Mechanism	1.2,2.2.3, 3.2.2,4.5.1,4.5.3
CO4	TPS3	Apply	Value	Mechanism	1.2,2.2.3, 3.2.2,4.5.1,4.5.3
CO5	TPS3	Apply	Value	Mechanism	1.2,2.2.3, 3.2.2,4.5.1,4.5.3
CO6	TPS3	Apply	Value	Mechanism	1.2,2.2.3, 3.2.2,4.5.1,4.5.3

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	-	-									L		
CO2	S	M	L	-	M	L	M	L	M	L		M	M	M	L
CO3	S	M	L	-	M	L	M	L	M	L		M	M	M	L
CO4	S	M	L	-	M	L	M	L	M	L	L	M	M	M	L

CO5	S	M	L	-	M	L	M	L	M	L		M	M	M	L
CO6	S	M	L	-	M	L	M	L	M	L	L	M	M	M	L

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Assignment			Terminal Examination
	1	2	3	1	2	3	
Remember	20	20	20	-	-	-	10
Understand	20	20	20	20	20	20	30
Apply	60	60	60	80	80	80	60
Analyse	-	-	-	-	-	-	-
Evaluate	-	-	-	-	-	-	-
Create	-	-	-	-	-	-	-

Assessment Pattern: Psychomotor

Psychomotor Skill	Miniproject/Assignment/Practical Component
Perception	
Set	
Guided Response	40
Mechanism	60
Complex Overt Responses	
Adaptation	
Origination	

Sample Questions for Course Outcome Assessment**

** (2 to 3 at the cognitive level of course outcome)

Course Outcome 1(CO1):

1. Compare the advantages of 3 tier architecture over 2 tier architecture?
2. Compare the differences between IIS/Apache in regards to web development.
3. Write a CSS Rule to change color of all elements containing attribute class = “greenmove” to green and shift them down to 25 pixels and right 15 pixels?

Course Outcome 2(CO2):

1. Write a Java Script to get input from the user in XHTML and convert to lowercase and uppercase?
2. Write a Java script to generate a counter with 2 seconds delay
3. Write a Java script to generate Fibonacci series

Course Outcome 3(CO3):

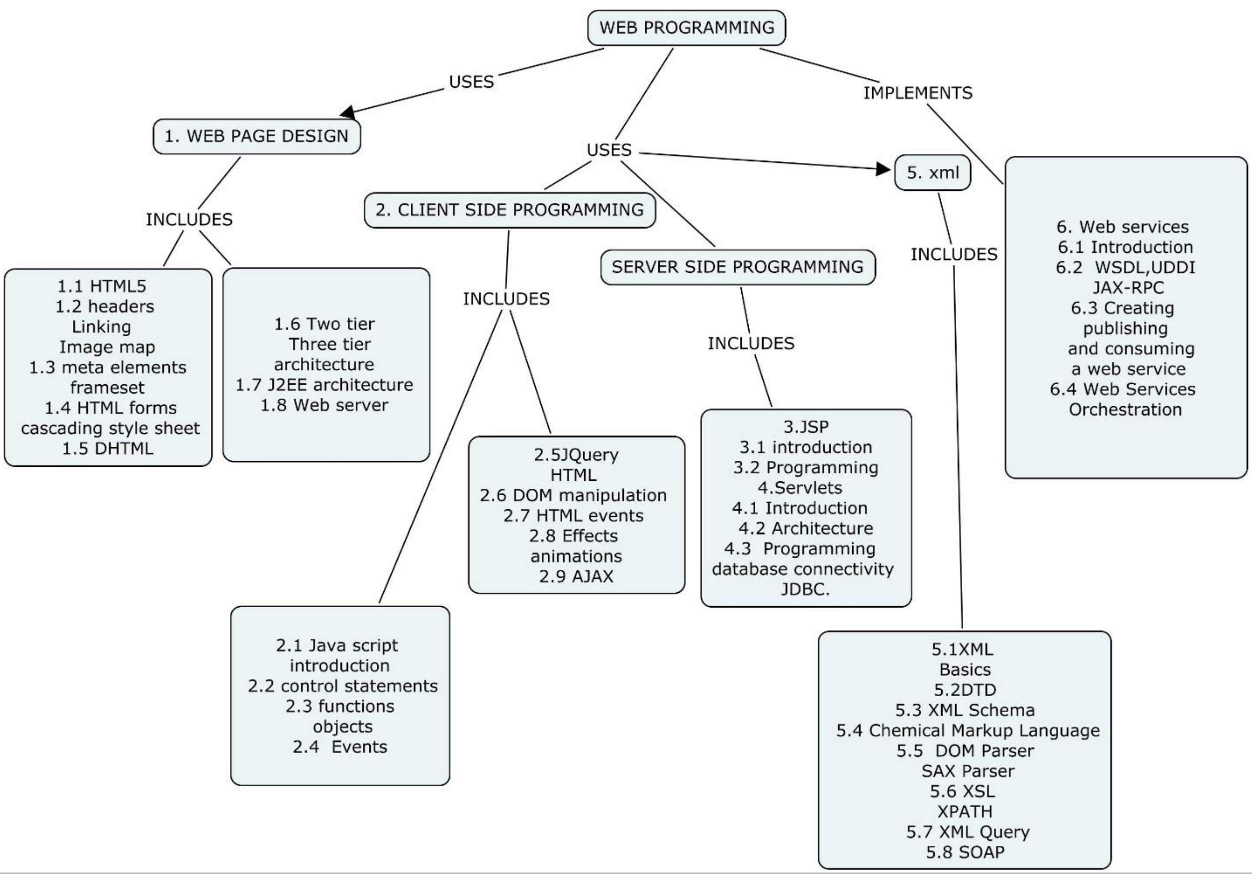
1. Write a client server application using JSP to get radius sent by browser and find area of circle
2. Develop three tier application for online registration of a course using JSP.
3. Develop client server application using JSP for calculating factorial of a number which is sent from client.

Course Outcome 4 (CO4):
1. Write a client server application using Servlet to get pay details sent by browser and find the net pay for employee
2. Develop three tier application for online exam of a course using Servlet.
3. Develop client server application using Servlet for calculating square root of a number which is sent from client.

Course Outcome 5 (CO5):
1. Write an XML and DTD for Storing Recipes.
2. Construct the book's XML document using cascading style sheets
3. Illustrate the principles of XSLT.

Course Outcome 6(CO6):
1. Illustrate the principles of publishing in web service.
2. Write the principles of creating in web service.
3. Illustrate the concept of consuming a web service.

Concept Map



Syllabus

Web page design: HTML5: headers, Linking, Images, Image map, meta elements, frameset, HTML forms, cascading style sheet., DHTML: object model, Event model, Two tier and Three tier architecture, J2EE architecture, Web server : Architecture, HTTP request types, IIS.

Client side programming: Java script: introduction, control statements, functions, objects. Event handling. JQuery: HTML and DOM manipulation, HTML event methods, Effects and animations, AJAX

Server Side programming: JSP introduction, programming, Servlets - Introduction, Architecture, Programming with database connectivity- JDBC.

XML : XML basics, DTD, XML Schema, Chemical Markup Language, DOM Parser, SAX Parser, XSL, XPATH, XMLQuery, SOAP.

Web services : Introduction, WSDL, UDDI, JAX-RPC, Creating publishing and consuming a web service, Web Services Orchestration.

Learning Resources

1. Deitel and Deitel, “Internet and World Wide Web How to Program”, Prentice Hall of India, Fifth Edition, 2018.
2. Paul J.Deitel and Harvey M.Deitel, “AJAX, Rich Internet Applications, and Web Development for Programmers”, Pearson Education, First Edition, 2009.

Online courses:

The Web Developer Bootcamp – Udemy.com
The course covers - HTML, CSS, JS, Node.

The Complete Web Developer Course 2.0 – Udemy.com
Learn Web Development using HTML, CSS, Javascript, PHP, Python, MySQL.

The Complete JavaScript Course 2019: Build Real Projects – Udemy.com

websites
www.w3schools.com

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1.	**Web Page Design**		
1.1	HTML5	1	CO1
1.2	Headers, Linking, Image maps	1	CO1
1.3	Meta elements, Frameset	1	CO1
1.4	Forms	1	CO1
1.5.	DHTML –object model ,Event model	1	CO1
1.6	Two tier and Three tier architecture	1	CO1
1.7	J2EE architecture	1	CO1

1.8	Web servers : Architecture, HTTP request types, IIS	1	CO1
2	**Client side programming**		
2.1	Java scripts introduction	1	CO2
2.2	Control statements	1	CO2
2.3	Functions, objects	1	CO2
2.4	Events	1	CO2
2.5	JQuery HTML	1	CO2
2.6	JQuery DOM implementation	1	CO2
2.7	Event Methods	1	CO2
2.8	Effects and Animations	1	CO2
2.9	AJAX	1	CO2
3	**JSP**		
3.1	JSP Introduction	1	CO3
3.2	Programming examples	2	CO3
4.	**Servlets**		
4.1	Introduction	1	CO4
4.2	Architecture	1	CO4
4.3	Programming with data base connectivity, JDBC	2	CO4
5	**XML**		
5.1	Basics	1	CO5
5.2	DTD,XML Schema	1	CO5
5.3	Chemical Markup language	1	CO5
5.4	DOM Parser, SAX parser	1	CO5
5.5	XSL	1	CO5
5.6	XPATH	1	CO5

5.7	XML query	1	CO5
5.8	SOAP	1	CO5
6	**Web services**		
6.1	Introduction	1	CO6
6.2	WSDL,UDDI,JAX-RPC	1	CO6
6.3	Create, Publish and Consume web services	1	CO6
6.4	Web Services Orchestration	1	CO6
	Total	36	

Course Designers:

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2. T.Manikandan tmcse@tce.edu

18CS630	ARTIFICIAL INTELLIGENCE

Category	L	T	P	Credit
PC	3	0	0	3

Preamble

This course introduces the basic concepts and techniques of Artificial Intelligence. Artificial intelligence is the sub area of computer science devoted to creating software and hardware to get computers to do things that would be considered intelligent as if people did them. This course will help the students to gain generic problem solving skills that have applicability to a wide range of real-world problems. Students can learn how machines can engage in problem solving, reasoning, learning, and interaction.

Prerequisite

Students are expected to have a significant level of programming ability like some C programming, knowledge of search algorithms and data structures such as balanced binary trees.

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Explain the key characteristics of intelligent agents	15
CO2	Solve search problems by applying a suitable search strategy	25
CO3	Find the optimal move for a given game using adversarial search	25
CO4	Construct a plan graph for the given problem like Constraints satisfaction problems and STRIPS problems	10
CO5	Construct knowledge representations using logic to facilitate inference in the given problem domain	15
CO6	Apply Natural Language Processing techniques and Neural Networks to solve a given problem	10

*** Weightage depends on Bloom's Level, number of contact hours

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	Guided Response	1.2,2.3.2,4.4.3
CO2	TPS3	Apply	Value	Mechanism	1.2,2.3.2,3.2.3,4.4.3
CO3	TPS3	Apply	Value	Mechanism	1.2,2.3.2,3.2.3,4.4.3

CO4	TPS3	Apply	Value	Mechanism	1.2,2.3.2,3.2.3,4.4.3
CO5	TPS3	Apply	Value	Mechanism	1.2,2.3.2,3.2.3,4.4.3
CO6	TPS3	Apply	Value	Mechanism	1.2,2.3.2,3.2.3,4.4.3

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L						L				L	L		L
CO2	S	M	L		M	L	L	M	L	M	L	L	M	L	M
CO3	S	M	L		M	L	L	M	L	M	L	L	M	L	M
CO4	S	M	L		M	L	L	M	L	M	L	**L**	M	L	M
CO5	S	M	L		M	L	L	M	L	M	L	L	M	L	M
CO6	S	M	L		M	L	L	M	L	M	L	L	M	L	M

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	**Continuous Assessment Tests**			**Assignment**			**Terminal Examination**
	1	**2**	**3**	**1**	**2**	**3**	
Remember	30	20	20	-	-	-	20
Understand	30	20	20	30	30	30	20
Apply	40	60	60	70	70	70	60
Analyse	0	0	0	-	-	-	-
Evaluate	0	0	0	-	-	-	-
Create	0	0	0	-	-	-	-

Assessment Pattern: Psychomotor

Psychomotor Skill	Miniproject /Assignment/Practical Component
Perception	-
Set	-
Guided Response	30
Mechanism	70
Complex Overt Responses	-
Adaptation	-
Origination	-

Sample Questions for Course Outcome Assessment**

** (2 to 3 at the cognitive level of course outcome)

Course Outcome1 (CO1):

1 List out the goals for a system to be rational.
2 What is the Turing test?
3 What do you mean by utility function?
4 Classify the agents
5 Explain the structure of a simple reflex agent

Course Outcome2 (CO2):

1 Explain Depth First Search with suitable example.
2 How to measure the problem-solving performance of an algorithm?
3 Describe a state space in which iterative deepening search performs much worse than depth-first search.
4 Implement a genetic algorithm approach to the travelling salesperson problem.
5 How can we avoid ridge and plateau in Hill Climbing?

Course Outcome3 (CO3)

1 Implement move generators and evaluation functions for the following games: chess, Othello and checkers.
2 Construct a general alpha-beta game-playing agent that uses above implementations
3 Describe state descriptors, move generators and terminal tests for poker game
4 Find an optimal move for two-player game using adversarial search technique.

Course Outcome4 (CO4)

1. Describe the differences and similarities between problem solving and planning

2. What do you mean by action schema?
3. Demonstrate the Graph Plan algorithm.
4. Illustrate the forward state-space search with suitable problem.
5. Construct levels 0, 1 and 2 of the planning graph for the STRIPS problem.

Course Outcome5 (CO5)

1. List out the steps in knowledge engineering process of a first order logic.
2. Differentiate two quantifiers in the logics.
3. Consider a knowledge base KB that contains he following propositional logic

   Sentences:

   Q => P

   Q v R

   P => ¬ Q

   a) Construct a truth able that shows the truth value of each sentence in KB and indicate the models in which the KB is true.

   b) Does KB entail Q? Use he definition of entailment to justify your answer.

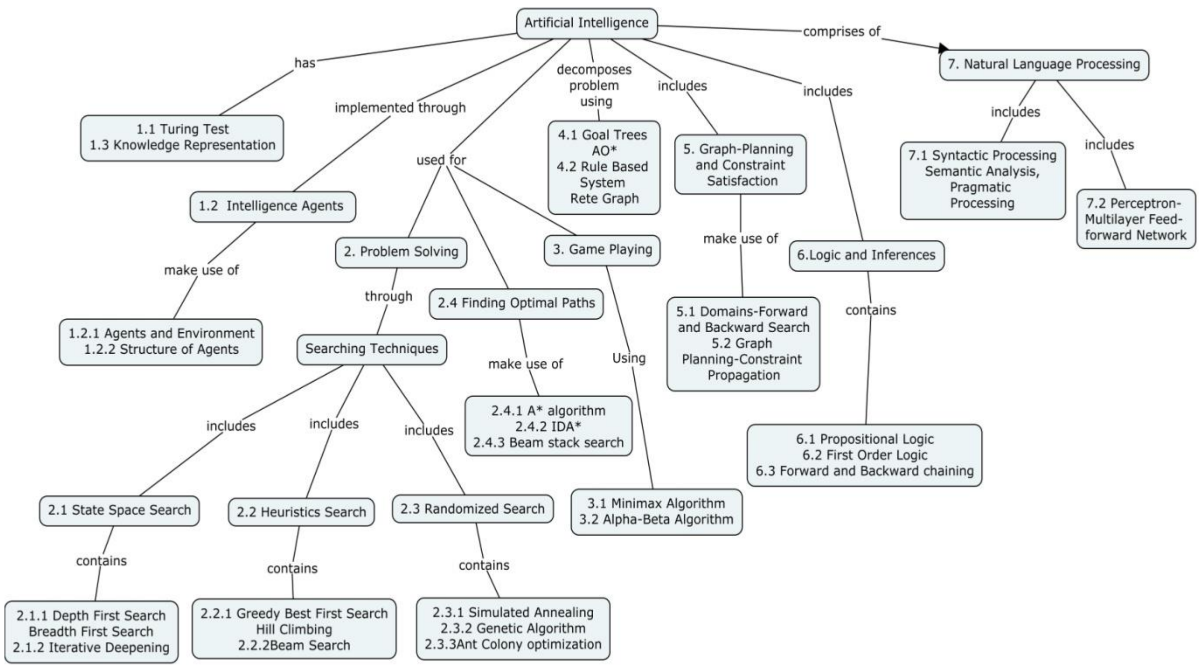
   c) Extend the truth table and use the definition of entailment to justfy your answer.

4. Write down a first-order logic sentence such that every world in which it is true contains Exactly one object in its domain.
5. Suppose that a block-stacking robot with a predicate calculus internal representation needs to look for two blocks (on the table or on top of another block) that are clear (nothing on top) in order to put one on top of the other. Write a first-order predicate calculus representation of the desired blocks.

Course Outcome6 (CO6)

1. Construct techniques for the purpose of keyword normalization
2. Apply N-Grams technique and generate bi-grams from given sentence
   "Artificial Intelligence book is a great source to learn data science"
3. How to create a document term matrix
4. Define Polysemy
5. State a context-free dependency graph
6. Apply text cleaning steps and generate trigrams phrases from the following sentence
   "#Artificial-Intelligence book is a great source to learn @data_science"

Concept Map



Syllabus

Introduction: Turing Test – Intelligent Agents - Knowledge Representation - Problem Solving using Searching: State Space Search-Depth First Search-Breadth First Search-Iterative Deepening Search-Heuristic Search: Greedy Best First Search-Hill Climbing-Beam Search-Randomized Search: Simulated Annealing-Genetic Algorithm-Ant Colony Optimization-Finding Optimal Paths: A* - IDA* - Beam stack search- Game Playing: Minimax Algorithm-Alpha beta Algorithm-Problem decomposition: Goal Trees- AO* - Uncertainty and Probability reasoning – Bayesian Networks- Statistical Learning methods like learning with complete data and hidden variable-Expectation – Maximization -Rule Based Systems- Rete Graph-Planning and Constraint Satisfaction: Domains-Forward and Backward Search-Graph Planning-Constraint Propagation-Logic and Inferences: Propositional Logic-First Order Logic-Forward and Backward chaining-Applications of Natural Language Processing and Neural Networks - Syntactic Processing-Semantic Analysis - Pragmatic Processing - Perceptron- Multilayer Feed-forward Network

Learning Resources

1. Stuart Russell and Peter Norvig. Artificial Intelligence: A Modern Approach, 4th Edition, Prentice Hall, Feb 2020.
2. Deepak Khemani. A First Course in Artificial Intelligence, McGraw Hill Education (India), 2013.
3. Elain Rich and Kevin Knight, “Artificial Intelligence ", Tata McGraw Hill, Third Edition, 2008.
4. G. Luger, “Artificial Intelligence: Structures and Strategies for complex problem solving”, Fourth Edition, Pearson Education, 2002.
5. Stefan Edelkamp and Stefan Schroedl. Heuristic Search: Theory and Applications, organ Kaufmann, 2011.

6. Journals- Artificial Intelligence, AI Magazine, IEEE Expert, Machine Learning, Computer Vision Image Processing and Graphics, IEEE Transactions on Neural Networks.
7. NPTEL Lectures

Course Contents and Lecture Schedule

Module No.	**Topic**	**No. of Lectures**	**Course Outcomes**
1	**Introduction(5)**		
1.1	Turing test	1	CO1
1.2	Intelligent Agents	1	CO1
1.2.1	Agents and Environment	1	CO1
1.2.2	Structure of agents	1	CO1
1.3	Knowledge Representation	1	CO1
2	**Problem solving using Searching(14)**		
2.1	State Space Search	1	CO2
2.1.1	Depth First Search, Breadth First Search	1	CO2
2.1.2	Iterative Deepening Search	1	CO2
2.2	Heuristics Search	1	CO2
2.2.1	Greedy Best First Search, Hill Climbing	1	CO2
2.2.2	Beam Search	1	CO2
2.3	Randomized Search	1	CO2
2.3.1	Simulated Annealing	1	CO2
2.3.2	Genetic Algorithm	1	CO2
2.3.3	Ant Colony Optimization	1	CO2
2.4	Finding Optimal Paths	1	CO3
2.4.1	A*	1	CO3

2.4.2	IDA*	1	CO3
2.4.3	Beam stack search	1	CO3
3	**Game Playing(3)**		
3.1	Minimax Algorithm	1	CO3
3.2	Alpha beta Algorithm	1	CO3
4	**Problem decomposition(3)**		
4.1	Goal Trees, AO*- Uncertainty and Probability reasoning – Bayesian Networks- Statistical Learning methods like learning with complete data and hidden variable- Expectation – Maximization	2	CO3
4.2	Rule Based Systems, Rete Graph	1	CO3
5	**Graph-Planning and Constraint Satisfaction(2)**		
5.1	Domains-Forward and Backward Search	1	CO4
5.2	Graph Planning-Constraint Propagation	1	CO4
6	**Logic and Inferences(6)**		
6.1	Propositional Logic	2	CO5
6.2	First Order Logic	2	CO5
6.3	Forward and Backward chaining	2	CO5
7	**Applications of Natural Language Processing and Neural Networks(3)**		
7.1	Syntactic Processing- Semantic Analysis- Pragmatic Processing	1	CO6
7.2	Perceptron- Multilayer Feed-forward Network	2	CO6
	Total	36	

Course Designers:

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2. Dr.S.Mercy Shalinie shalinie@tce.edu

18CS670	WEB PROGRAMMING LAB

Category	L	T	P	Credit
PC	0	0	2	1

Preamble

Students learn how to choose their communication approach by considering platform, dynamically updating the web contents based on the client requirements. They will also learn how to transport data using XML and XML related technologies and protocols and also how to communicate with databases. This course emphasis the working in Application like Ajax, JQuery and also standardization of XML Documents for the purpose of data exchange and integrate the communication mechanism.

Prerequisite

Web Programming fundamentals

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Design web pages using HTML and DHTML (apply)	15
CO2	Develop client side programs using client side scripting languages (apply)	15
CO3	Develop Application to demonstrate the use of AJAX and JQUERY (apply)	15
CO4	Develop three tier applications using JSP. (apply)	20
CO5	Develop three tier applications using Servlet (apply)	20
CO6	Apply XML in web page design (apply)	15

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value	Mechanism	1.2,2.2.3,3.2.2,4.5.1,4.5.3
CO2	TPS3	Apply	Value	Mechanism	1.2,2.2.3, 3.2.2,4.5.1,4.5.3
CO3	TPS3	Apply	Value	Mechanism	1.2,2.2.3, 3.2.2,4.5.1,4.5.3
CO4	TPS3	Apply	Value	Mechanism	1.2,2.2.3, 3.2.2,4.5.1,4.5.3
CO5	TPS3	Apply	Value	Mechanism	1.2,2.2.3, 3.2.2,4.5.1,4.5.3
CO6	TPS3	Apply	Value	Mechanism	1.2,2.2.3,3.2.2,4.5.1,4.5.3

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L	-	M	L	L	M	M	L	L	M	M	L	M
CO2	S	M	L	-	M	L	L	M	M	L	L	M	M	L	M

CO3	S	M	L	-	M	L	L	M	M	L	L	M	M	L	M
CO4	S	M	L	-	M	L	L	M	M	L	L	M	M	L	M
CO5	S	M	L	-	M	L	L	M	M	L	L	M	M	L	M
CO6	S	M	L	-	M	L	L	M	M	L	L	M	M	L	M

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Model Examination	Terminal Examination
Remember		
Understand	20	20
Apply	80	80
Analyse		
Evaluate		
Create		

Assessment Pattern: Psychomotor

Psychomotor Skill	Miniproject /Practical Component/Observation
Perception	
Set	
Guided Response	20
Mechanism	80
Complex Overt Responses	
Adaptation	
Origination	

List of Experiments/Activities with CO Mapping

Sl. No.	Experiments	CO mapping
1	Create a home page for your project using HTML.	CO1
2	Implement Client side form design and validation.	CO2
3	Create a Webpage to handle Events and Objects using Java Script.	CO2
4	Develop a JSP application for online registration of course.	CO4
5	Implement online students marks processing using JSP with database connectivity	CO4
6	Write a Servlet application which communicates with Browser	CO5
7	Develop Application to demonstrate the use of AJAX. (To dynamically update cricket score)	CO3
8	Develop application to demonstrate applications of JQuery.	CO3
9	Present a XML document using XSLT.	CO6
10	Implement a program for DOM to Process XML File	CO6

Learning Resources:

1. Deitel and Deitel, “Internet and World Wide Web How to Program”, Prentice Hall of India, Fifth Edition, 2018.

Online courses:

1. The Web Developer Bootcamp – Udemy.com
   The course covers - HTML, CSS, JS, Node.

2. The Complete Web Developer Course 2.0 – Udemy.com
   Learn Web Development using HTML, CSS, Javascript, PHP, Python, MySQL.

3. The Complete JavaScript Course 2019: Build Real Projects – Udemy.com

websites

www.w3schools.com

Course Designers:

1) M.Sivakumar mskcse@tce.edu
2) T.Manikandan tmcse@tce.edu

18CS680 ARITIFICIAL INTELLIGENCE LAB

Category	L T P	Credit
PC	0 0 2	1

Preamble

The laboratory course will facilitate the Students to apply the concept of artificial intelligence for different problems like eight queens, travelling salesperson problem using machine learning libraries, Python, LISP and PROLOG. These experiments are aimed at imparting a practical exposure to the students to gain generic problem solving skills that have applicability to a wide range of real-world problems. Students can learn how machines can engage in problem solving, reasoning, learning, and interaction.

Prerequisite

Nil

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Implement hill climbing, A* algorithm for gaming applications	15
CO2	Implement randomized search techniques for problem solving	20
CO3	Develop the solutions for combinatorial problems using intelligent optimization algorithms like Simulated Annealing, Genetic Algorithm, Particle Swarm Optimization	25
CO4	Construct rule based systems for any application using logic programming language	15
CO5	Implement solutions for constraint satisfaction problem	10
CO6	Construct solutions for Image Classification and Object Detection in any large dataset	15

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value	Mechanism	1.2, 2.3.2,3.2.3, 4.4.3, 4.5.3
CO2	TPS3	Apply	Value	Mechanism	1.2, 2.3.2,3.2.3, 4.4.3, 4.5.3
CO3	TPS3	Apply	Value	Mechanism	1.2, 2.3.2, 3.2.3,4.4.3, 4.5.3
CO4	TPS3	Apply	Value	Mechanism	1.2, 2.3.2, 3.2.3,4.4.3, 4.5.3
CO5	TPS3	Apply	Value	Mechanism	1.2, 2.3.2, 3.2.3,4.4.3, 4.5.3
CO6	TPS3	Apply	Value	Mechanism	1.2, 2.3.2, 3.2.3,4.4.3, 4.5.3

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L		L	L		M	L	M		M	M	L	L
CO2	S	M	L		M	L		M	L	M		M	M	L	L

CO3	S	M	L		L	L		M	L	M		M	M	L	L
CO4	S	M	L		L	L		M	L	M		M	M	L	L
CO5	S	M	L		L	L		M	L	M		M	M	L	L
CO6	S	M	L		M	L		M	L	M		M	M	L	L

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Model Examination	Terminal Examination
Remember		
Understand		
Apply	100	100
Analyse		
Evaluate		
Create		

Assessment Pattern: Psychomotor

Psychomotor Skill	Miniproject /Practical Component/Observation
Perception	
Set	
Guided Response	
Mechanism	100
Complex Overt Responses	
Adaptation	
Origination	

List of Experiments / Activities with CO Mapping

S.No.	Name of the Experiment	No. of sessions	Course Outcome
1.	Implement Hill climbing algorithm	2	CO1
2.	Write a program to generate the output for A* algorithm	2	CO1
3.	Solve travelling salesperson problem using Best First Search	2	CO2
4.	Write a program to show the Tic Tac Toe game for 0 and X	2	CO2
5.	Apply any one randomized search technique (Simulated annealing, Genetic Algorithms, Particle swarm optimization) for solving problems like, TSP, Graph coloring, Vertex cover problem, shortest path problems, etc	2	CO3
6.	Generate, view and access decision tree and rules	2	CO3
7.	Implement a k-means clustering algorithm for any given data set	2	CO3

8.	Develop any rule based system for an application of your choice	2	CO4
9.	Implement any one Propositional calculus related problem	2	CO4
10.	Solve the crossword puzzle problem as constraint satisfaction problem	2	CO5
11.	Implement Image Classification (MNIST Handwritten Digit Recognition) using Back propagation	2	CO6
12.	Implement Object Detection (MNIST Semi-supervised Image Recognition) using Convolutional Networks	2	CO6
	Total	24	

Learning Resources

1. Stuart Russell and Peter Norvig. Artificial Intelligence: A Modern Approach, 3rd Edition, Prentice Hall, 2009.
2. Deepak Khemani. A First Course in Artificial Intelligence, McGraw Hill Education (India), 2013.

Course Designer:

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18CSEA0	DATA SCIENCE USING PYTHON

Category	L	T	P	Credit
ES	2	-	2	3

Preamble

This course encompasses the use of mathematics, statistics, and computer science to study and evaluate data. The key objective of this course is to extract valuable information for strategic decision making, product development, trend analysis, and forecasting.

Prerequisite

Basic knowledge in linear algebra, calculus, probability theory, statistics and programming.

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage in %
CO1	Practice Python functionality and libraries used for data science.	15
CO2	Use linear algebra, descriptive statistics to represent data and to understand distributions of data.	15
CO3	Interpret the significance of data using inferential statistics and visualization techniques.	15
CO4	Prepare the data to improve its quality and to build the effective models.	15
CO5	Develop and assess data-driven models for real world problems.	20
CO6	Solve the real-world problems using data analytics techniques.	20

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value	Mechanism	1.3,4.4.3,4.5.3
CO2	TPS3	Apply	Value	Mechanism	1.3,2.1.1,2.1.2
CO3	TPS3	Apply	Value	Mechanism	1.3,2.1.4
CO4	TPS3	Apply	Value	Mechanism	1.3,2.1.3,2.2
CO5	TPS3	Apply	Value	Mechanism	1.3,4.6.1,2.1.2
CO6	TPS3	Apply	Value	Mechanism	1.3,2.1,2.2,3.1.5,3.2.3,3.2.6

Mapping with Programme Outcomes and Programme Specific Outcome

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L		L		L		L	L		L	M	L	L
CO2	S	M	L		L		L		L	L		L	M	L	L

CO 3	S	M	L		L		L		L	L		L	M	L	L
CO 4	S	M	L		L		L		L	L		L	M	L	L
CO 5	S	M	L		L		L		L	L		L	M	L	L
CO 6	S	M	L	L	L	L	L	L	L	L	L	L	M	L	L

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Practical Component			Terminal Examination
	1	2	3	1	2	3	
Remember	20	20	25	-	-	-	20
Understand	30	30	25	-	-	-	30
Apply	50	50	50	100	100	100	50
Analyse	-	-	-	-	-	-	-
Evaluate	-	-	-	-	-	-	-
Create	-	-	-	-	-	-	-

Assessment Pattern: Psychomotor

Psychomotor Skill	~~Mini project~~/~~Assignment~~/Practical Component
Perception	-
Set	-
Guided Response	-
Mechanism	100
Complex Overt Responses	-
Adaptation	-
Origination	-

Sample Questions for Course Outcome Assessment

Course Outcome 1(CO1):

1. Given the names and grades for each student in a Physics class of students, store them in a nested list and print the name(s) of any student(s) having the second lowest grade.
2. Find the value of h (231,8) for the function below?

```
def h(m,n):
 ans = 0
        while (m >= n):
                (ans,m) = (ans+1,m-n)
return(ans)
```

Course Outcome 2(CO2):

1. Find the number of vectors present in the null space of the given matrix $\begin{matrix} 1 & -3 & -5 \\ -2 & 1 & 3 \end{matrix}$
   Reflect your recommendations in data science process.

2. Consider the matrix $\begin{matrix} 1 & 2 & 2 \\ 3 & 4 & 7 \\ -2 & 0 & 6 \end{matrix}$. Find the Eigen value ,determinant and rank of the matrix

Course Outcome 3(CO3):

1. In a class of 50,000 students what is the probability that more than 5050 students get grades D or worse (D or F) (approximately).
2. Find the statistical test/ technique would you use: We are an online shopping portal. We can tell if someone who is on our website is a mac user or a PC user. We want to test the hypothesis that among people who purchase something from our website mac users tend to spend more money than PC users.
3. Your task is to conduct ANOVA over this data to check whether you get evidence that prices over the land were not same for the three years considered. Find the F-statistic for the given data.

Course Outcome 4 (CO4):

1. Design the Friendship structure of users in a social networking site.
2. Use the relevant wrangling techniques to reduce the number of rows and columns in the healthcare dataset [https://data.gov.in/keywords/healthcare]
3. Demonstrate various chart typologies to represent the features.

Course Outcome 5 (CO5):

1. Given the following 3D input data, identify the principal component.
   1 1 9
   2 4 6
   3 7 4
   4 11 4
   5 9 2
   For the data given in the previous question, find the transformed input along the first two principal components.
2. Suppose you are only allowed to use binary logistic classifiers to solve a multi-class classification problem. Given a training set with 2 classes, this classifier can learn a model, which can then be used to classify a new test point to one of the 2 classes in the training set. You are now given a 6 class problem along with its training set, and have to use more than one binary logistic classifier to solve the problem, as mentioned before. You propose the following scheme (also known as one Vs one approach in ML terminology) - you will first train a binary logistic classifier for every pair of classes. Now, for a new test point, you will run it through each of these models, and the class which wins the maximum number of pairwise contests, is the predicted label for the test point. How many binary logistic classifiers will you need to solve the problem using your proposed scheme?
3. Consider the linear regression equation (Y = 5X +40) for the below table.

X	5	6	7	8	9
Y	45	76	78	87	79

Which of the following is a MAE (Mean Absolute Error) for this linear model?

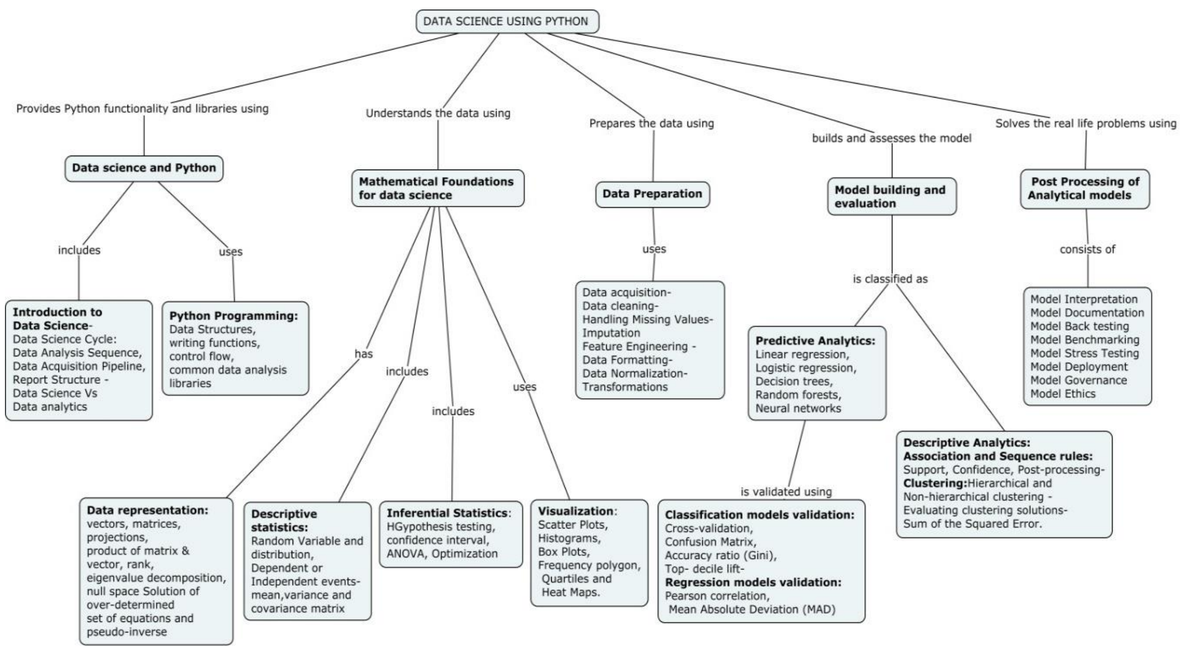
Course Outcome 6(CO6):

1. Produce a data science project for the following scenario. Twitter Classification Dataset has become an integral part of sentiment analysis problems. The dataset is 3MB in size and has 31,962 tweets. Identify the tweets which are hate tweets and which are not.

[https://datahack.analyticsvidhya.com/contest/practice-problem-twitter-sentiment-analysis/]

2. Design a data science project for the following scenario.
   Student Evaluation Dataset is based on an evaluation form filled out by students for different courses. It has different attributes including attendance, difficulty, score for each evaluation question, among others. This is an unsupervised learning problem. The dataset has 5820 rows and 33 columns**.**
   [https://archive.ics.uci.edu/ml/datasets/Wine+Qualityhttps://archive.ics.uci.edu/ml/datasets/Turkiye+Student+Evaluation]

Concept Map



Syllabus

Theory Component:

Data science and Python

Introduction to Data Science- Data Science Cycle: Data Analysis Sequence, Data Acquisition Pipeline and Report Structure - Data Science Vs Data analytics - Python Programming: Data Structures, writing functions, control flow, common data analytics libraries (SciPy, Pandas and SciKit-Learn etc).

Math and Statistics for Data Science

Data representation: vectors, matrices, projections, product of matrix & vector, rank, eigenvalue decomposition, null space - solution of over-determined set of equations and pseudo-inverse-Dimensionality reduction: PCA and SVD – **Descriptive statistics:** Random Variable and distribution, Dependent or Independent events- mean, variance and covariance matrix- **Inferential Statistics:** Hypothesis testing, confidence interval, ANOVA, Optimization-

Visualization: Scatter Plots, Histogram, Box Plots, Frequency polygon, Quartiles and Heat Maps.

Data Wrangling and Integration
Data acquisition- Data cleaning- Handling Missing Values- Imputation- Feature Engineering -Data Formatting- Data Normalization- Transformations

Model building and Evaluation
Predictive Analytics: Linear regression, Logistic regression, Decision trees, Random forests, Neural networks –**Classification models validation**: Cross-validation, Confusion Matrix, Accuracy ratio (Gini),Top- decile lift-**Regression models validation**: Pearson correlation, Mean Absolute Deviation (MAD)-**Descriptive Analytics**-Association and Sequence rules: Support, Confidence, Post-processing, Clustering-Hierarchical and Non-hierarchical clustering- **Evaluating clustering solutions**- Sum of the Squared Error.

Post Processing of Analytical models
Model Interpretation -Model Documentation- Model Back testing- Model Benchmarking-Model Stress Testing-Model Deployment-Model Governance-Model Ethics

Mini Project
Understanding the domain and Problem – Use the Mathematical Foundations to understand the data - Data wrangling and Integration - Model building and Evaluation

Mini Project domain: [Not limited to]
Search engine engineering, corporate analytics, Healthcare, gaming, financial services, e-commerce, aviation, transportation, logistics, social network, agriculture and energy.
Team Size: 3 Members

Practical Component:

Practicing the fundamental concepts of Python.

Analysing the data using descriptive statistics and visualization.

Analysing the data using inferential statistics and visualization.

Performing different types of data pre-processing methods.

Selecting efficient subset Implement using dimensionality reduction techniques.

Building an appropriate model for the given dataset.

Evaluating the performance of the model-built using relevant metrics.

Produce a mini project on data science for the real-world problems.

Learning Resources

1. Bart Baesens, ‘Analytics in a Big Data World: The Essential Guide to Data Science and its Applications’, Wiley and SAS Business Series, Kindle Edition, Wiley Publishers, 2014, First Edition.
2. EMC Education Services, ‘Data Science and Big Data Analytics Discovering, Analysing, Visualizing and Presenting Data’, Wiley Publishers, 2015,First Edition

3. David Paper, ‘Data Science Fundamentals for Python and MongoDB’, Apress Publishers, 2018, First Edition
4. Jake VanderPlas, “Python Data Science Handbook: Essential Tools for Working with Data” , O'Reilly Publishers, 2016, First Edition.
5. Dmitry Zinoviev, ‘Data Science Essentials in Python: Collect - Organize - Explore - Predict – Value’ , The Pragmatic Programmers,2016,First Edition
6. https://github.com/Apress/practical-web-scraping-for-data-science
7. https://www.hackerrank.com/domains/python
8. https://www.dataquest.io/
9. https://realpython.com/tutorials/data-science/

Course Contents and Lecture Schedule

Module No.	Topic	No. of Lectures	Course Outcome
1	**Data science and Python**		
1.1	Introduction to Data Science- Data Science Cycle: Data Analysis Sequence, Data Acquisition Pipeline, Report Structure - Data Science Vs Data analytics	2	CO1
1.2	Python Programming: Data Structures, writing functions, control flow, common data analysis libraries SciPy, Pandas and SciKit-Learn etc).	2	CO1
2	**Math and Statistics for Data Science**		
2.1	**Data representation:** vectors, matrices, projections, product of matrix & vector, rank, eigenvalue decomposition, null space - solution of over-determined set of equations and Pseudo-inverse	2	CO2
2.2	Dimensionality reduction: PCA and SVD **Descriptive statistics:** Random Variable and distribution, Dependent or Independent events-mean, variance and covariance matrix	2	CO2
2.3	**Inferential Statistics:** Hypothesis testing, confidence interval, ANOVA, Optimization	2	CO2
2.4	**Visualization:** Scatter Plots, Histogram, Box Plots, Frequency polygon, Quartiles and Heat Maps.	2	CO2
3	**Data Wrangling and Integration**		
3.1	Data acquisition- Data cleaning- Handling Missing Values- Imputation	2	CO4
3.2	Feature Engineering -Data Formatting- Data Normalization- Transformations	2	CO4
4	**Model Building and Evaluation**		
4.1	**Predictive Analytics:** Linear regression, Logistic regression, Decision trees, Random forests, Neural networks	3	CO5
4.2	**Classification models validation**: Cross-validation, Confusion Matrix, Accuracy ratio (Gini),Top- decile lift-**Regression models validation**: Pearson correlation, Mean Absolute Deviation (MAD)	1	CO5

Module No.	Topic	No. of Lectures	Course Outcome
4.3	**Descriptive Analytics**-Association and Sequence rules: Support, Confidence, Post-processing, Clustering-Hierarchical and Non-hierarchical clustering -**Evaluating clustering solutions**- Sum of the Squared Error.	2	CO5
5	**Post Processing of Analytical models**		
5.1	Model Interpretation -Model Documentation- Model Back testing- Model Benchmarking - Model Stress Testing-Model Deployment-Model Governance - Model Ethics	2	CO6
	Total	**24**	

Course Contents and Lecture Schedule for Laboratory

Module No.	Topic	No. of Hours	Course Outcome
1.	Practice basic functions and libraries in python.	2	CO1
2.	Write a program to import, export different categories of data using relevant data structures.	2	CO1
3.	Design a program to understand the data distribution using visualization techniques.	2	CO2
4.	Implement a program to determine the relationship between the features.	2	CO2
5.	Implement a program to select the sample data using inferential statistics.	2	CO3
6.	Develop a program to implement data pre-processing methods.	2	CO4
7.	Implement a program to select relevant features using dimensionality reduction techniques.	2	CO4
8.	Write a program to build appropriate models using pre-processed data.	2	CO5
9.	Develop the python code to evaluate the model for decision making.	2	CO5
10.	Design a data science project and Report Submission.	6	CO6
	Total Hours	**24**	

Course Designers:

1. Dr.M.Nirmala Devi mnit@tce.edu

18ES690	ENGINEERING DESIGN PROJECT

Category	L	T	P	Credit
Project	1	0	4	3

Preamble

An engineer must understand the economic, social, political, sustainability and environmental contexts in which the need arises. Engineering solutions are always created in response to some societal/industrial need. Understanding the societal/industrial need is central to success in engineering design. Therefore, the engineering students have been assigned on the problem identification phase of engineering design. Now, they have an opportunity to reflect and realise the knowledge that have been gained through the courses such as 18ES150 Engineering Exploration, 18ES290 Lateral Thinking, 18ES390 Design Thinking, 18XX490 Project Management and 18ES590 System Thinking. This course will enable the students to integrate CDIO Skill-based courses and their domain-specific courses. More specifically, by employing the broad knowledge they gain from experiences in foundation elective, general elective and audit courses, students are better equipped to provide engineering solution societal and/or industrial needs.

Prerequisite

Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	Course Outcome Statement	Weightage in %
CO1	Execute different phases of engineering design project including functional composition and design specification in a team.	20
CO2	Evaluate the alternate engineering design approaches as per the performance criteria with design verification and validation.	20
CO3	Evaluate a design with the use of test verification matrix / Design Failure Mode Effect Analysis (DFMEA)/ Usability testing	15
CO4	Explain the significance of Intellectual Property rights and the procedure for searching and filing a patent.	15
CO5	Exhibit team work with appropriate conflict management strategies.	10
CO6	Prepare appropriate design documents and deliver effective technical presentations	10

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value	Mechanism	1.1, 1.2, 2.1.1, 3.1.2, 3.2.3, 3.2.6, 4.1.2
CO2	TPS5	Evaluate	Organise	Adaptation	1.1, 1.2, 2.1.2, 2.5.1, 2.5.2, 3.1.2, 3.2.3, 3.2.6, 4.1.2
CO3	TPS5	Evaluate	Organise	Adaptation	1.1, 1.2, 2.1.3, 3.1.2, 3.2.3, 3.2.6, 4.1.2, 4.3.1

CO4	TPS2	Understand	Respond	Guided Response	1.1, 1.2, 2.1.4, 3.1.2, 3.2.3, 3.2.6, 4.1.2, 4.4.1
CO5	TPS3	Apply	Value	Mechanism	1.1, 1.2, 2.1.5, 3.1.2, 3.2.3, 3.2.6, 4.1.2, 4.4.1
CO6	TPS3	Apply	Value	Mechanism	1.1, 1.2, 2.1.4, 3.1.2, 3.2.3, 3.2.6, 4.1.2, 4.4.1

Mapping with Programme Outcomes

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	S	M	L	-	-	M	M	M	S	S	S	S			
CO 2	S	S	S	M	-	M	M	M	S	S	S	S			
CO 3	S	S	S	M	S	M	M	S	S	S	S	S			
CO 4	M	L	-	-	-	M	M	-	-	-	-	S			
CO 5	S	M	L	-	-	M	M	S	S	S	M	S			
CO 6	S	M	L	-	-	-	-	S	S	S	-	S			

S- Strong; M-Medium; L-Low

Assessment Pattern:

Phases	Deliverables	Marks	Course Outcomes
Continuous Assessment			
Review 1 – Engineering Design Project Selection, functional decomposition and Specification	Technical Report	10	CO1, C06
Review 2 – Evaluation of Design Approaches	Technical Report	20	CO2, CO5, CO6
Review 3 – Design Verification and validation	Technical Report	20	CO3, CO4, CO6
End-Semester Examination			
Demonstration	Prototype	60	CO1, CO2, CO3, CO4 CO5, CO6
Design Portfolio Presentation	Portfolio Document	40	

- Reports are to be submitted at each review. The report and presentation will be evaluated based on customized Rubrics for periodic reviews.
- Demonstration and Design Portfolio presentation will be evaluated by two faculty members nominated by their respective Head of the Department.

Syllabus

Project Selection – Search Phase, Preliminary Design Review (PDR) and Critical Design Review (CDR), Project Specification, Proposal Report, Proposal Presentation

Engineering Design Process - The NASA Design Approach, Design Verification and Validation ,Design Verification Plan – DFMEA, test verification matrix, Usability testing, DRIDS-V Design Approach and Plan

Intellectual Property Rights – Trademarks, Copyrights and Patents, Types of patents, Searching patents, Filing Patents

Team formation and Communication – Types of teams, Team Conflict Management – common causes, cultural styles and conflict, Project Team Evaluation, Conducting Meetings and Making Presentations

Learning Resources

- Harvey F. Hoffman, “The Engineering Capstone Course: Fundamentals for Students and Engineers”, Springer, 2014
- https://sharepoint.ecn.purdue.edu/epics/teams/Public%20Documents/EPICS_Design_Process.pdf?_ga=2.252800138.2089889711.1612784342-1089955741.1612784342

Course Contents and Lecture Schedule

Module No	Topic	No. of Lectures	Course Outcome
1	**Project Selection**		
	Search Phase, Preliminary Design Review (PDR) and Critical Design Review (CDR), Project Specification, Proposal Report, Proposal Presentation	2	CO1, CO6
2	**Engineering Design Process**		
2.1	The NASA Design Approach	1	CO2
2.2	Design Verification and Validation	1	CO2
2.3	Design Verification Plan – DFMEA, test verification matrix, Usability testing,	2	CO3
2.4	DRIDS-V Design Approach and Plan	1	CO3
3	**Intellectual Property Rights**		
3.1	Trademarks, Copyrights and Patents,	1	CO4
3.2	Types of patents, Searching patents,.	1	CO4
3.3	Filing Patents	1	CO4
4	**Team formation and Communication**		
4.1	Types of teams, Team Conflict Management – common causes, cultural styles and conflict,	1	CO5
4.2	Project Team Evaluation, Conducting Meetings and Making Presentations	1	CO5, CO6
	Total	**12**	

Course Designers:

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CURRICULUM AND DETAILED SYLLABI

FOR

B.E DEGREE (Computer Science and Engineering) PROGRAMME

SEVENTH SEMESTER

FOR THE STUDENTS ADMITTED FROM THE

ACADEMIC YEAR 2018 - 2019 ONWARDS

THIAGARAJAR COLLEGE OF ENGINEERING

(A Government Aided ISO 9001-2008 certified
Autonomous Institution affiliated to Anna University)

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THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015
B.E Degree (Computer Science and Engineering) Programme

COURSES OF STUDY

(For the candidates admitted from 2018-19 onwards)

SEVENTH SEMESTER

Course Code	Name of the Course	Category	No. of Hours / Week			Credits
			L	T	P	
THEORY						
18CS710	Accounting and Finance	HSS	3	-	-	3
18CSPX0	Program Elective - III	PE	3	-	-	3
18CSPX0	Program Elective - IV	PE	3	-	-	3
18CSPX0	Program Elective - V	PE	3	-	-	3
18CSPX0	Program Elective - VI	PE	3	-	-	3
PRACTICAL						
18CS770	Engineering Tools Lab	PC	-	-	2	1
SPECIAL COURSES						
18ES790	Capstone Design Project	Project	-	-	6	3
	Total		**15**	**-**	**8**	**19**

EIGHTH SEMESTER

Subject code	Name of the subject	Category	No. of Hours / Week			Credits
			L	T	P	
THEORY						
18CSPX0	Program Elective - VI	PE	3	-	-	3
18CSPX0	Program Elective – VII	PE	3	-	-	3
PRACTICAL						
18CS810	Project	PC	-	-	18	9
	Total		**6**	**-**	**18**	**15**

BS : Basic Science
HSS : Humanities and Social Science
ES : Engineering Science
PC : Program Core
PE : Program Elective
GE : General Elective

L : Lecture
T : Tutorial
P : Practical

Note:
1 Hour Lecture is equivalent to 1 credit
1 Hour Tutorial is equivalent to 1 credit
2 Hours Practical is equivalent to 1 credit

THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015
B.E Degree (Computer Science and Engineering) Programme

SCHEME OF EXAMINATIONS
(For the candidates admitted from 2018-19 onwards)

SEVENTH SEMESTER

S.No.	Course Code	Name of the Course	Duration of Terminal Exam. in Hrs.	Marks			Minimum Marks for Pass	
				Continuous Assessment	Terminal Exam *	Max. Marks	Terminal Exam	Total
THEORY								
1	18CS710	Accounting and Finance	3	50	50	100	25	50
2	18CSPX0	Program Elective - III	3	50	50	100	25	50
3	18CSPX0	Program Elective - IV	3	50	50	100	25	50
4	18CSPX0	Program Elective - V	3	50	50	100	25	50
5	18CSPX0	Program Elective - VI	3	50	50	100	25	50
PRACTICAL								
6	18CS770	Engineering Tools Lab	3	50	50	100	25	50
7	18ES790	Capstone Design Project	3	50	50	100	25	50

EIGHTH SEMESTER

S.No.	Course Code	Name of the Course	Duration of Terminal Exam. in Hrs.	Marks			Minimum Marks for Pass	
				Continuous Assessment	Terminal Exam *	Max. Marks	Terminal Exam	Total
THEORY								
1	18CSPX0	Program Elective - VII	3	50	50	100	25	50
2	18CSPX0	Program Elective – VIII	3	50	50	100	25	50
PRACTICAL								
3	18CS810	Project	-	50	50	100	25	50

* Terminal Examination will be conducted for maximum marks of 100 and subsequently be reduced to 50 marks for the award of terminal examination marks

18CS710	ACCOUNTING AND FINANCE

Category		L	T	P	Credit
HSS		3	-	-	3

Preamble

Engineering profession involves lots of decision making. The decisions may range from operation to non-operation. For taking decisions of these kinds, an engineer needs among other data about the organization routine operations and non-routine operations. Accounting is a science which provides all the data by recording, classifying, summarizing and interpreting the various transactions taking place in an organization and thereby helps an engineer in taking vital decisions in an effective manner. Finance is an allied but a separate field relying on accounting and enables engineers in taking useful financial and cost related decisions by providing well defined concepts, tools and techniques

Prerequisite

Nil

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Prepare financial statements, common size statements and comparative statements.	20
CO2	Perform cost sheet, depreciation and its applications in business.	15
CO3	Compute various types of budgets in an organization	15
CO4	Practice break even analysis and activity based costing systems for a business applications.	15
CO5	Compute working capital requirements and long term investment decisions.	20
CO6	Apply the appropriate sources of finance and mobilize the right quantum of finance and use them in most profitable investment avenues	15

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value	Mechanism	1.1, 1.2, 2.1,3.2, 4.1.1, 4.1.2, 4.4.5, 4.6.5
CO2	TPS3	Apply	Value	Mechanism	1.1, 1.2, 2.1,3.2, 4.1.1, 4.1.2, 4.4.5, 4.6.5
CO3	TPS3	Apply	Value	Mechanism	1.1, 1.2, 2.1,3.2, 4.1.1, 4.1.2, 4.4.5, 4.6.5
CO4	TPS3	Apply	Value	Mechanism	1.1, 1.2, 2.1,3.2, 4.1.1, 4.1.2, 4.4.5, 4.6.5
CO5	TPS3	Apply	Value	Mechanism	1.1, 1.2, 2.1,3.2, 4.1.1, 4.1.2, 4.4.5, 4.6.5
CO6	TPS3	Apply	Value	Mechanism	1.1, 1.2, 2.1,3.2, 4.1.1, 4.1.2, 4.4.5, 4.6.5

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	M	L	-	-	M	S	M	S	S	S	S	M	M
CO2	S	M	L	-	-	-	M	M	S	S	S	M	M	M
CO3	S	M	L	-	-	-	-	S	S	S	S	S	M	M
CO4	M	M	L	-	M	M	L	S	S	S	S	M	-	S
CO5	M	M	L	-	S	M	M	S	S	S	M	M	-	-
CO6	L	M	L	-	-	M	M	S	M	M	M	S	M	M

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Assignment			Terminal Examination
	1	**2**	**3**	1	2	3	
Remember	20	20	20	-	-	-	20
Understand	30	30	30	-	-	-	20
Apply	50	50	50	100	100	100	60
Analyse	-	-	-	-	-	-	-
Evaluate	-	-	-	-	-	-	-
Create	-	-	-	-	-	-	-

Assessment Pattern: Psychomotor

Psychomotor Skill	**Mini project/Assignment/Practical Component**
Perception	
Set	
Guided Response	
Mechanism	Assignment
Complex Overt Responses	
Adaptation	
Origination	

Sample Questions for Course Outcome Assessment**

Course Outcome 1(CO1):

1. Prepare Trading Account, Profit and Loss Account and Balance Sheet from the following

S.NO	PARTICULARS	Debit balances (in Rs)	Credit balances(in Rs)
1	Capital		300000
2	Bank	15000	
3	Plant and machinery	40000	
4	Land and building	60000	
5	Debtors	20000	
6	Creditors		40000
7	Cash	70000	
8	Purchases and sales	35000	50000
9	Purchase returns and sales returns	7000	4000
10	Bills receivable	3000	
11	Bills payable		5000
12	Wages	40000	
13	Salaries	30000	
14	Discount		4000
15	Stock on Jan 2017	10000	
16	Furniture	7000	
17	Carriage inwards	5000	
18	Carriage outwards	6000	
19	Advertising	10000	
20	Travelling expense	3000	
21	Loans		60000
22	Vans	100000	
23	Telephone	2000	
	Total	**463000**	**463000**

2. From the following particulars, prepare comparative balance sheet of Malar Ltd as on 31st March 2017 and 31st March 2018.

Particulars	31st March 2017	31st March 2018
I EQUITY AND LIABILITIES		
1. Shareholders' fund		
a) Share capital		
b) Reserves and surplus	2,00,000	2,50,000
2. Non-current liabilities	50,000	50,000
Long-term borrowings		
3. Current liabilities	30,000	60,000
Trade payables		
	20,000	60,000
Total	**3,00,000**	**4,20,000**
II ASSETS		
1. Non-current assets		
a) Fixed assets	1,00,000	1,50,000
b) Non - current investments	50,000	75,000
2. Current assets		
a)Inventories	75,000	1,50,000
b) Cash and cash equivalents	75,000	45,000
Total	**3,00,000**	**4,20,000**

Course Outcome 2(CO2):

1. Classify the cost according to function.
2. Prepare cost sheet in the book of Vimi from the following particulars.

Opening stock: -	Raw material	=	Rs 5,000
	Finished goods	=	Rs 4,000
Closing stock:	Raw material	=	Rs 4,000
	Finished goods	=	Rs 5,000

Raw material purchased	=	Rs 50,000
Wages paid to laboures	=	Rs 20,000
Chargeable expenses	=	Rs 2,000
Rent and Taxes	=	Rs 7,400
Power	=	Rs 3,000
Experimental expenses	=	Rs 600
Sale of wastage of material	=	Rs 200
Office management salary	=	Rs 4,000
Office printing & stationery	=	Rs 200
Salaries to salesman	=	Rs 2,000
Commission to traveling agents	=	Rs 1,000
Sales	=	Rs 1, 00,000

Course Outcome 3(CO3):

1. Explain the advantages and applications of budgetary control.
2. From the forecast of income and expenditure prepare a cash budget for the months from April to June 2019.

Month	Sales Rs	Purchases Rs	Wages Rs	Office expenses Rs	Selling expenses Rs
Feb	70,000	45,000	4,500	2,700	1,800
Mar	72,000	43,000	4,700	3,000	2,000
Apr	75,000	44,000	4,900	2,900	2,200
May	71,000	40,000	5,000	3,000	2,100
Jun	70,000	42,000	5,000	2,800	1,900

- Plant worth Rs25, 000 purchased in June. 40% payable immediately and the remaining in two equal instalments in subsequent months.
- Advance tax payable in April Rs 4500
- Period of credit allowed
  - By suppliers 2 months
  - To customer 1 month
- Dividend payable Rs 7000 in June
- Delay in payment of wages and office expenses 1 month and selling expenses 1 month. Expected cash balance on 1st April Rs 30,000

Machinery expected to sell on May is Rs 20,000

Course Outcome 4 (CO4):

1. From the following information calculate the Breakeven point in terms of units and breakeven point in terms of sales. Sales....Rs.10,000, Variable costs Rs.6,000,fixed costs Rs.2000:profit Rs.2,000;No. Of units produced 1,000 units.
2. Calculate the breakeven point and margin of safety from the following information Fixed cost .Rs.10,000, sales in Rs.25,000,selling price per unit Rs.30; variablecost per unit Rs.10.

Course Outcome 5(CO5):

1. From the following information extracted from the books of a manufacturing company, compute the operating cycle in days and the amount of working capital required:

Period Covered	365 days
Average period of credit allowed by suppliers	16 days
Average Total of Debtors Outstanding	480
Raw Material Consumption	4,400
Total Production Cost	10,000
Total Cost of Sales	10,500
Sales for the year	16,000
Value of Average Stock maintained:	
Raw Material	320
Work-in-progress	350
Finished Goods	260

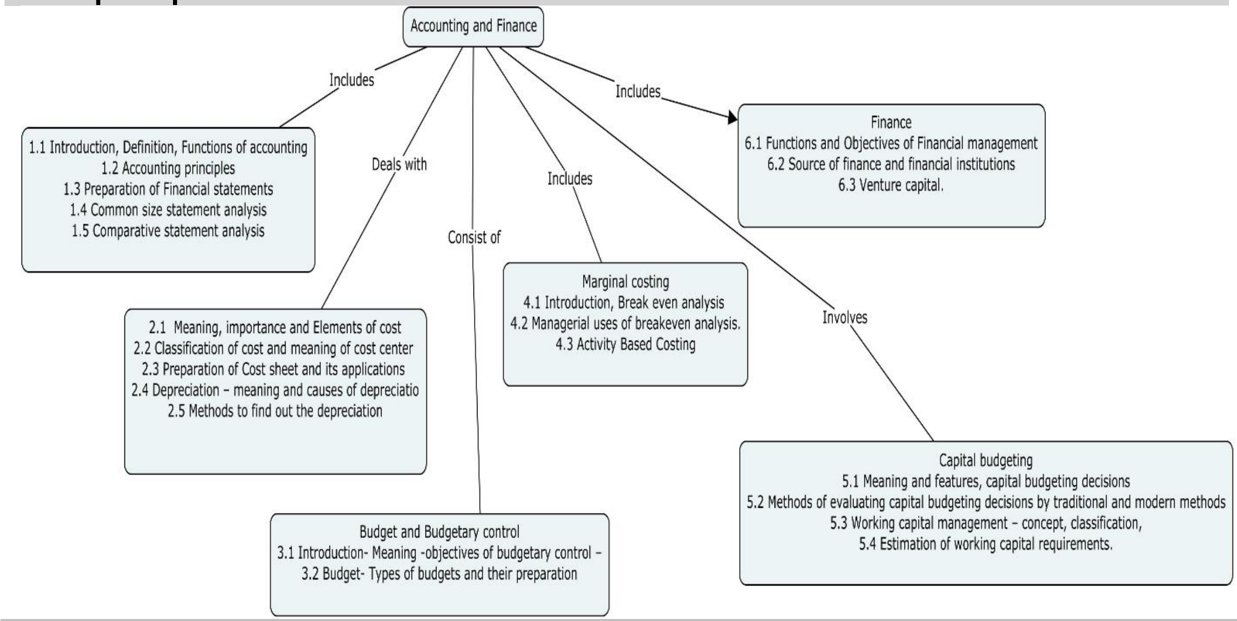
2. From the following data of a project, Calculate IRR and suggest whether the project is to be undertaken or not if the cut off rate is 9%.

Cash Out flow (Rs.)		1,50,000
Cash Inflow(Rs.)	**Year 1**	41,000
	Year 2	50,000
	Year 3	50,000
	Year 4	42,000

Course Outcome 6(CO6):

1. Analyse the sources of finance to start small scale business.
2. Suggest suitable sources of finance to start a business with a capital of 60 crores.

Concept Map



Syllabus

Accounting Introduction definition, functions of accounting, accounting principles. Preparation of financial statements and study them with common size and comparative statements.

Cost Accounting - Meaning and importance -Elements of cost- classification of cost- Cost centre, Preparation of cost sheet and its applications .Depreciation – meaning and causes of depreciation, Methods to find out the depreciation

Budget and Budgetary control- Introduction-Meaning -objectives of budgetary control –Budget- Types of budgets and their preparation.

Marginal costing- Introduction, Break even analysis –Managerial of breakeven analysis. Activity based Costing.

Capital budgeting- Meaning and features, capital budgeting decisions, Methods of evaluating capital budgeting decisions by traditional and modern methods. Working capital management - concept, classification, and Estimation of working capital requirements.

Finance: Functions, Objectives of financial management and Sources of finance and financial institutions, Venture capital.

Course Contents and Lecture Schedule

Module No	**Topic**	**No. of Lectures**	**Cos**
1	**Accounting**		CO1
1.1	Introduction, Definition, Functions of accounting	1	
1.2	Accounting principles	1	
1.3	Preparation of Financial statements	3	
1.4	Common size statement analysis	1	
1.5	Comparative statement analysis	1	
2	**Cost Accounting**		CO2
2.1	Meaning, importance and Elements of cost	1	
2.2	classification of cost and meaning of Cost centre,	1	

2.3	Preparation of Cost sheet and its applications	3	
2.4	Depreciation – meaning and causes of depreciation	1	
2.5	Methods to find out the depreciation	2	
3	**Budget and Budgetary control**		CO3
3.1	Introduction- Meaning -objectives of budgetary control –	1	
3.2	Budget- Types of budgets and their preparation	4	
4	**Marginal costing**		CO4
4.1	Introduction, Break even analysis	2	
4.2	Managerial uses of breakeven analysis.	1	
4.3	Activity Based Costing	2	
5	**Capital budgeting**		CO5
5.1	Meaning and features, capital budgeting decisions	1	
5.2	Methods of evaluating capital budgeting decisions by traditional and modern methods	4	
5.3	Working capital management – concept, classification,	1	
5.4	Estimation of working capital requirements.	1	
6	**Finance**		CO6
6.1	Functions and Objectives of Financial management	1	
6.2	Sources of finance and financial institutions	3	
6.3	Venture capital.	1	
	Total	**36 hrs**	

Learning Resources

1. M.C.Shukla,T.S.Grewal,“AdvancedAccounts-Volume-I,2010 Reprint, S. Chand & company Ltd.,2010.
2. Prasanna Chandra, “Financial Management-Theory and practice” seventh Reprint,Tata McGraw-Hill publishing company Limited,2010.
3. P.S.BoopathiManickam “Financial and Management Accounting” PSG publications 2009.
4. Don R. Hansen and Maryanne M. Mowen “Cost Management: Accounting and Control, Fifth Edition” Thomson, 2006.
5. Michael C . Ehrhardt and Eugene F . Brigham, “Financial Management: Theory and Practice -thirteenth edition” South-Western cengage learning, 2011
6. Pandey, “Financial Management”, Vikas Publishing House Pvt. Ltd., 2007
7. Paramasivan.C, Subramanian.T, “Financial management” New Age international Publishers, 2014.
8. https://nptel.ac.in/courses/110/106/110106135/: Decision making using financial accounting, Prof. G Arun Kumar, IIT Madras
9. https://nptel.ac.in/courses/110/101/110101131/ : Financial Accounting, Dr. Varadraj Bapat, IIT Bombay.
10. https://nptel.ac.in/courses/110/107/110107127/: Management Accounting, Prof. Anil K. Sharma, IIT Roorkee.
11. https://www.youtube.com/watch?v=P9JIBbZas3w: Introduction to accounting, Dr.S.Vaidhyasubramanian, Adjunct professor, Sastra University.

Course Designers:

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18CS770	ENGINEERING TOOLS LAB

Category	L	T	P	Credit
PC	-	-	2	1

Preamble

This course enables students to gain higher order thinking skills in the core knowledge areas of Computer Science and Engineering. This lab represents a confluence of experiments from key-learning areas such as networks, systems, databases, software engineering and multimedia. It aims at imparting a hands-on experience using tools and techniques, which will be useful for a student in completing his/her final year project.

Prerequisite

Nil

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Test the performance of connection oriented and connectionless transport protocols in a simulated environment	15
CO2	Develop and Implement parallel algorithms for a given application using MPI and OpenMP	15
CO3	Create and manipulate video files using open source video editing tools like Blender, Ajax Animator, Adobe Flash, Maya.	15
CO4	Choose the relevant machine learning model for the given data and assess model with appropriate metrics and also manage the roles in a database system	20
CO5	Design, test and analyze the performance of Operating System(OS) components like schedulers, I/O drivers by modifying the open source-code of OS	20
CO6	Develop scripts to automate the testing of web applications	15

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value	Mechanism	1.2,2.2.3,3.2.3,3.2.4
CO2	TPS3	Apply	Value	Mechanism	1.2, 2.2.3,3.2.3,4.5.3
CO3	TPS3	Apply	Value	Mechanism	1.2, 2.2.3,3.2.3,4.5.3
CO4	TPS4	Analyse	Organise	Complex Overt Responses	1.2,2.2.3, 3.2.3,3.2.4,3.2.6, 4.3.3

CO5	TPS4	Analyse	Organise	Complex Overt Responses	1.2,2.1.2,2.2.3, 3.2.3,3.2.4,3.2.6, 4.3.3
CO6	TPS3	Apply	Value	Mechanism	1.2,2.2.3,3.2.3,3.2.4,3.2.6, 4.3.3

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L		S	L	L	L	L	L		L	M	M	L
CO2	S	M	L		S	L	L	L	L	L		L	M	M	L
CO3	S	M	L		S	L	L	L	L	L		L	M	M	L
CO4	S	S	M	L	S	L	L	L	L	L		L	S	M	L
CO5	S	S	M	L	S	L	L	L	L	L		L	S	M	L
CO6	S	M	M		S	L	L	L	L	L		L	M	M	L

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Model Examination	Terminal Examination
Remember	-	-
Understand	20	20
Apply	50	50
Analyse	30	30
Evaluate	-	-
Create	-	-

Assessment Pattern: Psychomotor

Psychomotor Skill	~~Miniproject~~ /Practical Component/Observation
Perception	-
Set	-
Guided Response	20
Mechanism	50
Complex Overt Responses	30
Adaptation	-
Origination	-

List of Experiments/Activities with CO Mapping

Sl. No	List of Experiments	CO
1.	Analyze the performance of connection oriented and connectionless transport protocols in a simulation environment using NS3.	CO1
2.	Generate TCP,UDP, ICMP packet using TCP-NPing and analyze the packet structure using Tshark or Wireshark tool.	CO1
3.	Design the parallel program for all-pairs shortest path problem using MPI Library.	CO2
4.	Develop parallel program to perform matrix multiplication using OpenMP constructs.	CO2

5.	Design an advertisement using any open source 2D animation tool. Use the UI components, multimedia usage, location-based services etc.	CO3
6.	Create a short film using any open source 3D animation tool and show the Image manipulations.	CO3
7.	Validate the prediction performance of multidimensional data using Machine-learning models on WEKA and do statistical analysis using R.	CO4
8.	Create and manage users, groups and their access rights by using DCL commands. Test the data integrity and consistency using with ONDELETE/NULL options.	CO4
9.	Design and modify the schedulers for Minix OS.	CO5
10	Implement the I/O drivers for Minix OS.	CO5
11	Perform acceptance testing for a web application using Selenium.	CO6
12	Test the Performance of the given Web Application using JMeter.	CO6

Learning Resources

1. https://www.researchgate.net/publication/289433539_Simulation-based_ Performance_ of_ Transport_Protocols_Using_MPEG-4_Traffics_over_4G_ Network
2. http://jianh.web.engr.illinois.edu/papers/atc16-paper-huang.pdf
3. https://library.iimb.ac.in/bulletin_10
4. https://www.adobe.com/in/creativecloud/video/pro-video-tools.html
5. https://web.iiit.ac.in/~abhinav/OS/os.pdf
6. https://www.softwaretestinghelp.com/automation-testing-tutorial-5/

Course Designers:

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18ES790	**CAPSTONE DESIGN PROJECT** (COMMON TO B.E./B.TECH PROGRAMMES)

Category	L	T	P	Credit
Project	0	0	6	3

Preamble

Capstone Design Project is a culminating course where students work in teams to design, build, and test prototypes with real world applications. The Capstone Design course provides students an opportunity to work with real-world, open-ended, interdisciplinary challenges proposed by industrial and research project sponsors. They learn and apply the engineering design process: defining functional requirements, conceptualization, analysis, identifying risks and countermeasures, selection, and physical prototyping. Student teams design and build working, physical prototypes to validate their solutions. The course reemphasizes teamwork, project management, research and development.

Prerequisite

NIL

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement
CO1	Apply prior knowledge, independent research, published information, patents, and original ideas in addressing complex engineering problems and generating solutions.
CO2	Make design decisions based on product design requirements, product lifecycle considerations, resource availability, and associated risks
CO3	Develop design solutions in addressing performance requirements while satisfying relevant societal/industrial and professional constraints.
CO4	Demonstrate effective use of contemporary tools for engineering analysis, fabrication, testing, and design communication.
CO5	Plan, monitor, and manage project schedule, resources, and work assignments to ensure timely and within-budget completion.
CO6	Test and defend performance of a design product with respect to at least one primary design requirement.
CO7	Perform professionally—exhibiting integrity, accepting responsibility, taking initiative, and providing leadership necessary to ensure project success.
CO8	Use formal and informal communications with team, advisor, and clients to document and facilitate progress

CO Mapping with CDIO Curriculum Framework

CO#	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value	Mechanism	1.1, 1.2,1.3, 2.1, 2.2, 2.4, 3.1, 3.2, 4.1, 4.2, 4.3, 4.4, 4.5
CO2	TPS5	Evaluate	Organise	Adaptation	4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.1.5, 4.1.6, 4.2.1, 4.2.2, 4.2.3, 4.2.4
CO3	TPS3	Apply	Value	Mechanism	4.4.1, 4.4.2, 4.4.3, 4.4.4, 4.4.5
CO4	TPS4	Analyse	Organise	Complex Overt Response	4.5.1, 4.5.2, 4.5.3, 4.5.4, 4.5.5

CO5	TPS4	Analyse	Organise	Complex Overt Response	4.3.1, 4.3.2, 4.3.3, 4.3.4
CO6	TPS4	Analyse	Organise	Complex Overt Response	4.5.1, 4.5.2, 4.5.3, 4.5.4, 4.5.5
CO7	TPS3	Apply	Value	Mechanism	2.5.1, 2.5.2
CO8	TPS3	Apply	Value	Mechanism	3.2.1, 3.2.2, 3.2.3, 3.2.4, 3.2.5, 3.2.6

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	L	-	-	M	M	S	S	M	M	S
CO2	S	S	M	L	S	M	M	M	S	M	M	S
CO3	S	M	L	-	-	M	M	M	S	M	M	S
CO4	S	S	M	L	M	M	M	M	S	M	M	S
CO5	S	S	M	L	M	M	M	M	S	M	S	S
CO6	S	S	M	L	M	M	M	M	S	M	M	S
CO7	S	M	L	-	-	M	M	S	S	S	M	S
CO8	S	M	L	-	-	M	M	S	S	S	M	S

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Phases	Deliverables	Marks	Course Outcomes
Continuous Assessment			
Comprehensive Test on disciplinary knowledge*	MCQ format	20	CO1
Review 1 – Capstone Project Selection, functional decomposition and Technical Specification	Technical Report & Presentation	25	CO1, CO2, CO7, CO8
Review 2 – Evaluation of Design Approaches, Project planning and modern tool usage	Technical Report & Presentation	30	CO3, CO4, CO5, CO7, CO8
Review 3 – Evaluation of Testing and Validation, Documentation	Technical Report & Presentation	25	CO5, CO6, CO7, CO8
End-Semester Examination			
Demonstration of the product	Presentation & Viva -voce	60	CO1, CO2, CO3, CO4 CO5, CO6, CO7, CO8
Poster Presentation	Poster	40	

- Reports are to be submitted at each review. The report and presentation will be evaluated based on customized domain-specific rubrics for periodic reviews.
- Demonstration and Poster presentation will be evaluated by two faculty members nominated by their respective Head of the Department.

***** The content for comprehensive test on disciplinary knowledge shall be decided by the committee at department level.

Course Designers:

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CURRICULUM AND DETAILED SYLLABI

FOR

B.E DEGREE (Computer Science and Engineering) PROGRAMME

PROGRAMME ELECTIVES

FOR THE STUDENTS ADMITTED FROM THE

ACADEMIC YEAR 2018 - 2019 ONWARDS

THIAGARAJAR COLLEGE OF ENGINEERING

(A Government Aided ISO 9001-2008 certified
Autonomous Institution affiliated to Anna University)

MADURAI – 625 015, TAMILNADU

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18CSPA0	DATA WAREHOUSING AND MINING

Category	L	T	P	Credit
PE	3	0	0	3

Preamble

This course aims at facilitating the student to understand the concepts of data warehousing and various techniques involved in mining the data.

Prerequisite

The concepts of databases.

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage in %
CO1	Build a data warehouse for a given specification using DMQL and perform various On Line Analytical Processing operations on it.	20
CO2	Prepare a dataset for decision making process by using Data Cleaning, Transformation, Discretization, Feature extraction and Feature Selection methods.	20
CO3	Describe the different data mining techniques and compare data mining systems with database systems.	10
CO4	Generate association rules for a given database by applying association rule mining algorithms like Apriori, FP-Growth	15
CO5	Construct a classifier from the given dataset by using classification algorithm like Decision Tree and frequent pattern based method.	15
CO6	Discover clusters for a given database by applying clustering methods like partition based, density based clustering and concept based.	15
CO7	Describe the concepts of data mining applications like sequence mining, temporal mining, text mining and web mining.	5

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value	Mechanism	1.3, 2.1.1, 2.1.2, 2.1.5, 3.1, 4.3.3
CO2	TPS3	Apply	Value	Mechanism	1.3, 2.1, 2.1.1, 2.1.2, 2.1.5, 3.1, 4.3.3
CO3	TPS2	Understand	Respond	Guided Response	1.3,4.3.1
CO4	TPS3	Apply	Value	Mechanism	1.3, 2.1, 2.1.1, 2.1.5, 4.1.2
CO5	TPS3	Apply	Value	Mechanism	1.3, 2.1, 2.1.1, 2.1.5, 4.1.2
CO6	TPS3	Apply	Value	Mechanism	1.3, 2.1, 2.1.1, 2.1.5, 4.1.2
CO7	TPS2	Understand	Respond	Guided Response	1.3,4.3.2

Mapping with Programme Outcomes and Programme Specific Outcome

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L		M			M	M	L			M	M	M
CO2	S	M	L		M			M	M	L		L	M	M	M
CO3	M	L											L		
CO4	S	M	L	M	M	L	L	M	M	L		L	M	M	M
CO5	S	M	L	M	M	L	L	M	M	L		L	M	M	M
CO6	S	M	L	M	M	L	L	M	M	L		L	M	M	M
CO7	M	L											L		

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Assignment			Terminal Examination
	1	2	3	1	2	3	
Remember	20	20	20	-	-	-	15
Understand	30	30	30	-	-	-	25
Apply	50	50	50	100	100	100	60
Analyse	-	-	-	-	-	-	-
Evaluate	-	-	-	-	-	-	-
Create	-	-	-	-	-	-	-

Assessment Pattern: Psychomotor

Psychomotor Skill	Miniproject /Assignment/Practical Component
Perception	-
Set	-
Guided Response	10
Mechanism	90
Complex Overt Responses	-
Adaptation	-
Origination	-

Sample Questions for Course Outcome Assessment

Course Outcome1 (CO1):

1. Report the ‘Library management system’ in the form of a Star schema and give the implementation model using DMQL. (Apply)
2. Demonstrate the OLAP operations using DMQL with an example. (Apply)

3. Suppose that a data warehouse consists of the three dimensions time, doctor, and patient, and the two measures count and charge, where charge is the fee that a doctor charges a patient for a visit. Draw a snowflake schema diagram for the data warehouse. (Apply)

Course Outcome2 (CO2):

1. Normalize 23, -23, 27, 39, 41, 47, 50, 52, 54, 60 using the decimal scaling method. (Apply)
2. Suppose a group of 12 sales price records has been stored as follows:
   5, 10, 11, 13, 15, 35, 50, 55, 72, 92, 204, 215.
   Partition them into 3 bins by equal width binning. (Apply)
3. For the following Database, apply the entropy-based discretization for the numerical attribute and find the best split. (Apply)

S.NO	Age	Credit rating
1.	25	Fair
2.	29	Excellent
3.	35	Fair
4.	42	Excellent
5.	47	Fair
6.	49	Excellent
7.	32	Fair
8.	34	Fair
9.	37	Excellent
10.	40	Fair

Course Outcome3 (CO3):

1. Explain the major tasks of Data Mining. (Understand)
2. Differentiate OLTP and OLAP. (Understand)
3. Describe the steps in KDD process. (Understand)

Course Outcome4 (CO4):

1. Illustrate the significance of candidate set generation step of level wise algorithm. (Understand)
2. For the given database find all the frequent item sets using Apriori method and list all the strong association rules that match the metarule

   $\forall$ x € transaction , buys(X,item1) ^ buys(X,item2) $\Rightarrow$ buys(X,item3). (Apply)

TID	Items bought
100	{f, a, c, d, g, i, m, p}
200	{a, b, c, f, l, m, o}
300	{b, f, h, j, o, w}
400	{b, c, k, s, p}
500	{a, f, c, e, l, p, m, n}

Minimum Support = 30%

Minimum Confidence = 70%

3. For the given database, using the Apriori algorithm finds all the Strong association rules which is used for deciding the profit level of the company. Assume the min support=30% and min confidence=70%. (Apply)

S.NO	Age	Credit rating
1.	25	Fair
2.	29	Excellent
3.	35	Fair
4.	42	Excellent
5.	47	Fair
6.	49	Excellent

Course Outcome5 (CO5):

1. Describe the importance of pruning in decision tree construction with an example. (Understand)
2. For the following Database use ID3 algorithm to construct the decision tree and partition the database based on the classification rules obtained from the decision tree. (Apply)

Outlook	Temp(F)	Windy	Class
Sunny	medium	True	Play
Sunny	low	True	No
Overcast	low	True	Play
Overcast	high	False	Play
Rain	low	False	No
Rain	low	True	Play

3. For the above given database, compute the class association rules using the frequent pattern based approach, which will be helpful in making the decision to Play or No. (Apply).

Course Outcome6 (CO6):

1. Suppose that the data mining task is to Cluster the following eight points (with (x,y) representing locations) into 3 clusters

   A1(2,10), A2(2,5), A3(8,4), B1(5,8), B2(7,5), B3(6,4), C1(1,2), C2(4,9)

The distance function is Euclidean distance. Suppose initially assign A1, B1 and C1 as the center of each cluster respectively. Use K-Means algorithm to show the final three clusters. (Apply)

2. For the following data set using the COBWEB algorithm and construct the classification tree. (Apply)

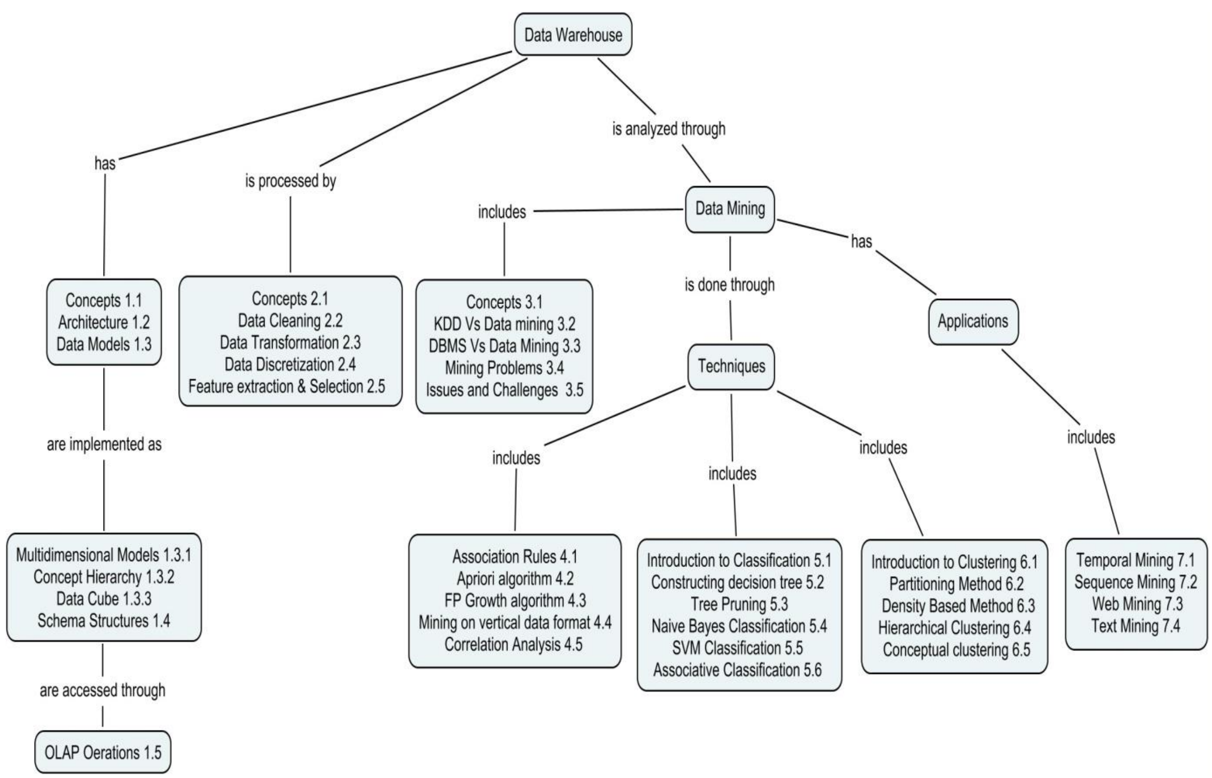
Outlook	Sunny	Sunny	Overcast	Overcast
Temperature	60	80	75	80
Humidity	90	70	90	70

3. Given two objects A1(22,1,42,10) and A2(20,0,36,8) compute the distance by Euclidean measure. (Apply)

Course Outcome7 (CO7):

1. Explain the use of Web mining. (Understand)
2. Outline the pre-processing steps in text mining. (Understand)
3. Differentiate temporal mining and Sequence mining with an example. (Understand)

Concept Map



Syllabus

Introduction to Data warehouse – Concepts, Architecture, Data Models, Multidimensional Models - Data Cube construction using DMQL, Concept Hierarchy, Schema Structures, OLAP operations using DMQL. **Pre-processing -** Concepts, Data Cleaning, Transformation, Discretization, Feature extraction & Selection, Preprocessing using R tool. **Introduction to Data Mining –** Concepts, KDD Vs Data mining, DBMS Vs Data Mining, Other Mining Problems, Issues and Challenges. **Association Techniques -** Introduction to Association Rules, Types of Assosiation Rules, Apriori algorithm, FP Growth algorithm, mining on vertical data format, correlation analysis, Association Rule generation using R tool. **Classification Techniques-** Introduction to Classification **-** Constructing decision tree (ID3 Algorithm), Tree Pruning, Naive Bayes Classification, SVM Classification, Associative Classification – Classification based on frequent patterns, Classifier model building using R tool. **Clustering Techniques -** Introduction to Clustering, Partitioning Method – K Means algorithm, Density Based Method – DBSCAN method, Hierarchical clustering, Conceptual clustering – COBWEB algorithm, Cluster model building using R tool. **Applications of Data Mining -** Temporal Mining, Sequence Mining, Web Mining and Text Mining.

Learning Resources

1. Jiawei Han, Micheline Kamper, Jian Pei, “Data Mining: Concepts and Techniques “, Morgan Kaufman, Third Edition, 2012.
2. Ian H. Witten , Eibe Frank , Mark Hall , “Data Mining: Practical Machine Learning Tools And Techniques”, ELSEVIER INDIA PVT . LTD, 2011.
3. Arun K.Pujari, “Data Mining Techniques”, Second Edition, Universities Press, 2010.
4. K.P.Soman, Shyam Diwakar, V.Ajay, “Insight into Data Mining – Theory and Practice”, Prentice Hall of India, 2006.
5. M.H Dunham, “Data Mining: Introductory and advanced topics”, Pearson Education, 2006.
6. https://courses.tce.edu/

Course Contents and Lecture Schedule

Module No.	Topic	No. of Lectures	Course Outcome
1	**Introduction to Data warehouse (6)**		
1.1, 1.2	Concepts and Architecture	1	CO1
1.3	Data Models - Multidimensional Models, Concept Hierarchy	1	CO1

Module No.	Topic	No. of Lectures	Course Outcome
1.3.2	Construction of data cube using DMQL	1	CO1
1.4	Schema Structures	2	CO1
1.5	OLAP operations using DMQL	1	CO1
2	**Data Preprocessing (6)**		
2.1	Preprocessing Concepts	1	CO2
2.2, 2.3	Data Cleaning, Transformation	1	CO2
2.4	Discretization	2	CO2
2.5	Feature extraction & Selection	1	CO2
2.6	Preprocessing the data using R tool	1	CO2
3	**Introduction to Data Mining (3)**		
3.1, 3.2	Concepts, KDD Vs Data mining	1	CO3
3.3, 3.4	DBMS Vs Data Mining, Other Mining Problems	1	CO3
3.5	Issues and Challenges.	1	CO3
4	**Association Techniques (7)**		
4.1	Introduction to Association Rules, Types of Association Rules	1	
4.2	Apriori algorithm	2	CO4
4.3	FP Growth algorithm	2	CO4
4.4, 4.5	Mining on vertical data format , correlation analysis	1	CO4
4.6	Association Rule generation using R tool	1	CO4
5	**Classification Techniques (6)**		
5.1	Introduction to Classification	1	CO5
5.2, 5.3	Constructing decision tree (ID3 Algorithm), Tree Pruning	2	CO5
5.4	Naive Bayes Classification	1	CO5
5.5, 5.6	SVM Classification, Associative Classification	1	CO5
5.6	Classifier model building using R tool	1	CO5
6	**Clustering Techniques (6)**		
6.1	Introduction to Clustering	1	CO6

Module No.	Topic	No. of Lectures	Course Outcome
6.2	Partitioning Method – K Means algorithm	1	CO6
6.3, 6.4	Density Based Method – DBSCAN algorithm, Hierarchical Method	1	CO6
6.5	Conceptual clustering – COBWEB algorithm	2	CO6
6.6	Cluster model building using R tool	1	CO6
7	**Data Mining Applications (2)**		
7.1, 7.2	Temporal Mining, Sequence Mining	1	CO7
7.3, 7.4	Web Mining and Text Mining	1	CO7
	Total	**36**	

Course Designer:

1. Mrs. A.M.Rajeswari amrcse@tce.edu

18CSPB0	**CRYPTOGRAPHY**

Category	L	T	P	Credit
PE	2	1	0	3

Preamble

Cryptography is the science of information and communication security. This course will discuss common security weaknesses, vulnerabilities, attack methods and mitigation approaches in network security. The focus of the course is on confidentiality, data integrity and non-repudiation. Real time applications of cryptographic primitives are addressed.

Prerequisite

Basics of Computer Networks

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Explain conceptually the network security issues, challenges, mechanisms and the need for Security Services	10
CO2	Demonstrate the fundamentals and mathematical foundations of cryptography	22
CO3	Encrypt and Decrypt messages using Private key cryptosystems	22
CO4	Encrypt and Decrypt messages using Public key cryptosystems	14
CO5	Ensure data integrity and non-repudiation security services through hashing and signing mechanisms	18
CO6	Describe the application of cryptographic algorithms in real time protocols	14

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	Guided Response	1.3, 2.3.1
CO2	TPS3	Apply	Value	Mechanism	1.1, 1.3, 2.1.1, 2.1.2
CO3	TPS3	Apply	Value	Mechanism	1.3, 2.1.1, 4.5.1
CO4	TPS3	Apply	Value	Mechanism	1.3, 2.1.1, 4.5.1
CO5	TPS3	Apply	Value	Mechanism	1.3, 2.1.1, 4.5.1
CO6	TPS2	Understand	Respond	Guided Response	1.3, 2.3.1

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L											L		
CO2	S	M	L					M				L	M		L
CO3	S	M	L					S				L	M		L

CO4	S	M	L					S				L	M		L
CO5	S	M	L					S				L	M		L
CO6	M	L				L	L						L		

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Assignment			Terminal Examination
	1	**2**	**3**	1	2	3	
Remember	20	10	20	-	-	-	20
Understand	20	20	20	20	20	20	20
Apply	60	70	60	80	80	80	60
Analyse	-	-	-	-	-	-	-
Evaluate	-	-	-	-	-	-	-
Create	-	-	-	-	-	-	-

Assessment Pattern: Psychomotor

Psychomotor Skill	~~Miniproject~~/Assignment/~~Practical Component~~
Perception	-
Set	-
Guided Response	20
Mechanism	80
Complex Overt Responses	-
Adaptation	-
Origination	-

Sample Questions for Course Outcome Assessment**

** (2 to 3 at the cognitive level of course outcome)

Course Outcome 1 (CO1):

1. Compare and contrast attack and a threat.
2. Define Non-Repudiation security service. Explain a mechanism to achieve the same.
3. Explain Shannon's theory for Perfect secrecy.

Course Outcome 2 (CO2):

1. Find the inverse of $(x^4 + x^3 + 1)$ in $\mathrm{GF}(2^5)$ using the modulus $(x^5 + x^2 + 1)$
2. Find $(17)^{-1} \bmod 59$ and $(-17)^{-1} \bmod 59$.
3. If 'n' is composite and passes the Miller Rabin Primality test for the base a, then 'n' is called a *strong psuedoprime* to the base a. Show that 2047 is a strong psuedoprime to the base 2.

Course Outcome 3 (CO3):

1. Eve captures Bob's Hill cipher machine, which uses a 2-by-2 matrix M mod 26. She tries a chosen plaintext attack. She finds that the plaintext **BA** encrypts to **HC** and the plaintext **ZZ** encrypts to **GT**. Find M.

2. Apply the next round of DES cipher which takes the following values as input. [Assume your own key]: L7: E967CD69 R7: 064ABA10
3. For the given input key: 00112233445566778899AABBCCDDEEFF$_{HEX}$ apply key expansion algorithm to generate the key $w_4 - w_7$ and $w_8 - w_{11}$.

Course Outcome 4 (CO4):

1. In RSA, given e=13 and n=143 encrypt and decrypt the message 'BECSE'.
2. Using Public Key Cryptography solve the problem of secure secret key sharing for Symmetric Ciphers.
3. For any two points P and Q (such that P≠Q) in the curve $E_{11}(1, 6)$, find (P + Q) and 2P.

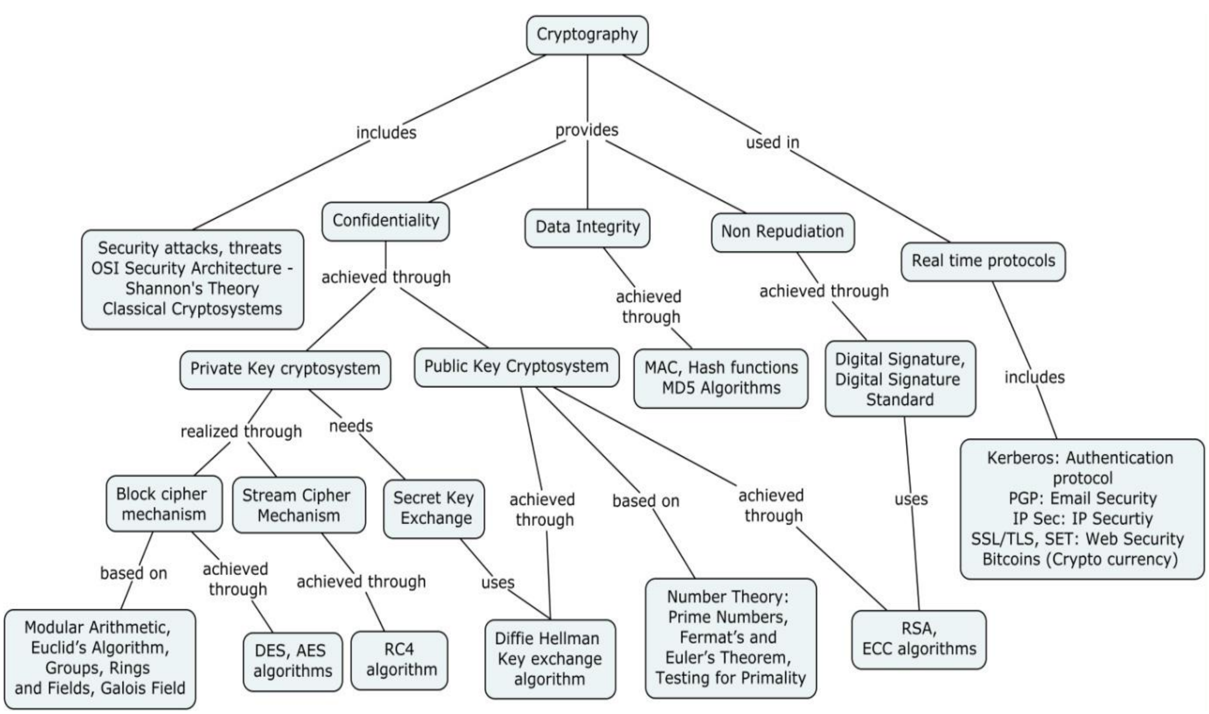
Course Outcome 5 (CO5):

1. For the message "GOD IS GREAT" using MD5, represent the message appropriately and perform the first three steps of Round F.
2. Consider Alice sending a message 'ALL IS WELL' to Bob. Authenticate the message before communication using any signing algorithm and verify the same at receiver side. Assume the necessary key values.
3. Illustrate the usage of RSA for digital signature with a working example.

Course Outcome 6 (CO6):

1. Explain the working of Kerberos authentication protocol with a neat diagram.
2. Explain the cryptographic primitives used in Bitcoin transactions.
3. Describe the construction of Dual Signature in SET.

Concept Map



Syllabus

Introduction: Security attacks and threats, OSI Security Architecture – mechanisms and services. Need for perfect secrecy, Shannon's theory. **Confidentiality:** Classification of Private-key cipher and Public-key cipher - Block cipher and Stream cipher - Classical encryption techniques, Modular Arithmetic – Hill cipher, common attacks on cryptosystems. **Block Cipher Mechanisms:** DES, Introduction to Finite Fields: Groups, Rings and Fields, Galois Fields, Advanced Encryption Standard. Block cipher modes of operation. **Stream Cipher Mechanisms:** Pseudo Random Number Generation algorithms, RC4 Stream Cipher. **Public Key Encryption**: Introduction to Number Theory- Prime Numbers, Fermat's and Euler's Theorem, Testing for Primality. Public key ciphers - RSA cryptosystem, Elliptic Curve Cryptography, **Key Management:** Diffie Hellman Key Exchange, Distribution of public keys. **Data Integrity:** Message Authentication Codes, Hash functions, MD5 Algorithm. **Non-Repudiation:** Digital Signature and Digital Signature Standard. **Real time applications:** Authentication Application – Kerberos, Electronic Mail Security – PGP, IP Security - IP Security Architecture. Web Security- Secure Socket Layer and Transport layer, Secure Electronic Transaction. Bitcoins (Crypto currency).

Learning Resources

1. William Stallings, Cryptography and Network Security - Principles and Practices, Seventh Edition, Pearson Education, 2017.
2. Behrouz A. Foruzan and Dabdeep Mukhopadhyay, Cryptography and Network Security, Third edition, Mc Graw Hill, 2015.
3. Douglus R. Stinson and Maura B. Paterson, Cryptography: Theory and Practice, Fourth edition, CRC Press, Taylor and Francis Group, 2018
4. https://www.coursera.org/learn/crypto

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1.	**Introduction (3)**		
1.1	Security attacks and threats	1	CO1
1.2	OSI Security architecture – Mechanisms and Services	1	CO1
1.3	Need for perfect secrecy – Shannon's Theory	1	CO1
2	**Confidentiality (22)**		
2.1	General cipher model - Classification of Ciphering techniques	1	CO3
2.2	Classical encryption techniques		CO2
2.3	Modular Arithmetic – Multiplicative inverse in Z_n	1	CO2
2.4	Hill Cipher – Tutorial	1	CO3
2.5	Common attacks on cryptosystems	1	CO3
2.6	**Private Key Cryptosystem - Block cipher mechanisms**		
2.6.1	Data Encryption Standard (DES) Algorithm	1	CO3
2.6.2	DES – Tutorial	1	CO3
2.6.3	Introduction to Finite Fields: Groups, Rings and Fields, Galois Fields – Tutorial	2	CO2
2.6.4	Advanced Encryption Standard (AES)	1	CO3

Module No.	Topic	No. of Hours	Course Outcome
2.6.5	AES – Tutorial	1	CO3
2.7	Block cipher modes of operation	1	CO3
2.8	**Stream Cipher mechanisms**		
2.8.1	Pseudo Random Number Generation algorithms.	1	CO2
2.8.2	RC4 Stream cipher algorithm - Tutorial	1	CO3
2.9	**Public Key Cryptosystem**		
2.9.1	Introduction to Number Theory- Prime Numbers, Fermat's and Euler's Theorem	1	CO2
2.9.2	Testing for Primality		CO2
2.9.3	Tutorial on number theory	1	CO2
2.9.4	RSA cryptosystem	2	CO4
2.9.5	Elliptic Curve Arithmetic	2	CO2
2.9.6	Elliptic Curve Cryptography	1	CO4
2.9.7	Tutorial on RSA, ECC	1	CO4
2.10	**Key Management** – Diffie Hellman Key Exchange algorithm, Distribution of public keys	1	CO4
3	**Data Integrity (4)**		
3.1	Message Authentication Codes	1	CO5
3.2	Hash Functions		
3.3	MD5 Algorithm	2	CO5
3.4	Tutorial on MD5	1	CO5
4	**Non-Repudiation (2)**		
4.1	Digital Signature and Digital Signature Standard	1	CO5
4.2	Tutorial on Digital signature	1	CO5
5	**Real time applications (5)**		
5.1	Authentication Application – Kerberos,	1	CO6
5.2	Electronic Mail Security – PGP, IP Security	1	CO6
5.3	Web Security- Secure Socket Layer and Transport layer, Secure Electronic Transaction - Tutorial	2	CO6
5.4	Bitcoins (Crypto currency)	1	CO6
	Total	36	

Course Designers:

1. M.Suguna mscse@tce.edu

18CSPC0	KERNEL PROGRAMMING

Category	L	T	P	Credit
PE	3	0	0	3

Preamble

This course introduces basics of designing kernel components in structuring the operating system. The course is structured on a widely used operating system minix. The students will get a chance to reinforce concepts in the working of a “real” operating system. The idea is to learn and explore a full-fledged operating system and to use it for kernel-based modifications.

Prerequisite

Basic Knowledge of Operating Systems

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Explain the role of kernel in operating system, the types of kernel design and the features of kernel	15
CO2	Illustrate the steps involved in the Kernel booting process	10
CO3	Configure and Control kernel daemon services using GUI tools and commands	20
CO4	Configure the System Network through configuration files and services	20
CO5	Configure the kernel to manage the processes executing in the system	15
CO6	Configure the file system and kernel modules of the operating system	20

*** Weightage depends on Bloom’s Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	Guided Response	1.3,2.3.2,4.4.3
CO2	TPS2	Understand	Respond	Guided Response	1.3,2.3.2,4.4.3
CO3	TPS3	Apply	Value	Mechanism	1.2,1.3, 2.3.2, 3.1.2,3.2.4,4.4.3
CO4	TPS3	Apply	Value	Mechanism	1.2,1.3, 2.3.2, 3.1.2,3.2.4,4.4.3
CO5	TPS3	Apply	Value	Mechanism	1.2,1.3, 2.3.2, 3.1.2,3.2.4,4.4.3
CO6	TPS3	Apply	Value	Mechanism	1.2,1.3,2.3.2, 3.1.2,3.2.4,4.4.3

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L			M								L		
CO2	M	L			M								L		
CO3	S	M	L	L	M	L			M	M	L		M	L	L

CO4	S	M	L	L	M	L			M	M	L		M	L	L
CO5	S	M	L	L	M	L			M	M	L		M	L	L
CO6	S	M	L	L	M	L			M	M	L		M	L	L

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Assignment			Terminal Examination
	1	2	3	1	2	3	
Remember	25	25	20	-	-	-	10
Understand	40	35	20	20	20	20	30
Apply	35	40	60	80	80	80	60
Analyse	-	-	-	-	-	-	-
Evaluate	-	-	-	-	-	-	-
Create	-	-	-	-	-	-	-

Assessment Pattern: Psychomotor

Psychomotor Skill	~~Miniproject~~ /Assignment/~~Practical Component~~
Perception	-
Set	-
Guided Response	20
Mechanism	80
Complex Overt Responses	-
Adaptation	-
Origination	-

Sample Questions for Course Outcome Assessment**
** (2 to 3 at the cognitive level of course outcome)

Course Outcome 1 (CO1):
1. List the tasks performed by kernel.
2. How does user mode differ from privileged mode?

Course Outcome 2 (CO2):
1. Explain the steps in booting of UNIX based kernel.
2. List the various run levels provided by Linux based kernel.

Course Outcome 3 (CO3):
1. Identify the command line and text-line utility of UNIX based kernel used to configure the kernel service. Give their functions. Using the tools, list the services running in the current run level and give the command option to disable the network service in the run level 5.
2. Demonstrate the steps used by the system administrator to collect information in case of kernel crash and give the tool used in this information gathering process.

Course Outcome 4(CO4):

1. Set up the Firewall for the UNIX based system and illustrate the steps. Using the Firewall restrict the access to the site Facebook.com and drop the packets coming with the HTTP and HTTPS applications.
2. Configure the firewall for the UNIX based system with default rules for incoming and outgoing messages. Accept the incoming messages from addresses 250.16.98.90 and 256.15.67.89 through the ports 21, 443. Drop the packets coming with the UDP protocol through the ports 53 and 8080.

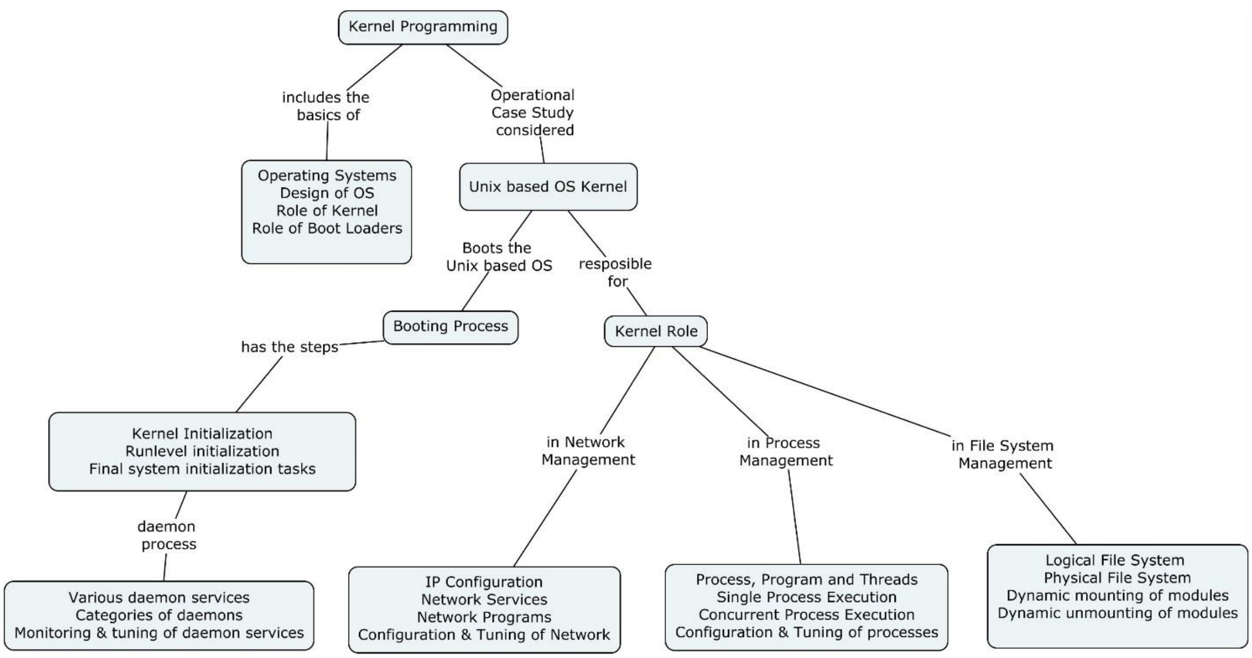
Course Outcome 5 (CO5)

1. Consider a UNIX based system. Using the process scheduler schedule a regular process of taking the backup of the database every day evening at 05:00PM and illustrate the steps performed by the Linux Process Manager component.
2. Illustrate the default schedulers available in UNIX based system and their functions.

Course Outcome 6 (CO6)

1. Consider a UNIX based System without the USB and Bluetooth modules not mounted during booting. Using the commands insmod, lsmod, and rmmod show the steps to mount the USB device and the Bluetooth device during runtime after the kernel is booted. Also illustrate the steps and give the difference between this method and the modprobe method of installation.
2. Name the files to work with when configuring the nfs. Give the command used to plugin a UNIX based kernel module.

Concept Map



Syllabus

Kernel Structure: UNIX kernel structure – Overview of Operating Systems and Kernel - Linux kernel design and modes of operation –The Kernel Source Structure – Kernel Data Structures – Case study - UNIX based operating system.

Kernel Booting & Initialization Process: Boot Process – Boot Loaders and Loading of Kernel – Initialization of the Kernel.

Kernel Daemon Processes: Daemon services - Categories of services - Significant services working- Starting and Stopping services - Configuring services through GUI tools - Configuring services through configuration files - configuring Syslog - configuring NFS.
nfs **Kernel role in System Networking:** Networking devices - The TCP/IP protocol stack - System IP address - Static IP address - Dynamic IP address - Setting up a DHCP server - Network Services – Network Programs - the ip program and netstat - Firewall – Configuration - the iptables – iptables rules.
Kernel role in Managing Processes: Programs, Processes and Threads - Process address space - Single process execution - Concurrent process execution - Starting, pausing, and resuming processes – System Calls - Interrupt handling - Killing processes & process termination, methods of killing processes and methods to shut down – Process Monitoring - GUI Monitoring tools, Command-line Monitoring tools.
Kernel role in File System operations: Disk storage and Accessing – File and types of Files - Root partition directories - /dev, /proc, /sys, /etc, /home, /bin, /usr, /var etc. – File Systems – mount points, mounting and unmounting file systems – Partitions – Device drivers – Dynamic Loading and unloading of kernel modules.

Learning Resources

1. Operating Systems Design and Implementation, Andrew S.Tanenbaum and Albert S. Woodhull, Pearson Prentice Hall, third edition, 2006.
2. Linux with Operating System Concepts, Richard Fox, CRC Press, Taylor & Francis, A Chapman & Hall Book, 2015.
3. Linux Kernel Development, Robert Love, Pearson Education, Third Edition, 2010.
4. Advanced Programming in the UNIX environment, W.Richard Stevens, Stephen A.Rago, Addison-Wesley Professional Computing Series, Third Edition, 2013, Pearson Education.
5. The Linux Kernel Module Programming Guide, Peter Jay Salzman, Michael Burian, OriPomerantz, 2009, Soho Books publisher.
6. Linux System Programming, Robert Love, O’Reilly Media, Inc., Second Edition, 2014.
7. https://www.udemy.com/course/linux-kernel-module-programming/

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcomes
1.	**Kernel Structure (5)**		
1.1	UNIX kernel structure	1	CO1
1.2	Overview of Operating Systems and Kernel	1	CO1
1.3	Kernel design and modes of operation	1	CO1
1.4	The Kernel Source Structure and Kernel Data Structures	1	CO1
1.5	Case study - UNIX based operating system	1	CO1
2.	**Kernel Booting & Initialization Process (3)**		
2.1	Boot Process	1	CO2
2.2	Boot Loaders and Loading of Kernel	1	CO2
2.3	Initialization of the Kernel	1	CO2
3.	**Kernel Daemon Processes (7)**		
3.1	Daemon Services	1	CO3
3.2	Categories of services	1	CO3
3.3	Examination of Significant kernel services	1	CO3
3.4	Starting and Stopping services	1	CO3

Module No.	Topic	No. of Hours	Course Outcomes
3.5	Configuring services through GUI tools	1	CO3
3.6	Configuring services through configuration files - Configuring Syslog & Configuring NFS	2	CO3
4.	**Kernel role in System Networking (8)**		
4.1	Networking devices & The TCP/IP protocol stack	1	CO4
4.2	System IP address - Static IP address & Dynamic IP address	2	CO4
4.3	Setting up a DHCP server	1	CO4
4.4	Network Services	1	CO4
4.5	Network Programs - the ip program and netstat	1	CO4
4.6	Firewall – Configuration	1	CO4
4.7	The iptables& rules of iptables	1	CO4
5.	**Kernel role in Managing Processes (6)**		
5.1	Programs, Processes and Threads	1	CO5
5.2	Process address space - Single process execution & Concurrent process execution	1	CO5
5.3	Starting, pausing, and resuming processes	1	CO5
5.4	System Calls & Interrupt handling		CO5
5.5	Killing processes & process termination, methods of killing processes and methods to shut down	1	CO5
5.6	Process Monitoring - GUI Monitoring tools, Command-line Monitoring tools	1	CO5
6	**Kernel role in File System operations (7)**		
6.1	Disk storage and Accessing	1	CO6
6.2	File and types of Files	1	CO6
6.3	Root partition directories - /dev, /proc, /sys, /etc, /home, /bin, /usr, /var etc.	1	CO6
6.4	File Systems – mount points, mounting and unmounting file systems	2	CO6
6.5	Partitions – Device drivers – Dynamic Loading and unloading of kernel modules	2	CO6
	Total No. of hours	36	

Course Designers:

1. G.MadhuPriya gmadhupriya@tce.edu

18CSPD0	DATA SCIENCE USING PYTHON

Category	L	T	P	Credit
PE	2	-	2	3

Preamble

This course encompasses the use of mathematics, statistics, and computer science to study and evaluate data. The key objective of this course is to extract valuable information for strategic decision making, product development, trend analysis, and forecasting.

Prerequisite

Basic knowledge on linear algebra, calculus, probability theory, statistics and programming.

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage in %
CO1	Practice Python functionality and libraries used for data science.	15
CO2	Use linear algebra, descriptive statistics to represent data and to understand distributions of data.	15
CO3	Interpret the significance of data using inferential statistics and visualization techniques.	15
CO4	Prepare the data to improve its quality and to build the effective models.	15
CO5	Develop and assess data-driven models for real world problems.	20
CO6	Solve the real-world problems using data analytics techniques.	20

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value	Mechanism	1.3,4.4.3,4.5.3
CO2	TPS3	Apply	Value	Mechanism	1.3,2.1.1,2.1.2
CO3	TPS3	Apply	Value	Mechanism	1.3,2.1.4
CO4	TPS3	Apply	Value	Mechanism	1.3,2.1.3,2.2
CO5	TPS3	Apply	Value	Mechanism	1.3,4.6.1,2.1.2
CO6	TPS3	Apply	Value	Mechanism	1.3,2.1,2.2,3.1.5,3.2.3,3.2.6

Mapping with Programme Outcomes and Programme Specific Outcome

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L		L		L		L	L		L	M	L	L
CO2	S	M	L		L		L		L	L		L	M	L	L
CO3	S	M	L		L		L		L	L		L	M	L	L

CO4	S	M	L		L		L		L	L		L	M	L	L
CO5	S	M	L		L		L		L	L		L	M	L	L
CO6	S	M	L	L	L	L	L	L	L	L	L	L	M	L	L

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Practical Component			Terminal Examination
	1	2	3	1	2	3	
Remember	20	20	25	-	-	-	20
Understand	30	30	25	-	-	-	30
Apply	50	50	50	100	100	100	50
Analyse	-	-	-	-	-	-	-
Evaluate	-	-	-	-	-	-	-
Create	-	-	-	-	-	-	-

Assessment Pattern: Psychomotor

Psychomotor Skill	~~Mini project/Assignment~~/Practical Component
Perception	-
Set	-
Guided Response	-
Mechanism	100
Complex Overt Responses	-
Adaptation	-
Origination	-

Sample Questions for Course Outcome Assessment

Course Outcome 1(CO1):

1. Given the names and grades for each student in a Physics class of students, store them in a nested list and print the name(s) of any student(s) having the second lowest grade.
2. Find the value of h (231,8) for the function below?

```
def h(m,n):
 ans = 0
        while (m >= n):
                (ans,m) = (ans+1,m-n)
return(ans)
```

Course Outcome 2(CO2):

1. Find the number of vectors present in the null space of the given matrix $\begin{matrix} 1 & -3 & -5 \\ -2 & 1 & 3 \end{matrix}$
   Reflect your recommendations in data science process.
2. Consider the matrix $\begin{matrix} 1 & 2 & 2 \\ 3 & 4 & 7 \\ -2 & 0 & 6 \end{matrix}$. Find the Eigen value ,determinant and rank of the matrix

Course Outcome 3(CO3):

1. In a class of 50,000 students what is the probability that more than 5050 students get grades D or worse (D or F) (approximately).
2. Find the statistical test/ technique would you use: We are an online shopping portal. We can tell if someone who is on our website is a mac user or a PC user. We want to test the hypothesis that among people who purchase something from our website mac users tend to spend more money than PC users.
3. Your task is to conduct ANOVA over this data to check whether you get evidence that prices over the land were not same for the three years considered. Find the F-statistic for the given data.

Course Outcome 4 (CO4):

1. Design the Friendship structure of users in a social networking site.
2. Use the relevant wrangling techniques to reduce the number of rows and columns in the healthcare dataset [https://data.gov.in/keywords/healthcare]
3. Demonstrate various chart typologies to represent the features.

Course Outcome 5 (CO5):

1. Given the following 3D input data, identify the principal component.
   1 1 9
   2 4 6
   3 7 4
   4 11 4
   5 9 2
   For the data given in the previous question, find the transformed input along the first two principal components.
2. Suppose you are only allowed to use binary logistic classifiers to solve a multi-class classification problem. Given a training set with 2 classes, this classifier can learn a model, which can then be used to classify a new test point to one of the 2 classes in the training set. You are now given a 6 class problem along with its training set, and have to use more than one binary logistic classifier to solve the problem, as mentioned before. You propose the following scheme (also known as one Vs one approach in ML terminology) - you will first train a binary logistic classifier for every pair of classes. Now, for a new test point, you will run it through each of these models, and the class which wins the maximum number of pairwise contests, is the predicted label for the test point. How many binary logistic classifiers will you need to solve the problem using your proposed scheme?
3. Consider the linear regression equation (Y = 5X +40) for the below table.

X	5	6	7	8	9
Y	45	76	78	87	79

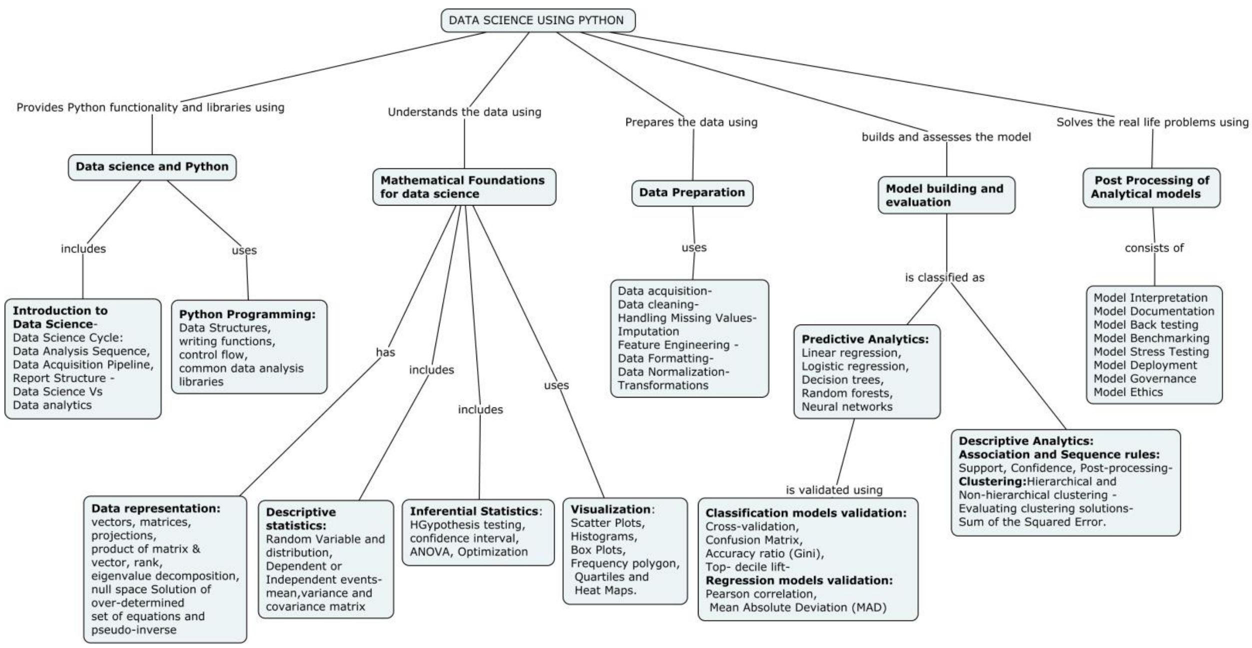
Which of the following is a MAE (Mean Absolute Error) for this linear model?

Course Outcome 6(CO6):

1. Produce a data science project for the following scenario. Twitter Classification Dataset has become an integral part of sentiment analysis problems. The dataset is 3MB in size and has 31,962 tweets. Identify the tweets which are hate tweets and which are not. [https://datahack.analyticsvidhya.com/contest/practice-problem-twitter-sentiment-analysis/]
2. Design a data science project for the following scenario.

Student Evaluation Dataset is based on an evaluation form filled out by students for different courses. It has different attributes including attendance, difficulty, score for each evaluation question, among others. This is an unsupervised learning problem. The dataset has 5820 rows and 33 columns**.**
[https://archive.ics.uci.edu/ml/datasets/Wine+Qualityhttps://archive.ics.uci.edu/ml/datasets/Turkiye+Student+Evaluation]

Concept Map



Syllabus

Theory Component:

Data science and Python

Introduction to Data Science- Data Science Cycle: Data Analysis Sequence, Data Acquisition Pipeline and Report Structure - Data Science Vs Data analytics - Python Programming: Data Structures, writing functions, control flow, common data analytics libraries (SciPy, Pandas and SciKit-Learn etc).

Math and Statistics for Data Science

Data representation: vectors, matrices, projections, product of matrix & vector, rank, eigenvalue decomposition, null space - solution of over-determined set of equations and pseudo-inverse- Dimensionality reduction: PCA and SVD – **Descriptive statistics:** Random Variable and distribution, Dependent or Independent events- mean, variance and covariance matrix- **Inferential Statistics:** Hypothesis testing, confidence interval, ANOVA, Optimization- **Visualization:** Scatter Plots, Histogram, Box Plots, Frequency polygon, Quartiles and Heat Maps.

Data Wrangling and Integration

Data acquisition- Data cleaning- Handling Missing Values- Imputation- Feature Engineering -Data Formatting- Data Normalization- Transformations

Model building and Evaluation
Predictive Analytics: Linear regression, Logistic regression, Decision trees, Random forests, Neural networks –**Classification models validation**: Cross-validation, Confusion Matrix, Accuracy ratio (Gini),Top- decile lift-**Regression models validation**: Pearson correlation, Mean Absolute Deviation (MAD)-**Descriptive Analytics**-Association and Sequence rules: Support, Confidence, Post-processing, Clustering-Hierarchical and Non-hierarchical clustering-**Evaluating clustering solutions**- Sum of the Squared Error.

Post Processing of Analytical models
Model Interpretation -Model Documentation- Model Back testing- Model Benchmarking-Model Stress Testing-Model Deployment-Model Governance-Model Ethics

Mini Project
Understanding the domain and Problem – Use the Mathematical Foundations to understand the data - Data wrangling and Integration - Model building and Evaluation

Mini Project domain: [Not limited to]
Search engine engineering, corporate analytics, Healthcare, gaming, financial services, e-commerce, aviation, transportation, logistics, social network, agriculture and energy.
Team Size: 3 Members

Practical Component:

Practicing the fundamental concepts of Python.

Analysing the data using descriptive statistics and visualization.

Analysing the data using inferential statistics and visualization.

Performing different types of data pre-processing methods.

Selecting efficient subset Implement using dimensionality reduction techniques.

Building an appropriate model for the given dataset.

Evaluating the performance of the model-built using relevant metrics.

Produce a mini project on data science for the real-world problems.

Learning Resources

1. Bart Baesens, 'Analytics in a Big Data World: The Essential Guide to Data Science and its Applications', Wiley and SAS Business Series, Kindle Edition, Wiley Publishers, 2014, First Edition.
2. EMC Education Services, 'Data Science and Big Data Analytics Discovering, Analysing, Visualizing and Presenting Data', Wiley Publishers, 2015,First Edition
3. David Paper, 'Data Science Fundamentals for Python and MongoDB', Apress Publishers, 2018, First Edition
4. Jake VanderPlas, "Python Data Science Handbook: Essential Tools for Working with Data" , O'Reilly Publishers, 2016, First Edition.
5. Dmitry Zinoviev, 'Data Science Essentials in Python: Collect - Organize - Explore - Predict – Value' , The Pragmatic Programmers,2016,First Edition
6. https://github.com/Apress/practical-web-scraping-for-data-science
7. https://www.hackerrank.com/domains/python

8. https://www.dataquest.io/
9. https://realpython.com/tutorials/data-science/

Course Contents and Lecture Schedule

Module No.	Topic	No. of Lectures	Course Outcome
1	**Data science and Python**		
1.1	Introduction to Data Science- Data Science Cycle: Data Analysis Sequence, Data Acquisition Pipeline, Report Structure - Data Science Vs Data analytics	2	CO1
1.2	Python Programming: Data Structures, writing functions, control flow, common data analysis libraries SciPy, Pandas and SciKit-Learn etc).	2	CO1
2	**Math and Statistics for Data Science**		
2.1	**Data representation:** vectors, matrices, projections, product of matrix & vector, rank, eigenvalue decomposition, null space - solution of over-determined set of equations and Pseudo-inverse	2	CO2
2.2	Dimensionality reduction: PCA and SVD **Descriptive statistics:** Random Variable and distribution, Dependent or Independent events- mean, variance and covariance matrix	2	CO2
2.3	**Inferential Statistics:** Hypothesis testing, confidence interval, ANOVA, Optimization	2	CO2
2.4	**Visualization:** Scatter Plots, Histogram, Box Plots, Frequency polygon, Quartiles and Heat Maps.	2	CO2
3	**Data Wrangling and Integration**		
3.1	Data acquisition- Data cleaning- Handling Missing Values- Imputation	2	CO4
3.2	Feature Engineering -Data Formatting- Data Normalization- Transformations	2	CO4
4	**Model Building and Evaluation**		
4.1	**Predictive Analytics:** Linear regression, Logistic regression, Decision trees, Random forests, Neural networks	3	CO5
4.2	**Classification models validation**: Cross-validation, Confusion Matrix, Accuracy ratio (Gini),Top- decile lift-**Regression models validation**: Pearson correlation, Mean Absolute Deviation (MAD)	1	CO5
4.3	**Descriptive Analytics**-Association and Sequence rules: Support, Confidence, Post-processing, Clustering-Hierarchical and Non-hierarchical clustering -**Evaluating clustering solutions**- Sum of the Squared Error.	2	CO5
5	**Post Processing of Analytical models**		

Module No.	Topic	No. of Lectures	Course Outcome
5.1	Model Interpretation -Model Documentation- Model Back testing- Model Benchmarking - Model Stress Testing-Model Deployment-Model Governance - Model Ethics	2	CO6
	Total	**24**	

Course Contents and Lecture Schedule for Laboratory

Module No.	Topic	No. of Hours	Course Outcome
1.	Practice basic functions and libraries in python.	2	CO1
2.	Write a program to import, export different categories of data using relevant data structures.	2	CO1
3.	Design a program to understand the data distribution using visualization techniques.	2	CO2
4.	Implement a program to determine the relationship between the features.	2	CO2
5.	Implement a program to select the sample data using inferential statistics.	2	CO3
6.	Develop a program to implement data pre-processing methods.	2	CO4
7.	Implement a program to select relevant features using dimensionality reduction techniques.	2	CO4
8.	Write a program to build appropriate models using pre-processed data.	2	CO5
9.	Develop the python code to evaluate the model for decision making.	2	CO5
10.	Design a data science project and Report Submission.	6	CO6
	Total Hours	**24**	

Course Designers:

1. Dr.M.Nirmala Devi mnit@tce.edu

18CSPE0	WIRELESS NETWORKS

Category	L	T	P	Credit
PE	3	0	0	3

Preamble

This course on Wireless Networks provides an introduction to the basic concepts of wireless networks, architecture and topologies. The objective of this course is to introduce the fundamental concepts and also discuss the main issues in wireless networks such as mobility management, capacity expansion and security. At the end of the course, the students will have a firm understanding of the basic principles of wireless Networks and the issues involved.

Prerequisite

Data communication and Networks

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Explain the generations of wireless networks, principles of IEEE 802.11 standards for WLAN, GPRS, wireless local loops and operation of Bluetooth.	35
CO2	Construct a suitable multiplexing/duplexing technique for a given specification.	5
CO3	Determine the capacity of a CDMA system, along with its output based on a spread spectrum technique.	15
CO4	Develop a suitable mechanism to increase the capacity of a cellular network.	15
CO5	Determine the handoff transitions in a cellular network based on different algorithms.	15
CO6	Explain the security mechanisms in IEEE802.11 wireless LAN and GSM.	15

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	Guided Response	1.3,4.3.2
CO2	TPS3	Apply	Value	Mechanism	1.3, 2.1.1,3.2.3,4.4.3
CO3	TPS3	Apply	Value	Mechanism	1.3,2.1.1,3.2.3,4.4.3
CO4	TPS3	Apply	Value	Mechanism	1.3,2.1.1, 3.2.3,4.4.3
CO5	TPS3	Apply	Value	Mechanism	1.3,2.1.1, 3.2.3,4.4.3
CO6	TPS2	Understand	Respond	Guided Response	1.3,4.3.2

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	-	-	-	-	-	-	-	-	-	-	M	-	-
CO2	S	M	L	-	-	L	-	L	-	-	-	L	M	-	L
CO3	S	M	L	-	-	L	-	L	-	-	-	L	M	-	L
CO4	S	M	L	-	-	L	-	L	-	-	-	L	M	-	L
CO5	S	M	L	-	-	L	-	L	-	-	-	L	M	-	L
CO6	M	L	-	-	-	-	-	-	-	-	-	-	M	-	-

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Assignment			Terminal Examination
	1	**2**	**3**	1	2	3	
Remember	40	30	20	-	-	-	20
Understand	40	30	40	20	20	20	30
Apply	20	40	40	80	80	80	50
Analyse	-	-	-	-	-	-	-
Evaluate	-	-	-	-	-	-	-
Create	-	-	-	-	-	-	-

Assessment Pattern: Psychomotor

Psychomotor Skill	~~Miniproject~~/Assignment/~~Practical Component~~
Perception	-
Set	-
Guided Response	20
Mechanism	80
Complex Overt Responses	-
Adaptation	-
Origination	-

Sample Questions for Course Outcome Assessment**

** (2 to 3 at the cognitive level of course outcome)

Course Outcome1 (CO1):

1. State the limitations of first generation mobile networks.(Understand)
2. Describe the need for Wireless local loop. (Understand)
3. Explain the Bluetooth protocol stack. (Understand)

Course Outcome 2(CO2):

1. Construct the FDMA/TDMA/TDDscheme for 5 users.
2. Construct the TDMA/TDD scheme for 6 users.
3. Construct the CDMA/FDD scheme for 10 users.

Course Outcome 2(CO3):

1. Compute the capacity of IS-95 CDMA for the following specifications W=1.5 MHZ, R=9600 bps,
2. Sr=4, Gv=2.5, Ga=2.75 and Ho=1.67

2. In a CDMA system, each bit is encoded by K chips according to the users' codes. There are 3 users with the following codes.

Code for user A is <1, -1, -1,1, -1,1>

Code for user B is <1,1, -1, -1,1, 1>

Code for user C is <1,1, -1,1,1, -1>

If A sends a message 1101, show that it can be decoded only by using the code of A, by calculating the decoded outputs using the keys of all the users individually.

Course Outcome 4 (CO4):

1. We want to provide a Radio communication service to a city. The total BW available is 25 MHZ, and each user requires 20 KHZ of BW for voice communication. If we employ a cellular topology where 25 low power antennas are located and the cluster size is 5. Calculate the following

a) Number of simultaneous user when one antenna is used to cover the entire city

b) Number of simultaneous user per cell

c) Number of simultaneous user per cluster

d) Number of simultaneous user after cellular topology employed

e) calculate the ratio when compared to one antenna used.

2. Assume that you have six sector cells in a hexagonal geometry. Assume 60 degree and 120 degree directional antennas are used. Compute Sr in dB for reuse factors of 7,4 and 3. Draw the hexagonal grid corresponding to these cases. Comment on your results.

3. Assume that you have six sector cells in a hexagonal geometry. Assume 60 degree and 120 degree directional antennas are used. Compute Sr in dB for reuse factors of 7,4 and 3. Draw the hexagonal grid corresponding to these cases. Comment on your results.

Course Outcome 5 (CO5):

1. A mobile terminal samples signals from four BS as a function of time. The times and signal strengths from the samples are given in Table. Assume the mobile terminal is initially attached to BS1.The mobile makes handoff decisions by considering the signals from BS‟s after each sampling time. Show the handoff transitions between BSs for each of the following algorithms as a function of time. Find out the BS selected after each and every 2.5 seconds. If a condition is met for more than one BS, assume the best one (Strongest RSS) is selected.

I. Received signal strength (RSS)

II. RSS + Threshold of 1000 x 10 -12w

III. RSS +Hysteresis of 10−9 watts

Time(sec)	0	2.5	5	7.5	10
BS_1	8×10^{-9}	2×10^{-9}	2.5×10^{-9}	1.5×10^{-9}	0.9×10^{-12}
BS_2	2×10^{-9}	3.5×10^{-9}	1.5×10^{-9}	2.5×10^{-9}	1.2×10^{-9}
BS_3	105×10^{-12}	108×10^{-12}	150×10^{-12}	105×10^{-12}	0.5×10^{-9}
BS_4	100×10^{-12}	110×10^{-12}	110×10^{-12}	90×10^{-12}	0.75×10^{-9}

2. A mobile terminal samples signals from four BS as a function of time. The times and signal strengths from the samples are given in Table. Assume the mobile terminal is initially attached to BS1.The mobile makes handoff decisions by considering the signals from BS‟s after each sampling time. Show the handoff transitions between BSs for each of the following algorithms as a function of time. Find out the BS selected after each and every 2.5 seconds. If a condition is met for more than one BS, assume the best one (Strongest RSS) is selected.

I. Received signal strength (RSS)

II. RSS + Threshold of 1000 x 10 -12w

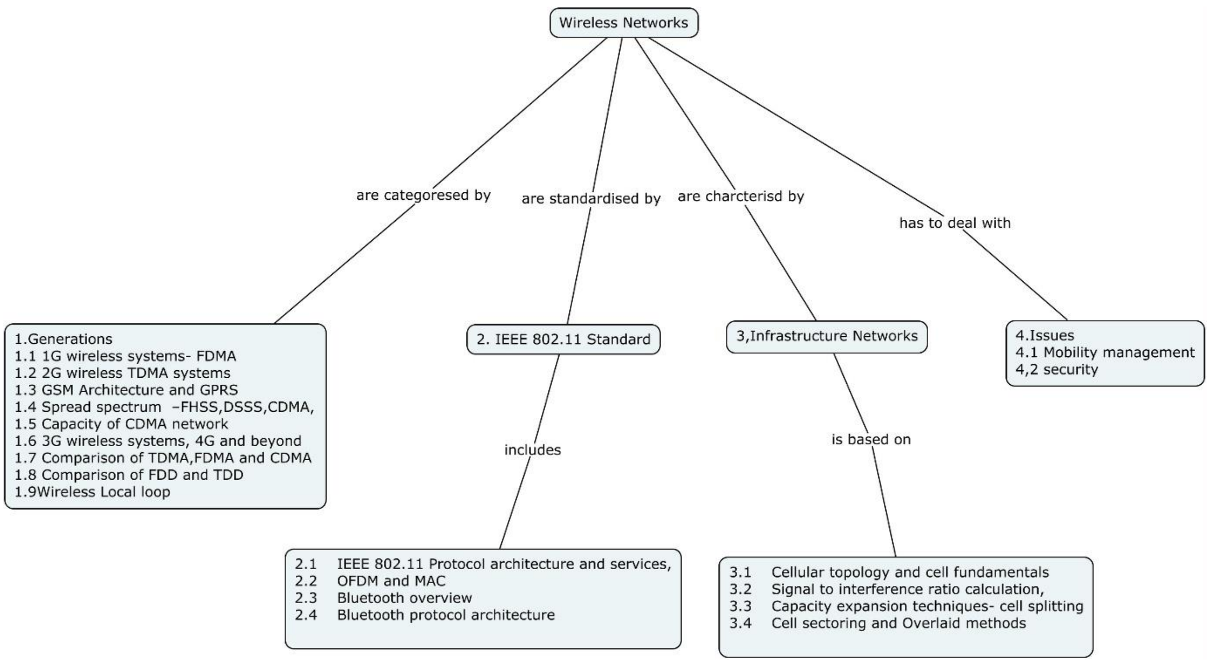
III. RSS +Hysteresis of 10−9 watts

Time(sec)	0	2.5	5	7.5	10
BS_1	$10 X 10^{-9}$	$3 X 10^{-9}$	$2X 10^{-9}$	$1.5 X 10^{-9}$	$0.9 x10^{-12}$
BS_2	$2 X 10^{-9}$	$3.5X 10^{-9}$	$1.5X 10^{-9}$	$2.5 X 10^{-9}$	$1 .2X 10^{-9}$
BS_3	$105 x10^{-12}$	$108x10^{-12}$	$150X10^{-12}$	$105 x10^{-12}$	$0.5 X 10^{-9}$
BS_4	$100X10^{-12}$	$110X10^{-12}$	$110X10^{-12}$	$90 x10^{-12}$	$0.75X 10^{-9}$

Course Outcome 6(CO6):

1. Explain the technique of generation of RC4 key in TKIP followed in IEEE 802.11.(Understand)
2. Explain the process of entity authentication and key agreement in GSM. (Understand)

Concept Map



Syllabus

Generations of wireless networks- 1G wireless systems- FDMA, 2G wireless systems-TDMA, GSM architecture and GPRS, Spread spectrum –FHSS,DSSS,CDMA, 3G wireless systems,4G and beyond , Comparison of TDMA,FDMA and CDMA ,Capacity of CDMA - Duplexing techniques FDD and TDD and comparison, Wireless Local loop, IEEE 802.11 LAN standard- IEEE 802.11 Protocol architecture and services, OFDM and MAC.- Bluetooth overview, Protocol architecture - Infrastructure Network Topology- Cellular topology ,Cell fundamentals, Signal to interference ratio calculation, Capacity expansion techniques – Cell splitting, sectoring and overlaid methods- Issues in mobility management- location and hand off- security mechanisms – Cryptographic protocols in IEEE802.11 WLAN and GSM

Learning Resources

1. William Stallings, “Wireless Communications and Networks”, Pearson education, 2003
2. Kaveh Pahlavan and Prashant Krishnamurthy, “Principles of Wireless Networks – A unified approach”, Pearson Education, Fourth Edition, 2003

3. Bernard Menezes , “Network Security and Cryptography”, Cengage Learning India, Third impression, 2014.
4. https://www.coursera.org/courses?query=wireless

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1	**Generations of wireless networks**		
1.1	1G wireless systems- FDMA	1	CO1
1.2	2G wireless TDMA systems	1	CO1
1.3	GSM Architecture and GPRS	2	CO1
1.4	Spread spectrum –FHSS,DSSS,CDMA,	3	CO3
1.5	Capacity of CDMA network	2	CO3
1.6	3G wireless systems, 4G and beyond	1	CO1
1.7	Comparison of TDMA,FDMA and CDMA	1	CO2
1.8	Comparison of FDD and TDD	1	CO2
1.9	Wireless Local loop	1	CO1
2	**IEEE 802.11 LAN standard**		
2.1	IEEE 802.11 Protocol architecture and services,	2	CO1
2.2	OFDM and MAC	2	CO1
2.3	Bluetooth overview	1	CO1
2.4	Bluetooth protocol architecture	2	CO1
3	**Infrastructure Network Topology**		
3.1	Cellular topology and cell fundamentals	1	CO4
3.2	Signal to interference ratio calculation,	1	CO4
3.3	Capacity expansion techniques- cell splitting	2	CO4
3.4	Cell sectoring and Overlaid methods	2	CO4
4	**Issues in mobility management and security**		
4.1	Mobility management- location management	2	CO5
4.2	Hand off management	3	CO5
4.3	Security mechanisms	2	CO6
4.4	Cryptographic protocols in IEEE802.11 WLAN and GSM	3	CO6
	Total	36	

Course Designers:

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18CSPF0	PARALLEL COMPUTING

Category	L	T	P	Credit
PE	3	-	-	3

Preamble

Parallel hardware has been ubiquitous now. Almost all laptop, desktop or server uses multicore processor. Although many programs can obtain satisfactory performance on a single core, students should be made aware of the vast performance improvements that can be obtained with parallelism. This course will facilitate the students to write parallel programs using MPI, Pthreads and OpenMP. They will also learn how to solve the computational intensive applications in the cluster as well as in the cloud environment.

Prerequisite

- Basic knowledge in Design and Analysis of Algorithms and Computer Architecture

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Explain the fundamental principles of parallel programming models and parallel algorithm design	15
CO2	Develop parallel algorithms for various applications by using domain decomposition techniques and parallel models	15
CO3	Implement parallel program for distributed memory multicore machines using using MPI	20
CO4	Develop parallel program for shared memory architectures using OpenMP	15
CO5	Identify other emerging parallel computing models and develop real life applications.	15
CO6	Estimate the complexities of parallel algorithms and explain the emprical observations	20

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	Guided Response	1.3,4.3.2
CO2	TPS3	Apply	Value	Mechanism	1.3, 2.1.1,2.1.5,4.5.3
CO3	TPS3	Apply	Value	Mechanism	1.3, 2.1.1,2.1.5,4.5.3
CO4	TPS3	Apply	Value	Mechanism	1.3, 2.1.1,2.1.5,4.5.3
CO5	TPS3	Apply	Value	Mechanism	1.3,2.1.1,2.1.5,4.5.3
CO6	TPS4	Analyze	Organise	Complex Overt Responses	1.3,4.4.2,4.5.3

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L											L		
CO2	S	M	L					L		L		L	M		L

CO3	S	M	L					L		L		L	M		L
CO4	S	M	L		L			L		L		L	M	L	L
CO5	S	M	L					L		L		L	M		L
CO6	S	S	M	L				L		L		L	M	L	L

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Miniproject			Terminal Examination
	1	**2**	**3**	1	2	3	
Remember	20	20	-		-	-	10
Understand	50	30	20	20	20	20	30
Apply	30	50	50	50	50	50	50
Analyse	-	-	30	30	30	30	10
Evaluate	-	-	-		-	-	-
Create	-	-	-		-	-	-

Assessment Pattern: Psychomotor

Psychomotor Skill	Mini project/~~Assignment/Practical Component~~
Perception	-
Set	-
Guided Response	20
Mechanism	50
Complex Overt Responses	30
Adaptation	-
Origination	-

Sample Questions for Course Outcome Assessment**

** (2 to 3 at the cognitive level of course outcome)

Course Outcome 1(CO1):

1. Classify computers based on Flynn's Taxonomy.
2. Explain the parameters that affects the performance of an interconnect in a parallel hardware.
3. Distinguish instruction level parallelism and thread level parallelism

Course Outcome 2(CO2):

1. Consider the performance of a program that exploits the "blocked" approach to multithreading to hide memory latency, where the average miss latency is 100 cycles, the average run length is 15 cycles, and the average context switch latency is 5 cycles. What is the expected processor efficiency with two threads per processor?
2. Examine various parallel algorithm models and figure out their significance and Applicability.
3. Devise a Parallel algorithm for finding the sum of 16 values on a processor array organized as a 2-D Mesh

Course Outcome3 (CO3):

1. Write a simple program to illustrate the Blocking and Non-Blocking message passing directives.
2. What do the various MPI collective functions do it the communicator contains a single process?
3. Compare the performance of a program that uses MPI allreduce to the butterfly-structured allreduce

Course Outcome4 (CO4):

1. Use OpenMP directives for parallelization; write a program in C that modifies the data elements of a N X N matrix.
2. Write an OpenMP program that determines the default scheduling of parallel for loops.
3. Write a program to synchronize the producer consumer problem using the appropriate directives in OpenMP.

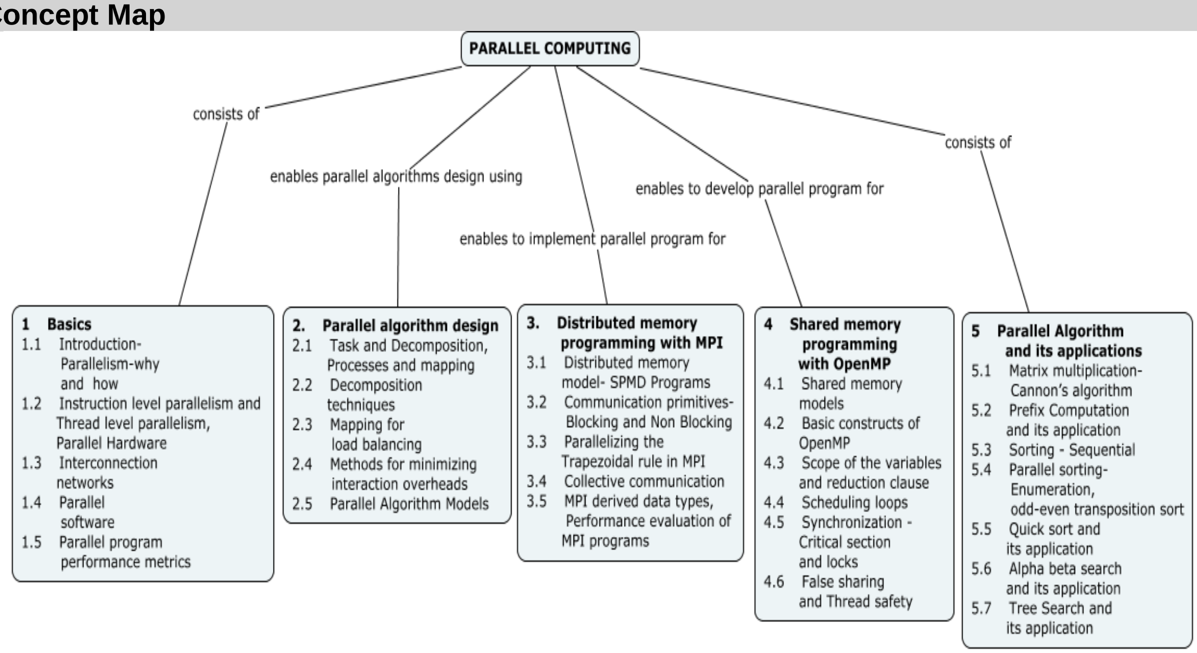
Course Outcome 5 (CO5):

1. Examine various parallel algorithm models and figure out their significance and applicability.
2. Consider the matrix vector multiplication with an 8 x 800000 matrix. Suppose that doubles use 8 bytes of memory and that a cache line is 64 bytes. What is the minimum and maximum number of cache lines that are needed to store the vector.
3. Write about the importance of the Enumeration and odd even transposition sort.

Course Outcome6(CO6):

1. Write a parallel program for odd-even sort and find out the performance of the program using the different performance metrics.
2. Construct the task dependency graph for Quicksort algorithm to sort a sequence of 14 numbers using suitable decomposition technique.
3. Apply Best First Branch and Bound search for traveling salesperson problem for find an optimal tour and represent it in state space tree.

Concept Map



Syllabus

Basics: Introduction, Parallel processing terminology, Parallel hardware, parallel software Performance **Parallel Programming Design Principles and Models** Task and Decomposition, Processes and mapping, Decomposition techniques, Mapping for load balancing, methods for minimizing interaction overheads, Parallel Algorithm Models. **Distributed memory programming with MPI:** MPI programs, Communication, Message matching, Trapezoidal rule in MPI, Collective Communication, Derived data types, Performance evaluation of MPI programs. **Shared memory programming with OpenMP**: OpenMP Constructs, scope of variables, Reduction clause, Parallel for Directives, scheduling loops, Critical sections and lock Programming Platforms, cache coherence and false sharing, Thread safety. **Parallel algorithm and applications for analysis:** Arrays and Matrices, Matrix multiplications, Prefix computation, Enumeration Sort, Odd even transposition sort, Quick Sort based Algorithm, Alpha Beta search, Tree search

Learning Resources

1. Peter S. Pacheco, "Introduction to Parallel Programming" Morgan Kaufmman, Second edition, Reprint 2014.
2. Grama, G. Karypis, V. Kumar, A. Gupta, ""Introduction to Parallel Computing", Addison- Wesley, 2nd Edition, 2009
3. Calvin Lin, Lawrence Snyder, "Principles of Parallel Programming", Pearson Education, First Edition, 2010.
4. Michael J. Quinn, "Parallel Computing –Theory and Practice", Tata McGraw Hill Publishing Company Limited, Second edition, 2006.
5. https://online.stanford.edu/courses/cs149-parallel-computing

Course Contents and Lecture Schedule

Module No.	Topic	No. of Lectures	
1.	**Basics**		
1.1	Introduction-Parallelism-why and how	1	CO1
1.2	Instruction level parallelism and Thread level parallelism, Parallel Hardware	2	CO1
1.3	Interconnection networks	1	CO1
1.4	Parallel software	1	CO1
1.5	Parallel program performance metrics	1	CO1
2.	**Parallel algorithm design**		
2.1	Task and Decomposition, Processes and mapping	1	CO2
2.2	Decomposition techniques	2	CO2
2.3	Mapping for load balancing	2	CO2
2.4	Methods for minimizing interaction overheads	1	CO2
2.5	Parallel Algorithm Models	1	CO2
2.	**Distributed memory programming with MPI**		
3.1	Distributed memory model- SPMD Programs	1	CO3
3.2	Communication primitives- Blocking and Non-Blocking	2	CO3
3.3	Parallelizing the Trapezoidal rule in MPI	2	CO3
3.4	Collective communication		

Module No.	**Topic**	**No. of Lectures**	
3.5	MPI derived data types, Performance evaluation of MPI programs	2	CO3
4	**Shared memory programming with OpenMP**		
4.1	Shared memory models	1	CO4
4.2	Basic constructs of OpenMP	1	CO4
4.3	Scope of the variables and reduction clause	1	CO4
4.4	Scheduling loops	1	CO4
4.5	Synchronization -Critical section and locks	1	CO4
4.6	False sharing and Thread safety		
5	**Parallel Algorithm and its applications**		
5.1	Matrix multiplication- Cannon's algorithm	1	CO5
5.2	Prefix Computation and its application	1	CO5
5.3	Sorting - Sequential	1	CO5
5.4	Parallel sorting- Enumeration, odd-even transposition sort	2	CO5
5.5	Quick sort and its application	2	CO6
5.6	Alpha beta search and its application	2	CO6
5.7	Tree Search and its application	2	CO6
	Total No.of Hours	**36**	

Course Designers:

1. Dr.P.Chitra pccse@tce.edu

18CSPG0	MICROSERVICES ARCHITECTURE

Category	L	T	P	Credit
PE	3	0	0	3

Preamble

Micro services Architecture is one of the methods for implementing a service-oriented architecture. This course helps students gain expertise in developing a Micro services Architecture-based solution. Apply Micro services principles to specific business requirements to build a scalable & performing solution.

Prerequisite

Nil

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Understand various micro services Architectural styles	15
CO2	Explain various techniques to implement security for micro services design	10
CO3	Apply best practices for inter process communication among micro services	20
CO4	Migrate monolithic systems in an orderly fashion	20
CO5	Design test cases for micro services testing using various methods	15
CO6	Use Dockers to maximize scalability in micro services-based applications	20

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	Guided Response	1.1, 1.2, 4.1.1, 4.1.2
CO2	TPS2	Understand	Respond	Guided Response	1.1, 1.2, 4.1.1, 4.1.2
CO3	TPS3	Apply	Value	Mechanism	1.1, 1.2, 2.1.1, 2.1.5, 4.1.1, 4.1.2, 4.4.1, 4.4.3
CO4	TPS3	Apply	Value	Mechanism	1.1, 1.2, 1.3, 2.1.1, 4.1.1, 4.1.2
CO5	TPS3	Apply	Value	Mechanism	1.1, 1.2, 1.3, 2.1.1, 3.1.1, 4.1.1, 4.1.2
CO6	TPS3	Apply	Value	Mechanism	1.1, 1.2, 1.3, 2.1.1, 3.1.1, 4.1.1, 4.1.2

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L											L		
CO2	M	L											L		
CO3	S	M	L	M	M	L	L	L		L		L	M	L	L
CO4	S	M	L	M	M	L	L	L		L		L	M	L	L
CO5	S	M	L	M	M	L	L	L		L		L	M	L	L
CO6	S	M	L	M	M	L	L	L		L		L	M	L	L

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Assignment			Terminal Examination
	1	2	3	1	2	3	
Remember	20	20	10	-	-	-	20
Understand	40	30	30	30	30	30	30
Apply	40	50	60	70	70	70	50
Analyse							
Evaluate							
Create							

Assessment Pattern: Psychomotor

Psychomotor Skill	Miniproject/Assignment/Practical Component
Perception	
Set	
Guided Response	30
Mechanism	70
Complex Overt Responses	
Adaptation	
Origination	

Sample Questions for Course Outcome Assessment

** (2 to 3 at the cognitive level of course outcome)

Course Outcome1(CO1):

1. What are the features of Micro services?
2. What are the pros and cons of Micro service Architecture?
3. Discuss the key differences between SOA and Micro services Architecture.

Course Outcome2(CO2):

1. What Is OAuth?
2. What are the types of credentials of Two Factor Authentication?

3. How Is Security Implemented In A Spring Boot Application?

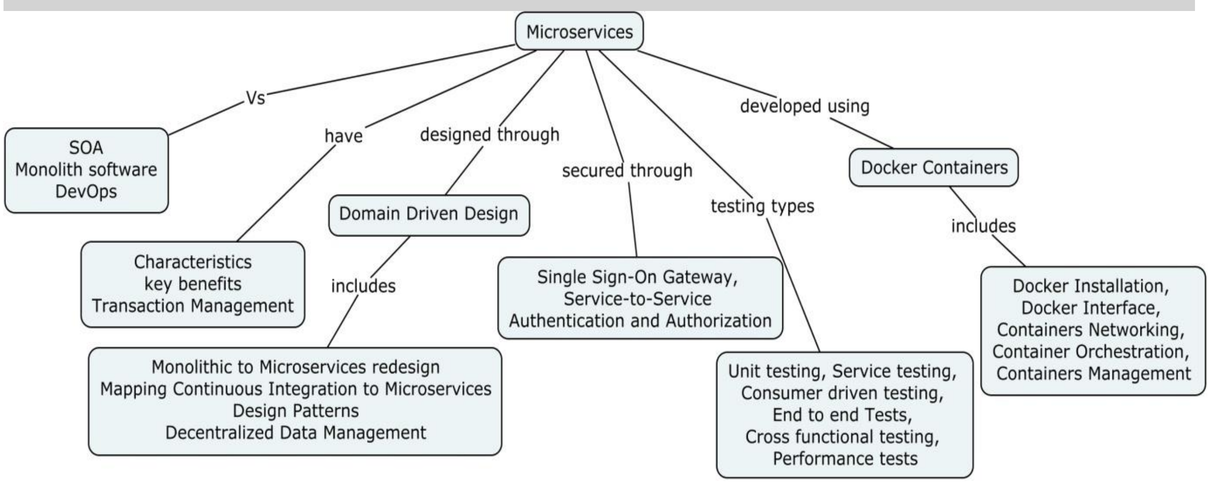
Course Outcome3(CO3):
1. What do you understand by Distributed Transaction?
2. Discuss the role of Web, RESTful APIs in Micro services.
3. Demonstrate the process by which you can balance the server-side load by utilizing Spring Cloud

Course Outcome 4 (CO4):
1. State the need for Domain Driven Design.
2. Discuss the challenges faced while converting monolithic software to Micro services.
3. Illustrate the process of redesigning monolithic software to micro service with an example.

Course Outcome 5 (CO5):
1. What is the difference between Mock or Stub?
2. Explain three types of Tests for Micro services
3. Illustrate the process of Cross-Functional testing.

Course Outcome6(CO6):
1. What is the purpose of Docker?
2. Which Embedded Containers Are Supported By Spring Boot?
3. Demonstrate the process of Multiple Micro services deployment using Docker Networking.

Concept Map



Syllabus

Evolution of Micro services

Monolithic Architecture, Distributed Architecture, Service oriented Architecture, Micro services in nutshell, SOA vs. Micro service, Micro service & API, Micro services key benefits, Micro services and DevOps

Architecture

REST Architecture principles, Micro service Characteristics, Inter-Process Communications, Microservice Transaction Management

Design

Domain Driven Design, Monolith Software, Monolith vs Microservices, Monolithic to Microservices redesign, Mapping Continuous Integration to Microservices, Repackaging/Refactoring, Decouple the User interface and Backend Business logic, Microservice Design Patterns, Microservice Architecture - Independent Processes, Decentralized Data Management

Security

Microservice Security Principles, Single Sign-On Gateway, Service-to-Service Authentication and Authorization

Testing

Testing scenarios and strategy, Test at Different Levels, Unit testing, Service testing, consumer driven testing, End to end Tests, Cross functional testing, Performance tests

Containers

Docker Containers, Docker Installation, Docker Interface, Containers Networking, Container Orchestration, Containers Management, Case studies

Learning Resources

1. Newman, Sam. Building microservices: designing fine-grained systems. " O'Reilly Media, Inc.", 2015.
2. Nadareishvili, Irakli, et al. Microservice architecture: aligning principles, practices, and culture. " O'Reilly Media, Inc.", 2016.
3. Microservices Resource Guide: http://martinfowler.com/microservices/

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1.	**Evolution of Microservices (7)**		
1.1	Monolithic Architecture, Distributed Architecture	2	CO1
1.2	Service oriented Architecture	2	CO1
1.3	Micro services in nutshell, SOA vs. Micro service,	1	CO1
1.4	Micro service & API, Micro services key benefits,	1	CO1
1.5	Micro services and DevOps	1	CO1
2.	**Architecture (7)**		
2.1	REST Architecture principles	2	CO3

2.2	Micro service Characteristics	1	CO3
2.3	Inter-Process Communications	2	CO3
2.4	Micro service Transaction Management	2	CO3
3.	**Design (9)**		
3.1	Domain Driven Design	1	CO4
3.2	Monolith Software, Monolith vs Micro services	1	CO4
3.3	Monolithic to Micro services redesign	2	CO4
3.4	Mapping Continuous Integration to Micro services	1	CO4
3.5	Repackaging/Refactoring, Decouple the User interface and Backend Business logic	1	CO4
3.6	Micro service Design Patterns	1	CO4
3.7	Micro service Architecture - Independent Processes, Decentralized Data Management	2	CO4
4.	**Security (3)**		
4.1	Micro service Security Principles, Single Sign-On Gateway	1	CO2
4.2	Service-to-Service Authentication and Authorization	2	CO2
5.	**Testing (4)**		
5.1	Testing scenarios and strategy, Test at Different Levels	1	CO5
5.2	Unit testing, Service testing	1	CO5
5.3	Consumer driven testing, End to end Tests	1	CO5
5.4	Cross functional testing, Performance tests	1	CO5
6	**Containers (6)**		
6.1	Docker Containers, Docker Installation, Docker Interface	2	CO6
6.2	Containers Networking, Container Orchestration,	2	CO6
6.3	Containers Management, Case studies	2	CO6

Course Designers:

1. Dr.A.Malini amcse@tce.edu

18CSPH0	BLOCKCHAIN TECHNOLOGY AND APPICATIONS

Category	L	T	P	Credit
PE	3	0	0	3

Preamble

The widespread popularity of digital crypto currencies has led the foundation of Block chain, which is fundamentally a public digital ledger to share information in a trustworthy and secure way. This course is designed to deal with the concept and applications of Block chain which have now spread from crypto currencies to various other domains, including business process management, smart contracts, IoT and so on.

Prerequisite

Basics of Computer Networks

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Describe the fundamentals of Block chain such as consensus problem, decentralisation and smart contracts	13
CO2	Illustrate the necessary cryptographic primitives for Block chain	20
CO3	Experiment the working of Crypto currency based transaction using Bitcoins	13
CO4	Discuss the concept of smart contracts using Ethereum and Hyper ledger platforms	20
CO5	Demonstrate the usage of Block chain in various applications like e-Governance, Security, etc.	17
CO6	Illustrate the privacy and security protocols for Block chain architecture	17

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	Guided Response	1.3,2.2.2
CO2	TPS3	Apply	Value	Mechanism	1.3,2.1.1,4.5.1
CO3	TPS3	Apply	Value	Mechanism	1.3,2.1.1,4.5.1
CO4	TPS2	Understand	Respond	Guided Response	1.3,2.1.1,4.5.1
CO5	TPS3	Apply	Value	Mechanism	1.3,2.1.1,4.5.1

CO6	TPS3	Apply	Value	Mechanism	1.3,2.1.1,3.1.3.2.6

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L											M		
CO2	S	M	L			L		L					M		
CO3	S	M	L			L		L					M		
CO4	M	L			M								M	M	
CO5	S	M	L	L		L		L	S	S			M	L	S
CO6	S	M	L			L		L					M		

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Assignment			Terminal Examination
	1	**2**	**3**	1	2	3	
Remember	20	20	20	-	-	-	20
Understand	40	40	20	20	20	-	20
Apply	40	40	60	80	80	100	60
Analyse	-	-	-	-	-	-	-
Evaluate	-	-	-	-	-	-	-
Create	-	-	-	-	-	-	-

Assessment Pattern: Psychomotor

Psychomotor Skill	**Assignment**
Perception	-
Set	-
Guided Response	20
Mechanism	80
Complex Overt Responses	-
Adaptation	-
Origination	

Course Outcome 1 (CO1):

1. What determines whose block will end up on the consensus branch?
2. Explain the methods of decentralisation.
3. What is a ledger? Is Blockchain an incorruptible ledger?

Course Outcome 2 (CO2):

1. Let H be a hash function that is both hiding and puzzle-friendly. Consider G(z) = H(z) ‖ z last where z last represents the last bit of z. Show that G is puzzle-friendly but not hiding.

2. In ScroogeCoin, suppose Mallory tries generating (sk, pk) pairs until her secret key matches someone else’s. What will she be able to do? How long will it take before she succeeds, on average? What if Alice’s random number generator has a bug and her key generation procedure produces only 1,000 distinct pairs?
3. The following is a first attempt at an Elliptic Curve signature scheme. We have a global elliptic curve, prime p, and "generator" G. Alice picks a private signing key XA and forms the public verifying key YA = XAG. To sign a message M:
   - Alice picks a value k.
   - Alice sends Bob M, k and the signature S = M kXAG.
   - Bob verifies that M = S + kYA

   a. Show that this scheme works. That is, show that the verification process produces an equality if the signature is valid.

   b. Show that the scheme is unacceptable by describing a simple technique for forging a user's signature on an arbitrary message.

Course Outcome 3(CO3) :

1. Consider the steps involved in processing Bitcoin transactions. Which of these steps are computationally expensive? If you’re an entity validating many transactions (say, a miner) what data structure might you build to help speed up verification?
2. Write the Bitcoin Script PubKey script for a transaction that can be redeemed by anybody who supplies a square root of 1764.
3. BitCorp has just noticed that Mallory has compromised one of their servers holding their Bitcoin private keys. Luckily, they are using a 2-of-3 multi-signature wallet, so Mallory has learnt only one of the three sets of keys. The other two sets of keys are on different servers that Mallory cannot access. How do they re-secure their wallet and effectively revoke the information that Mallory has learned?

Course Outcome 4 (CO4):

1. Describe the best way to create an asset in Hyper ledger Fabric?
2. Bitcoin and Ethereum are the two biggest giants of the crypto currency world. Bitcoin (BTC) was the first coin and Ethereum (ETH) followed a few years later. Discuss in detail similarities and differences between the two.
3. Explain the consensus algorithms which are supported by Hyperledger frameworks .

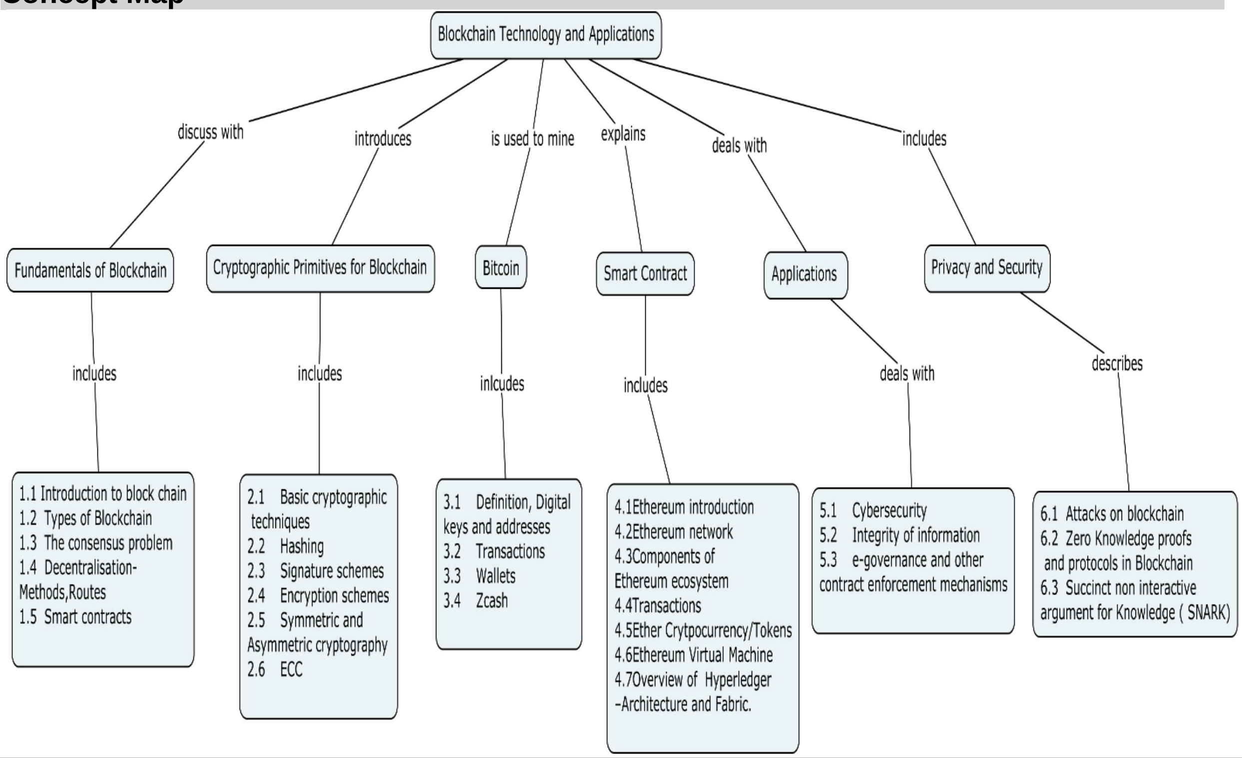
Course Outcome 5 (CO5):

1. The music industry has gone a big change in last decade due to the growth of Internet and availability of a number of streaming services over the Internet. It is impacting everyone in the music industry-artists, labels, publishers, songwriters and streaming service providers. The process by which music royalties are determined has always been convoluted one, but the rise of the Internet has made it even more complex giving rise to the demand of transparency in the royalty payments by artists and songwriters.
   Demonstrate how the blockchain can play a role by maintaining a comprehensive, accurate distributed database of music rights ownership information in a public ledger.
2. Namecoin is an alternative blockchain technology (with small variations) that is used to implement decentralized version of Domain Name Server (DNS) that is resilient to censorship. Current DNS servers are controlled by governments and large corporations, and could abuse their power to censor, hijack, or spy on your Internet usage. Use Blockchain technology since DNS or phonebook of the Internet is maintained in a

decentralized manner and every user can have the same phone book data on their computer and provide a solution to the above problem.
3. Show how blockchain technology can be used to increase network size and make DDoS attacks more difficult.

Course Outcome 6(CO6):
1. Illustrate the Zero Knowledge proofs and protocols in Blockchain with real time applications.
2. Demonstrate the working Succinct non interactive argument for Knowledge (SNARK
3. Consider a program, denoted C, taking two inputs: C(x, w). The input x is the public input, and w is the secret witness input. The output of the program is boolean, i.e. either true or false. The goal then is given a specific public input x, prove that the prover knows a secret input w such that C(x,w) == true. Show a zero knowledge proof for the given scenario.

Concept Map



Syllabus

Fundamentals of Blockchain : Introduction to block chain-Types of Blockchain- The consensus problem –Decentralisation-Methods,Routes -Smart contracts
Cryptographic Primitives for Blockchain:–Basic cryptographic techniques - Hashing, signature schemes, encryption schemes, symmetric and asymmetric cryptography – ECC
Bitcoin:–Definition, Digital keys and addresses-Transactions-Wallets-Zcash
Smart Contract:– Ethereum introduction–Ethereum network-Components of Ethereum ecosystem-Transactions, Ether Crytpocurrency/Tokens ,Ethereum Virtual Machine- Overview of Hyperledger –Architecture and Fabric.
Applications :Cybersecurity- Integrity of information, e-governance and other contract enforcement mechanisms

Privacy and Security- Attacks on blockchain - Zero Knowledge proofs and protocols in Blockchain - Succinct non interactive argument for Knowledge (SNARK)

Learning Resources

1. Imran Bashir ,Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained, 2018,2nd Edition
2. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder " Bitcoin and Cryptocurrency Technologies",Princeton University Press,2016.
3. S. Shukla, M. Dhawan, S. Sharma, S. Venkatesan, 'Blockchain Technology: Cryptocurrency and Applications', Oxford University Press, 2019.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Lectures	Course Outcome
1.	**Fundamentals of Blockchain**		
1.1	Introduction to block chain	1	CO1
1.2	Types of Blockchain	1	CO1
1.3	The consensus problem	1	CO1
1.4	Decentralisation-Methods,Routes	1	CO1
1.5	Smart contracts	1	CO1
2.	**Cryptographic Primitives for Blockchain**		
2.1	Basic cryptographic techniques	1	CO2
2.2	Hashing	1	CO2
2.3	Signature schemes	1	CO2
2.4	Encryption schemes	1	CO2
2.5	Symmetric and Asymmetric cryptography	2	CO2
2.6	ECC	1	CO2
3	**Bitcoin**		
3.1	Definition, Digital keys and addresses	1	CO3
3.2	Transactions	1	CO3
3.3	Wallets	2	CO3
3.4	Zcash	1	CO3
4	**Smart Contract**		
4.1	Ethereum introduction	1	CO4
4.2	Ethereum network	1	CO4
4.3	Components of Ethereum ecosystem	1	CO4
4.4	Transactions	1	CO4
4.5	Ether Crytpocurrency/Tokens		CO4
4.6	Ethereum Virtual Machine	1	CO4
4.7	Overview of Hyperledger –Architecture and Fabric.	2	CO4
5	**Applications**		
5.1	Cybersecurity	2	CO5
5.2	Integrity of information	2	CO5
5.3	e-governance and other contract enforcement mechanisms	2	CO5
6	**Privacy and Security**		
6.1	Attacks on blockchain	2	CO6

Module No.	Topic	No. of Lectures	Course Outcome
6.2	Zero Knowledge proofs and protocols in Blockchain	2	CO6
6.3	Succinct non interactive argument for Knowledge (SNARK)	2	CO6
	Total Hours	36	

Course Designers:

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2. Raja Lavanya rlit@tce.edu

		Category	L	T	P	Credit
18CSPJ0	**5G ARCHITECTURE AND PROTOCOLS**	PE	3	0	0	3

Preamble

This course will introduce students to 5G networks. It provides an overview of the standard 5G networks, as well as gives descriptions of technologies and the key concepts in the 3rd Generation Partnership Project specifications. This course also includes web software concepts, overview of the 5G core architecture, 5G core concepts and protocols.

Prerequisite

Basic knowledge of Computer networks

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage in %
CO1	Outline the differences between 5G system / core network and previous incarnations of the core network.	15
CO2	Discuss the role of small cells for 5G Mobile Networks	15
CO3	Determine the parameters for the enhancement of mobility and security in 5G	20
CO4	Apply trade-off techniques in wireless networks for guaranteed Quality of Service in 5G	15
CO5	Determine the mapping between the 5G specifications and the web-scale concepts like SDN and Virtualization Technologies.	20
CO6	Illustrate the protocol and service descriptions from a system perspective for various deployment options to achieve effective 5G implementation.	15

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	Guided Response	1.3,2.3.2,4.4.3
CO2	TPS2	Understand	Respond	Guided Response	1.3,2.3.2,4.4.3
CO3	TPS3	Apply	Value	Mechanism	1.3,2.3.2,3.2.3,4.4.3
CO4	TPS3	Apply	Value	Mechanism	1.3,2.3.2, 3.2.3,4.4.3
CO5	TPS3	Apply	Value	Mechanism	1.3,2.3.2, 3.2.3,4.4.3
CO6	TPS2	Understand	Respond	Guided Response	1.3,2.3.2,4.4.3

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L											L		

CO 2	M	L											L		
CO 3	S	M	L			L	L	L		L		L	M	L	L
CO 4	S	M	L			L	L	L		L		L	M	L	L
CO 5	S	M	L			L	L	L		L		L	M	L	L
CO 6	M	L											L		L

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Assignment			Terminal Examination
	1	2	3	1	2	3	
Remember	30	20	20	-	-	-	20
Understand	70	30	40	50	50	50	40
Apply	0	50	40	50	50	50	40
Analyse	0	0	0	-	-	-	-
Evaluate	0	0	0	-	-	-	-
Create	0	0	0	-	-	-	-

Course Outcomes Assessment Pattern: Psychomotor

Psychomotor Skill	Miniproject /Assignment/Practical Component
Perception	-
Set	-
Guided Response	50
Mechanism	50
Complex Overt Responses	-
Adaptation	-
Origination	-

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. State the differences between 4G and 5G networks
2. Discuss few applications of 5G networks.
3. Sketch the basic 5G architecture.

Course Outcome 2 (CO2):

1. Explain the properties of 5G NR?
2. Discuss whether 5G requires new wireless spectrum?
3. Relate how femto cells aid in achieving scalability?

Course Outcome 3 (CO3):

1. Using the femtocell technology, show how high-mobility can be achieved in 5G systems.
2. Build a security solution to protect the 5G enterprise network attacked through the employees Smartphone as the malware propagation channel.
3. Examine the security issues and challenges in 5G communication system?

Course Outcome 4 (CO4):

1. Propose a solution to the problem of voice quality degradation.
2. Identify the relevance of 5G during development of public safety applications.

3. Examine the challenges considered in broadcast-broadband convergence with respect to Technology and regulations.

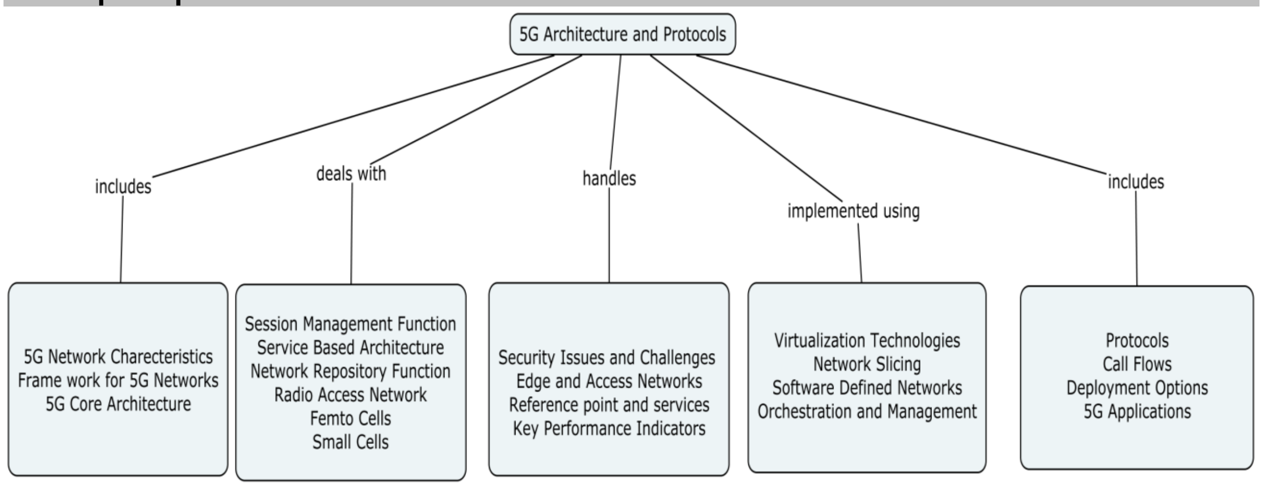
Course Outcome 5 (CO5):

1. Construct a cost effective approach to address the increased density issue in RAN.
2. Utilize the SDN component to improve the performance of the LTE-A system.
3. Examine the role of network function virtualization in 5G implementation.

Course Outcome 6 (CO6):

1. Explain the ARQMAC Protocol and its key functionalities?
2. Explain 5G specifications for the development and deployment of mobile networks covering 3G, 4G LTE, LTE-A and 5G.
3. Illustrate how 5G will include 4G/LTE Broadband Traffic Management, Content Delivery Networks, IP MPLS Core Network, Evolved Packet Core, Traffic Shaping, VoLTE and Wireless Infrastructure.

Concept Map



Syllabus

5G Introduction - Software Technologies for 5G Core - 5G Core Architecture Overview - Key Architecture Concepts - Session management- Service-Based Architecture- User Plane Function - Mobility management-Energy optimization- Access and Mobility Management Function- Network Repository Function - Security- Femto Cells – Small Cells-Security issues and challenges- Edge and Access Networks-IoT sensors- Quality of Service- Key Performance Indicators – Tools for active and passive analysis- Charging and Policy Control - Virtualization technologies -Network slicing-Network functions- Software Defined Networks - Reference points and services- Protocols- Call flows- Future outlook and applications-case studies.

Learning Resources

1. Stefan Rommer, Peter Hedman, Magnus Olsson, Lars Frid, Shabnam Sultana and Catherine Mulligan, "5G Networks Powering Digitalization", Paperback ISBN: 9780081030097, 1st Edition, Imprint: Academic Press , 2019
2. Jonathan Rodriguez ,"Fundamentals of 5G Mobile Network", ISBN:9781118867525,John Wiley & Sons Ltd, 2015

3. Erik Dahlman, Stefan Parkvall and Johan skold, “5G NR: The next generation wireless access technology”, ISBN 9780128143230, 1st Edition, Imprint: Academic Press , 2019
4. https://www.purdue.edu/newsroom/pitn/2019/Q1/holes-in-4g-and-5g-networks

	Course Contents and Lecture Schedule		
Module No	Topic	No of Lectures	Course Outcome
1	**Introduction to 5G**		
1.1	Introduction	1	CO1
1.2	5G Network architecture	1	CO1
1.3	5G Network characteristics	1	CO1
1.4	Framework for 5G networks	1	CO1
1.5	5G Core Architecture overview& key concepts	1	CO1
2	**Session and Mobility management**		
2.1	Session Management Function (SMF)	1	CO2
2.2	Service-Based Architecture (SBA)	1	CO2
2.3	User Plane Function (UPF)	2	CO2
2.4	Access and Mobility Management Function (AMF)	1	CO2
2.5	Network Repository Function (NRF)	2	CO3
2.6	Radio Access Network (RAN) and Radio Resource Control (RRC)	1	CO3
2.7	Energy Optimization	1	C03
2.8	Femto Cells – Small Cells	1	CO3
3	**Security and Quality of Service**		
3.1	Core networks	1	CO3
3.2	Security issues and challenges	2	CO3
3.3	Edge and access networks	1	CO4
3.4	Reference points and services	1	CO4
3.5	Internet of Things-sensors and communication	2	CO4
3.6	Key Performance Indicators	1	CO4
4	**Network Virtualization and Software Defined Networks**		
4.1	Virtualization technologies (NFV)	2	CO5
4.2	Network slicing	1	CO5
4.3	Network functions	1	CO5
4.4	Software Defined Networks(SDN)	2	CO5
4.5	Orchestration and management	2	CO5
5	**5G Protocols and Deployment**		
5.1	Protocols	2	CO6
5.2	Call flows	1	CO6
5.3	Deployment options	1	CO6
5.4	Effective Implementation of 5G networks-Case studies	1	CO6
	Total	36	

Course Designer

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18CSPK0	DEEP LEARNING

Category	L	T	P	Credit
PE	3	0	0	3

Preamble

The objective of this course is to cover the fundamentals of neural networks as well as some advanced topics such as recurrent neural networks, long short term memory cells and convolutional neural networks. The course also requires students to implement programming assignments related to these topics.

Prerequisite

Basic knowledge of probability theory, statistics and programming.

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Develop training algorithms for Neural Networks using Perceptron learning algorithm and Feed-Forward Networks	10
CO2	Demonstrate learning algorithms for Recurrent Neural Networks	10
CO3	Implement Convolutional Neural Networks algorithms and solve real-world problems	15
CO4	Identify the Generative model which is more appropriate for Images	20
CO5	Compare the recent DL algorithms to solve complex problems with an understanding of the trade-offs involved	20
CO6	Select the deep learning algorithms which are more appropriate for various types of learning tasks in domains like Vision, NLP, Speech	25

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value	Mechanism	1.3, 2.3.2,3.2.3, 4.4.3
CO2	TPS3	Apply	Value	Mechanism	1.3, 2.3.2, 3.2.3, 4.4.3
CO3	TPS3	Apply	Value	Mechanism	1.3, 2.3.2, 3.2.3, 4.4.3
CO4	TPS3	Apply	Value	Mechanism	1.3, 2.3.2, 3.2.3, 4.4.3
CO5	TPS4	Analyse	Organise	Complex Overt Responses	1.3,2.2.3, 2.4.2, 3.2.3, 4.4.3
CO6	TPS4	Analyse	Organise	Complex Overt Responses	1.3, 2.2.3, 2.4.2, 3.2.3, 4.4.3

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PS03
CO1	S	M	L		L			L		L		L	M		L
CO2	S	M	L		L			L		L		L	M		L
CO3	S	M	L		L			L		L		L	M		L
CO4	S	M	L		L			L		L		L	M		L
CO5	S	S	M	L	L	L	L	L	L	L	L	L	M	L	L
CO6	S	S	M	L	L	L	L	L	L	L	L	L	M	L	L

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Assignment			Terminal Examination
	1	**2**	**3**	**1**	**2**	**3**	20
Remember	20	20	20	-	-	-	30
Understand	40	30	20	-	-	-	50
Apply	40	30	40	70	70	70	10
Analyse	-	20	20	30	30	30	-
Evaluate	-	-	-	-	-	-	-
Create	-	-	-	-	-	-	-

Assessment Pattern: Psychomotor

Psychomotor Skill	~~Miniproject /~~Assignment/~~Practical Component~~
Perception	-
Set	-
Guided Response	70
Mechanism	30
Complex Overt Responses	-
Adaptation	-
Origination	-

Sample Questions for Course Outcome Assessment**

** (2 to 3 at the cognitive level of course outcome)

Course Outcome (CO1):

1. A Network Model is constructed with 'p' number of hidden layers and has learned for a particular scenario, where the outcome is of binary pattern. During the nth iteration, the model has finished its training. And in the testing phase, it produces a misclassified output. Develop methods to increase the predicting percentage.

2. Under a provided scenario, for an application we want to use Deep Learning Networks for efficient classification of patterns. In what kind of approach can we build a DL Network from the scratch.
3. A DL model has been trained and tested. At certain point during the testing, the model has produced a accuracy of 100% for all categories of images, belongs to different classes. On looking deeper into the architecture, a problem is found. That is, the model suffers from overfitting problem. Provide methods for leveraging from overfitting.

Course Outcome (CO2):

1. While translating a source language into another language, a problem is noticed. That is, the words present in the nth sentence, is considered for the translation, while the words present in the next following sentence, is not considered for a better level of translation. But on examining the parent case, it is found that the meaning which is meant to be conveying is correct, in target case it does not gives an exact meaning. The model suffers to remember the grammar used in the previous sentences. Develop a solution for correct translation.
2. Write brief note on Back Propagation through time

Course Outcome (CO3):

1. A Model is built by using CNN algorithm for 5 different categories of animals. On looking into the architecture, it is found that the layers converging from the top layer to the bottom layer is found to be out of order (Range of Convolutional matrix size expecting is greater the expected. Develop the corrections to be done for the correct flow of CNN algorithm for compiling successfully.
2. A Model is built form the scratch for the detection of postal address pin code number in the postcard. For training the model, a dataset is collected locally by the team, which consists of very small amount of samples. On testing the network, it is found that the model produced low accuracy. This low classification rate is due to the insufficient amount of samples used for training. The team does not have sufficient amount of time (Day) for completing their project work. Provide a way for the team to implement their project successfully, with the same dataset which they have.
3. Compare LeNet and AlexNet

Course Outcome (CO4):

1. Compare Restrictive Boltzmann Machines and Deep Boltzmann Machines
2. Mention the different types of Boltzmann Machines and explain them
3. Apply Gibbs Sampling for Censoring of medical data

Course Outcome (CO5):

1. Compare Multi – task deep learning and Multi – view deep learning
2. Analyse the Generative Adversarial Networks usage for the field of visual image and text recognition

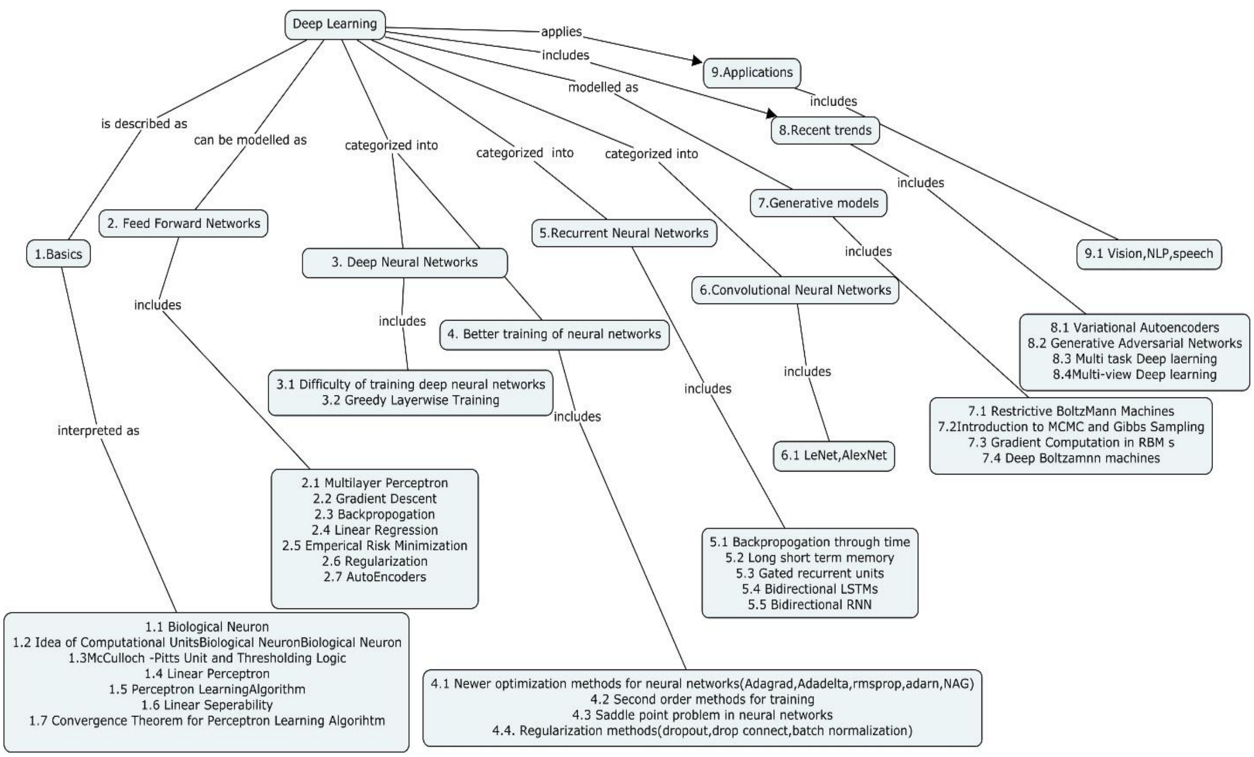
Course Outcome (CO6):

1. A farmer has large land areas, in which he planted certain type of vegetables. Every Morning he use to go around the land areas for identifying the plants which are affected by disease. He can easily identify the plants affected by disease, which are at the front. But the real

problem arises only when he wants to identify the plants in the middle of the land. Develop a DL application for him to easily identify the plants at the middle.

2. A farmer is provided with the application for identifying different types of plants, so that he can able to identify the species to which the particular plant belongs. But he does not know other languages, other than his mother tongue. Provide a real time application of Deep Learning by analyzing the problem faced by him.
3. A person is blind and he/she usually along with his/her friend goes to an ATM. On a particular day the friend is having some other commitments and does not able to accompany the blind person. So the blind person made a decision for going alone to the ATM. Provide a real time application of Deep Learning Model for solving his/her problem.

Concept Map



Syllabus

Basics: Review - Biological Neuron, Idea of computational units, McCulloch–Pitts unit and Thresholding logic, Linear Perceptron, Perceptron Learning Algorithm, Linear separability. Convergence theorem for Perceptron Learning Algorithm.

Feed forward Networks: Review- Multilayer Perceptron's, Gradient Descent, Backpropogation, Linear Regression, Empirical Risk Minimization, Regularization, Auto encoders

Deep Neural Networks: Difficulty of training deep neural networks, Greedy layer wise training

Better Training of Neural Networks: Newer optimization methods for neural networks (Adagrad, adadelta, rmsprop, adam, NAG), second order methods for training, Saddle point problem in neural networks, Regularization methods (dropout, drop connect, batch normalization).

Recurrent Neural Networks: Back propagation through time, Long Short Term Memory, Gated Recurrent Units, Bidirectional LSTMs, Bidirectional RNNs.

Convolutional Neural Networks: Basics, LeNet, AlexNet.

Generative models: Restrictive Boltzmann Machines (RBMs), Introduction to MCMC and Gibbs Sampling, gradient computations in RBMs, Deep Boltzmann Machines.

Recent trends: Variational Auto encoders, Generative Adversarial Networks, Multi-task Deep Learning, Multi-view Deep Learning.

Applications: Vision, NLP, Speech using Tensor Flow and Python

Learning Resources

1. Deep Learning, Ian Goodfellow and Yoshua Bengio and Aaron Courville, MIT Press, 2016.
2. Neural Networks: A Systematic Introduction, Raúl Rojas, Springer, 1996
3. Pattern Recognition and Machine Learning, Christopher Bishop, Springer, 2007
4. https://www.edx.org/learn/deep-learning
5. https://online.stanford.edu/courses/cs230-deep-learning

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcomes
1.	**Basics(6)- Review**		
1.1	Biological Neuron	1	CO1
1.2	Idea of computational units		CO1
1.3	McCulloch–Pitts unit and Thresholding logic		CO1
1.4	Linear Perceptron	1	CO1
1.5	Perceptron Learning Algorithm		CO1
1.6	Linear separability	1	CO2
1.7	Convergence theorem for Perceptron Learning Algorithm		CO2
2	**Feed-forward Networks(7) - Review**		
2.1	Multilayer Perceptron	1	CO2
2.2	Gradient Descent	1	CO2
2.3	Back propagation	1	CO3
2.4	Linear regression	1	CO3
2.5	Empirical Risk Minimization	1	CO3
2.6	Regularization	1	CO3
2.7	Auto encoders	1	CO3
3	**Deep Neural Networks(2)**		
3.1	Difficulty of training deep neural networks	1	CO4
3.2	Greedy layer wise training	1	CO4
4	**Better Training of Neural Networks(5)**		
4.1	Newer optimization methods for neural networks	1	CO4

Module No.	Topic	No. of Hours	Course Outcomes
	(Adagrad, adadelta, rmsprop, adam, NAG)		
4.2	second order methods for training	1	CO4
4.3	Saddle point problem in neural networks	1	CO4
4.4	Regularization methods (dropout, drop connect, batch normalization)	2	CO4
5	**Recurrent Neural Networks (5)**		
5.1	Back propagation through time	1	CO5
5.2	Long Short Term Memory	1	CO5
5.3	Gated Recurrent Units	1	CO5
5.4	Bidirectional LSTMs	1	CO5
5.5	Bidirectional RNN	1	CO5
6	**Convolutional Neural Networks(2)**		
6.1	Basics of CNN	2	CO5
6.2	LeNet	2	CO5
6.3	AlexNet	1	CO5
7	**Generative models(4)**		
7.1	Restrictive Boltzmann Machines (RBMs)	1	CO6
7.2	Introduction to MCMC and Gibbs Sampling	1	CO6
7.3	gradient computations in RBMs	1	CO6
7.4	Deep Boltzmann Machines	1	CO6
8	**Recent trends(4)**		CO6
8.1	Variational Autoencoders	1	CO6
8.2	Generative Adversarial Networks	1	CO6
8.3	Multi-task Deep Learning	1	CO6
8.4	Multi-view Deep Learning	1	CO6
9	**Applications(1)**		
9.1	Vision, NLP, Speech –Tensor Flow and Python	1	CO6
	Total	36	

Course Designers:

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2. Dr.S.Mercy Shalinie shalinie@tce.edu

18CSPL0	CLOUD COMPUTING

Category	L	T	P	Credit
PE	3	0	0	3

Preamble

This course is offered as an elective to the Under Graduate students of Computer Science and Engineering. This course is aimed at introducing cloud computing, the services offered by the cloud, the effective design of a data center, Virtualization, Programming models commonly adopted in the cloud, Cloud Storage and Cloud Security.

Prerequisite

Basic knowledge of Computer Programming and Object Oriented Programming

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Discuss the real time cloud providers and their service levels and illustrate the services offered	15
CO2	Demonstrate the design of a data center and discuss about IT service management	15
CO3	Make use of the existing cloud based architecture(s) for a given scenario and illustrate the architecture design	20
CO4	Apply the programming models that are commonly adopted in cloud	30
CO5	Find cloud security concerns and ways to implement security across layers	10
CO6	Illustrate the data availability, data replication, and data footprint reduction techniques of cloud storage services	10

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	Guided Response	1.3, 3.2.3
CO2	TPS3	Apply	Value	Mechanism	1.3,3.2.3,4.4.1
CO3	TPS3	Apply	Value	Mechanism	1.3,3.2.3,4.4.3
CO4	TPS3	Apply	Value	Mechanism	1.3,3.2.3,3.1.5
CO5	TPS3	Apply	Value	Mechanism	1.3,3.2.3,2.4.8
CO6	TPS3	Apply	Value	Mechanism	1.3,3.2.3,4.6.1

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L										L	L		

CO2	S	M	L		L			L	L	L		L	M		L
CO3	S	M	L		M		M		L	L		L	M	M	L
CO4	S	M	L		S	S	S		L	L	S	S	M	S	M
CO5	S	M	L		S		M		L	L		L	M	M	L
CO6	S	M	L		S		M		L	L		L	M	M	L

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	**Continuous Assessment Tests**			**Miniproject**			**Terminal Examination**
	1	**2**	**3**	1	2	3	
Remember	20	25	20	0	0	0	20
Understand	50	25	20	20	20	20	30
Apply	30	50	60	80	80	80	50
Analyse	0	0	0	0	0	0	0
Evaluate	0	0	0	0	0	0	0
Create	0	0	0	0	0	0	0

Assessment Pattern: Psychomotor

Psychomotor Skill	**Miniproject /~~Assignment/Practical Component~~**
Perception	-
Set	-
Guided Response	20
Mechanism	80
Complex Overt Responses	-
Adaptation	-
Origination	-

Sample Questions for Course Outcome Assessment**

** (2 to 3 at the cognitive level of course outcome)

Course Outcome 1 (CO1)

1. Illustrate the Infrastructure-as-a-Service offering provided by Amazon.
2. Identify the service offered by GoogleApps and illustrate that service.
3. Explain the key characteristics of Cloud Computing.

Course Outcome 2 (CO2)

1. Describe the capabilities of monitoring and automation software in the design of an efficient data center.
2. Explain the stages of incident management in ITIL.
3. List the service delivery components of ITIL process model.

Course Outcome 3 (CO3)

1. Identify the Cloud Computing Architecture that suits the use of one or more resource pools.
2. Illustrate how the cloud architecture overcomes the difficulties faced by traditional architecture.
3. State the advantages of Cloud Architectures.

Course Outcome 4 (CO4)

1. Write mapper and reducer code to find the top-N records from the file 'student.txt'.
2. Identify the programming model suitable for social networks and explain that programming model.
3. List the various programming models available for cloud computing.

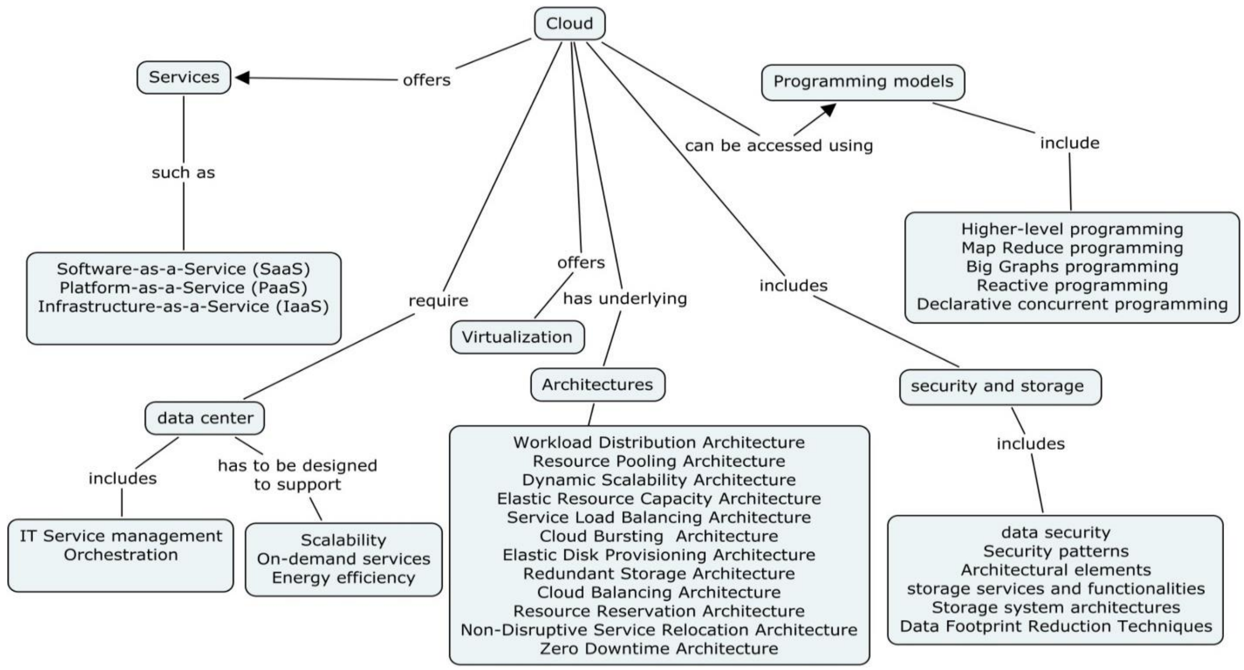
Course Outcome 5 (CO5)

1. Summarize the Cloud Security Requirements for Identity Management and Cloud-wide Time Service.
2. Discuss in detail the Cloud security patterns.
3. Explain the security concerns involved in cloud computing.

Course Outcome 6 (CO6)

1. Explain how the DFR techniques can be applied to your cloud to provide capacity optimization.
2. Illustrate the design of storage solutions that focus on the architecture or packaging of storage system.
3. Define a space-saving snapshot.

Concept Map



Syllabus

Cloud Fundamentals and Service Models - Cloud Computing Overview – benefits – limitations – Layers and types of cloud – Desired features of Cloud – Cloud providers - AWS, GCP and Azure **-** IT Services Delivery Model - Software-as-a-Service (SaaS) - Platform-as-a-Service (PaaS) - Infrastructure-as-a-Service (IaaS) – **Data Center and Virtualization** – IT Service management – Orchestration – Design considerations – Scalability, – On-demand services – Energy efficiency - Components and Benefits of Virtualization – Types of Virtualization – **Cloud Architectures** - Workload Distribution Architecture – Resource Pooling Architecture – Dynamic Scalability Architecture – Elastic Resource Capacity Architecture – Service Load Balancing Architecture - Cloud Bursting Architecture – Elastic Disk Provisioning Architecture - Redundant Storage Architecture - Cloud Balancing Architecture – Resource Reservation Architecture – Non-Disruptive Service Relocation Architecture – Zero Downtime Architecture – **Cloud Programming models** – Higher-level programming – Map Reduce programming – Big Graphs programming – Reactive programming – Declarative concurrent programming – **Cloud Security and storage** – Security concerns in cloud computing – Cloud data security – Security patterns and Architectural elements – Cloud storage services and functionalities – Storage system architectures - Data Footprint Reduction Techniques

Learning Resources

1. Thomas Erl, Zaigham Mahmood, Ricardo Puttini, "Cloud Computing: Concepts, Technology & Architecture", Prentice Hall Service Technology Series, 2013.

2. John Rittinghouse, James Ransome, “Cloud Computing: Implementation, Management and Security”, CRC Press 2010.
3. Greg Schulz, “Cloud and Virtual Data Storage Networking”, CRC Press, 2012.
4. Nelson Ruest, Danielle Ruest, “Virtualization, A Beginner’s Guide”, McGraw-Hill Companies, 2009.
5. https://www.edx.org/learn/cloud-computing
6. https://www.coursera.org/browse/information-technology/cloud-computing

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1	**Cloud Fundamentals and Service Models (5)**		
1.1	Cloud Computing Overview - Benefits and Limitations	1	CO1
1.2	Layers and types of cloud - Desired features of Cloud	1	CO1
1.3	Cloud providers – AWS, GCP and Azure	1	CO1
1.4	IT Services Delivery Model - Software-as-a-Service (SaaS)	1	CO1
1.5	Platform-as-a-Service (PaaS) - Infrastructure-as-a-Service (IaaS)	1	CO1
2	**Data Center and Virtualization (5)**		
2.1	IT Service management	1	CO2
2.2	Orchestration	1	CO2
2.3	Design considerations – Scalability, On-demand services – Energy efficiency	1	CO2
2.4	Components and Benefits of Virtualization	1	CO2
2.5	Types of Virtualization	1	CO2
3	**Cloud Architectures (7)**		
3.1	Workload Distribution Architecture – Resource Pooling Architecture	1	CO3
3.2	Dynamic Scalability Architecture, Elastic Resource Capacity Architecture	1	CO3
3.3	Service Load Balancing Architecture - Cloud Bursting Architecture	1	CO3
3.4	Elastic Disk Provisioning Architecture - Redundant Storage Architecture	1	CO3
3.5	Cloud Balancing Architecture, Resource Reservation Architecture	1	CO3
3.6	Non-Disruptive Service Relocation Architecture, Zero Downtime Architecture	2	CO3
4	**Cloud Programming models (11)**		

4.1	Higher-level programming	1	CO4
4.2	Map Reduce programming	2	CO4
4.3	Big Graphs programming	2	CO4
4.4	Reactive programming	2	CO4
4.5	Declarative concurrent programming	2	CO4
4.6	Case study – MapReduce, Pregel, Pig	2	CO4
5	**Cloud security and storage (8)**		
5.1	Security concerns in cloud computing	1	CO5
5.2	Cloud data security	1	CO5
5.3	Security patterns and Architectural elements	2	CO5
5.4	Cloud storage services and functionalities	2	CO6
5.5	Storage system architectures	1	CO6
5.6	Data Footprint Reduction Techniques	1	CO6

Course Designers:

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18CSPM0	INTERNET OF THINGS AND ITS APPLICATIONS

Category	L	T	P	Credit
PE	3	0	0	3

Preamble

This course aims at providing a basic understanding of Internet of Things, exemplifying the application areas where Internet of Things can be applied and enables designing prototypes of Internet-connected products using appropriate tools.

Prerequisite

Basic knowledge in Data Communication and Networks and Problem Solving Using Computers

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage in %
CO1	Appreciate the significance of IoT, WoT and Cloud of Things (Understand)	10
CO2	Design the general IoT architecture and connected domains. (Apply)	15
CO3	Interpret the requirements to figure out the suitable communication technology and protocols required for an IOT application. (Apply)	20
CO4	Explain the challenges in wearable computing, components of wearable technology and types of wearable. (Understand)	10
CO5	Design a step by step Model Specifications for an IoT System based on IoT – A reference model. (Apply)	20
CO6	Develop an IoT application for the given specification applying the IoT technologies. (Apply)	25

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	Guided Response	1.3,3.4.3
CO2	TPS3	Apply	Value	Mechanism	1.3 ,2.1.5, 3.4.3,4.3.2
CO3	TPS3	Apply	Value	Mechanism	1.3,2.1.5, 3.4.3, 4.3.2
CO4	TPS2	Understand	Respond	Guided Response	1.3, 2.2.2

CO5	TPS3	Apply	Value	Mechanism	1.3, 2.1.5,2.4.6, 3.4.3, 2.5.1, 4.3.2
CO6	TPS3	Apply	Value	Mechanism	1.3, 2.1.5, 2.5.1, 3.4.3,2.5.4, 4.5.1

Mapping with Programme Outcomes and Programme Specific Outcome

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L											L		
CO2	S	M	L			L	L	L		L		L	M	L	L
CO3	S	M	L			L	L	L		L		L	M	L	L
CO4	M	L											L		
CO5	S	M	L			L	L	L		L		L	M	L	L
CO6	S	M	L		L	L	L	L		L		L	M	L	L

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Assignment			Terminal Examination
	1	2	3	1	2	3	
Remember	20	20	20	-	-	-	15
Understand	40	30	30	30	30	30	35
Apply	40	50	50	70	70	70	50
Analyse	-	-	-	-	-	-	-
Evaluate	-	-	-	-	-	-	-
Create	-	-	-	-	-	-	-

Assessment Pattern: Psychomotor

Psychomotor Skill	~~Miniproject~~/**Assignment/**~~Practical Component~~
Perception	-
Set	-
Guided Response	30
Mechanism	70
Complex Overt Responses	-
Adaptation	-
Origination	-

Sample Questions for Course Outcome Assessment

Course Outcome 1 (CO1):
1. Differentiate On premises and connected system.
2. Define Web of Things.
3. List the IoT levels.

Course Outcome 2 (CO2):
1. Design a Smart Irrigation system and illustrate the architecture.
2. Design the work flow of centralized alarm management through IoT End Points.
3. Design an IoT Architecture for the given problem. Currently, our cities and urban areas are more crowded than ever before. As populations grow, the number of vehicles on roads increase as well, leading to traffic jams that pose major problems for commuters. IoT solutions that connect devices, such as smartphones, traffic signals, cameras and vehicles, can be used to create a smart transportation grid wherein information collected by each device can be used to prevent traffic jams. Data collected from devices can be used to inform drivers of congestions and monitor overall traffic patterns.

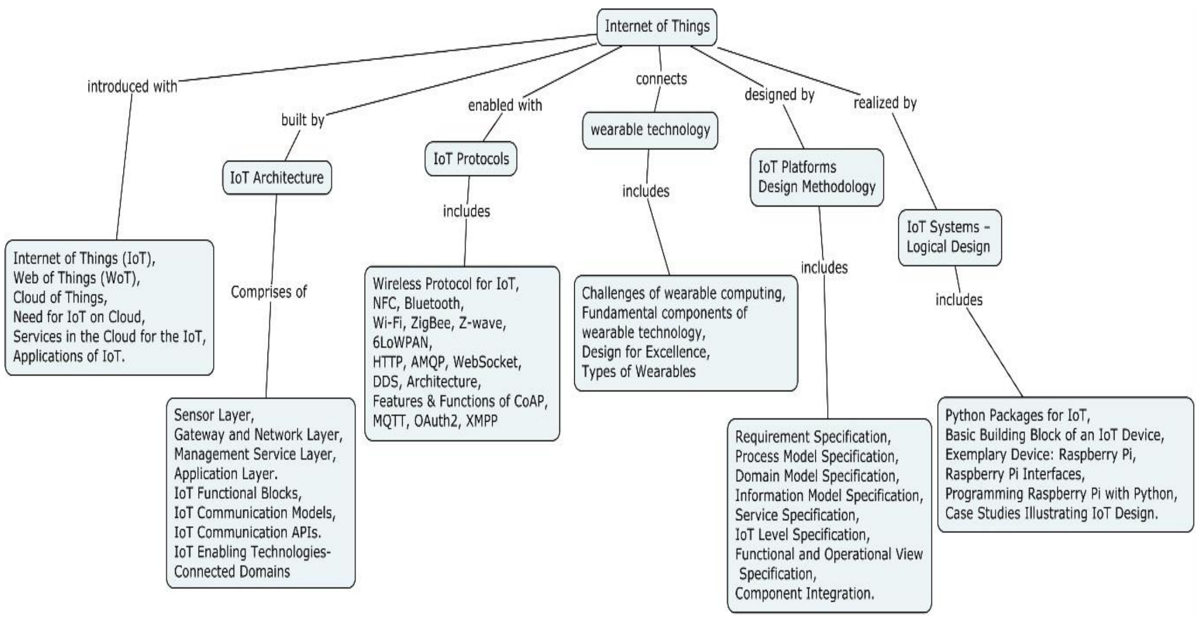
Course Outcome 3 (CO3):
1. Propose a design for Secure Development of IoT applications.
2. Propose a complete IoT solution including the communication protocol, Communication API and the functional blocks. The Amazon Basin Conservation Association's Los Amigos conservancy concession has started using small remotely controlled planes to monitor 550 square miles of Peruvian Amazon for illegal logging and mining. The drones will allow the handful of rangers to quickly investigate reports of deforestation, a major improvement over having to travel into remote parts of the jungle over unpaved roads.
3. Criticize the pros and cons of MQTT, CoAP as IoT protocols for resource-constrained devices?

Course Outcome 4 (CO4):
1. List the types of wearables.
2. Indicate the advantages of implementing edge analytics on wearable devices.
3. Differentiate augment reality, virtual reality and mixed reality.

Course Outcome 5 (CO5):
1. Demonstrate the steps involved in IoT system design methodology with a suitable example.
2. Construct the information model specification for Home automation system and explain the significance of the same.
3. Construct the deployment design of weather monitoring IoT System.

Course Outcome 6 (CO6):
1. Propose an alternate design for using 801.2 Wi-Fi communications for distributed communication over the sensor nodes.
2. Write a the blink program so that each LED blinks with its own independent schedule of 0.25 Hz for the Red LED, 0.5 Hz for the Green LED and 1 Hz for the Blue LED.
3. Write a program for light sensing device. The light intensity should be classified into dark, light, medium, and strong light. Three LEDs should be used to indicate whether it is dark (no LED turned on), there is low light (one LED turned on), medium light (two LEDs turned on) or strong light (all LED turned on).

Concept Map



Syllabus

Introduction to IoT: Overview and Introduction, Internet of Things (IoT), Web of Things (WoT), Cloud of Things, Need for IoT on Cloud, Services in the Cloud for the Internet of Things, Applications of IoT. **IoT Architecture:** IoT Architecture, Sensor Layer, Gateway and Network Layer, Management Service Layer, Application Layer. IoT Functional Blocks, IoT Communication Models, IoT Communication APIs. IoT Enabling Technologies- Wireless Sensor Networks, Cloud Computing, Big Data Analytics, Communication Protocols, Embedded Systems. Addressing Schemes. IoT Levels & Deployment Templates. Connected Domains – Connected Home, Connected Worker, Connected Automobile, Connected Industry. **Protocols Supporting IoT:** Wireless Protocol for IoT, Communication Technologies - NFC, Bluetooth, Wi-Fi, ZigBee, Z-wave, 6LoWPAN, HTTP, AMQP, WebSocket, DDS, Architecture, Features & Functions of CoAP, MQTT, OAuth2, XMPP, CoAP vs HTTP. **Wearable Technology:** History of wearable computing, Challenges of wearable computing, Fundamental components of wearable technology, Design for Excellence, Types of Wearables - Digital Eyewear, Ring, Band, Introduction to Augmented Virtuality, Virtual Reality, Mixed Reality in Wearables. **IoT Platforms Design Methodology:** IoT Design Methodology – Purpose and Requirement Specification, Process Model Specification, Domain Model Specification, Information Model Specification, Service Specification, IoT Level Specification, Functional and Operational View Specification, Component Integration. **IoT Systems – Logical Design using Python** - Introduction to Python, Python Packages of Interest for IoT, Basic Building Block of an IoT Device, Exemplary Device: Raspberry Pi, Raspberry Pi Interfaces, Programming Raspberry Pi with Python, Deployment in Cloud (AWS/Azure), Other IoT Devices- pcDuino, BeagleBone Black, Cubieboard. Case Studies Illustrating IoT Design.

Learning Resources

1. Olivier Hersent, David Boswarthick and Omar Elloumi, The Internet of Things: Key Applications and Protocols, Second Edition, Wiley Publisher, 2012
2. Arshdeep Bahga, Vijay Madisetti, Internet of Things: A Hands on Approach, 2014
3. Jean-Philippe Vasseur, Adam Dunkels, Interconnecting Smart Objects with IP: The Next Internet, Morgan Kuffmann, 2010

4. Samuel Greengard, The Internet of Things (The MIT Press Essential Knowledge series), MIT Press, 2015
5. Doukas, Charalampos, Building internet of things with the Arduino, CreateSpace Independent Publishing Platform, 2012.
6. https://online.stanford.edu/courses/xee100-introduction-internet-things

Course Contents and Lecture Schedule

Module No.	Topic	No. of Lectures	Course Outcomes
1.	**Introduction to IoT**		
1.1	Overview and Introduction, Internet of Things (IoT), Web of Things (WoT), Cloud of Things	1	CO1
1.2	Need for IoT on Cloud, Services in the Cloud for the Internet of Things	1	CO1
1.3	Applications of IoT	2	CO1
2.	**IoT Architecture**		
2.1	IoT Architecture, Sensor Layer, Gateway and Network Layer, Management Service Layer, Application Layer	1	CO2
2.2	IoT Functional Blocks, IoT Communication Models, IoT Communication APIs.	1	CO2
2.3	IoT Enabling Technologies, Addressing Schemes	1	CO2
2.4	IoT Levels & Deployment Templates	1	CO2
2.5	Connected Domains - Connected Home, Connected Worker, Connected Automobile, Connected Industry	1	CO2
3	**Protocols supporting IoT**		
3.1	Wireless Protocol for IoT, Communication Technologies - NFC, Bluetooth	1	CO3
3.2	Wi-Fi, ZigBee, Z-wave	2	CO3
3.3	6LoWPAN, HTTP	1	CO3
3.4	AMQP, WebSocket, DDS	1	CO3
3.5	CoAP, MQTT, OAuth2, XMPP, CoAP vs HTTP	2	CO3
4	**Wearable Technology**		
4.1	History of wearable computing, Challenges of wearable computing, Fundamental components of wearable technology.	1	CO4
4.2	Design for X	1	CO4
4.3	Types of wearables - Digital Eyewear, Ring, Band,	1	CO4
4.4	Introduction to Augmented Virtuality, Virtual Reality, Mixed Reality in Wearables.	1	CO4
5	**IoT Platforms Design Methodology :**		

Module No.	Topic	No. of Lectures	Course Outcomes
5.1	IoT Design Methodology – Purpose and Requirement Specification, Service Specification, IoT Level Specification,	1	CO5
5.2	Process Model Specification, Domain Model Specification, Information Model Specification,	2	CO5
5.3	Service Specification, IoT Level Specification	2	CO5
5.4	Functional and Operational View Specification, Component Integration.	2	CO5
6	**IoT Systems – Logical Design using Python**		
6.1	Introduction to Python, Python Packages of Interest for IoT	1	CO6
6.2	Basic Building Block of an IoT Device,	1	CO6
6.3	Exemplary Device: Raspberry Pi, Raspberry Pi Interfaces	1	CO6
6.4	Programming Raspberry Pi with Python.	3	CO6
6.5	Other IoT Devices- pcDuino, BeagleBone Black, Cubieboard	1	CO6
6.6	Case Studies Illustrating IoT Design.	2	CO6
	Total No. of Hours	36	

Course Designers:

1. M.Vijayalakshmi mviji@tce.edu

18CSPN0	STORAGE INFRASTRUCTURE MANAGEMENT

Category	L	T	P	Credit
PE	3	-	-	3

Preamble

The course on Storage Infrastructure Management aims to emphasize the need for information storage, provide an in depth coverage of technologies in the various phases of designing and building an Information Storage System and to provide an overview of various management techniques.

Prerequisite

Fundamental knowledge on Computer Organization

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage in %
CO1	Recognize the components and functions of information storage systems.	15
CO2	Demonstrate the functionalities of Storage Networking.	20
CO3	Develop the storage system for the given specification.	15
CO4	Demonstrate the process of Backup and Replication.	15
CO5	Relate the performance of Storage components.	15
CO6	Illustrate the security mechanisms for the Storage Networking models	20

CO Mapping with CDIO Curriculum Framework

CO#	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	Guided Response	1.3,4.3.2
CO2	TPS3	Apply	Value	Mechanism	1.3,2.1.5,3.2.3,4.3.2
CO3	TPS3	Apply	Value	Mechanism	1.3, 2.1.1,3.2.3,4.3.4
CO4	TPS3	Apply	Value	Mechanism	1.3, 2.2.3,3.2.3,4.5.1
CO5	TPS3	Apply	Value	Mechanism	1.3, 2.1.5,3.2.3,4.3.3
CO6	TPS3	Apply	Value	Mechanism	1.3, 3.2.3,4.3.1

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L											L		
CO2	S	M	L			L	L	L		L		L	M	L	L
CO3	S	M	L			L	L	L		L		L	M	L	L
CO4	S	M	L			L	L	L		L		L	M	L	L
CO5	S	M	L			L	L	L		L		L	M	L	L
CO6	S	M	L			L	L	L		L		L	M	L	L

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Assignment			Terminal Examination
	1	2	3	1	2	3	
Remember	20	20	30	-	-	-	20
Understand	40	30	30	20	20	20	35
Apply	40	50	40	80	80	80	45
Analyse	-	-	-	-	-	-	-
Evaluate	-	-	-	-	-	-	-
Create	-	-	-	-	-	-	-

Assessment Pattern: Psychomotor

Psychomotor Skill	~~Miniproject~~/Assignment/~~Practical Component~~
Perception	-
Set	-
Guided Response	20
Mechanism	80
Complex Overt Responses	-
Adaptation	-
Origination	-

Sample Questions for Course Outcome Assessment

Course Outcome1 (CO1):
1. How the Structured data differs from Unstructured?
2. What do you mean by downtime?
3. List the demerits of centralized data storage.

Course Outcome2 (CO2):
1. Employ the challenges of NAS and how it is overcome by SAN?.
2. Operate the fixed content and show how CAS support the storage and retrieval process.
3. Explain how FCoE stores and retrieves data.

Course Outcome3 (CO3):
1. ABC Corporation is trying to decide between an integrated or a gateway NAS solution. The existing SAN at ABC will provide capacity and scalability. The IT department is considering a NAS solution for the training department at ABC for training videos. The videos will only be used by the training department for evaluation of instructors. Develop a NAS solution.
2. Employ block level storage virtualization in a SAN environment and demonstrate how it supports non-disruptive data mobility and data migration.
3. A company is considering storage implementation. They do not have a current storage infrastructure to use, but they have a network that gives them good performance. Suggest whether native or bridged iSCSI should be used.

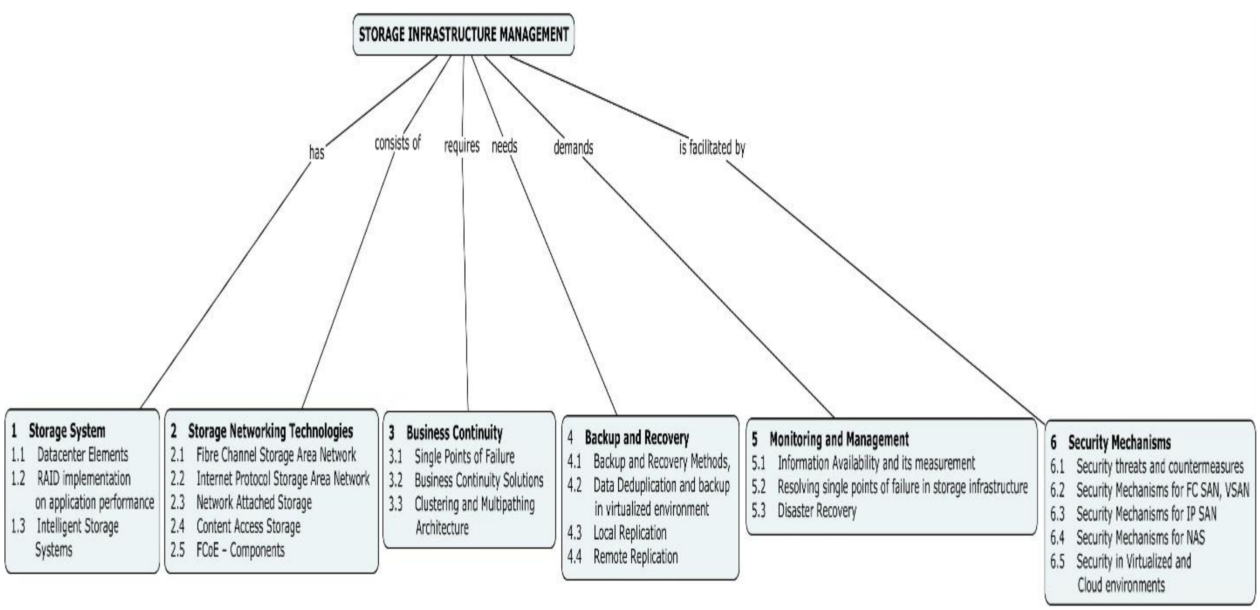
Course Outcome 4 (CO4):
1. Explain how remote replication technology can be helpful in disaster recovery.
2. Deploy the Backup process to support the Recovery.

3. Enlighten the importance of Replication than Backup.

Course Outcome 5 (CO5):
1. Consider a disk I/O system in which an I/O request arrives at the rate of 80 IOPS. The disk service time is 6ms.
    a. Compute the following
        i. Utilization of I/O controller
        ii. Total response time
        iii. Average queue size
        iv. Total time spent by a request in a queue
        v. Compute the preceding parameter if the service time is halved.
2. A 10k RPM drive is rated to perform 130 IOPS and a 15k RPM drive is rated to perform 180 IOPS for an application. The read/write ratio is 3:1. Compute the RAID-adjusted IOPS for the 10k and 15k drives for RAID 1, RAID 5 and RAID 6.
3. An application has 1000 heavy users at a peak of 2 IOPS each and 2000 typical users at a peak of 1 IOPS each, with a read/write ratio of 2:1. It is estimated that the application also experiences an overhead of 20% for other workloads. Calculate the IOPS requirement for RAID 1, RAID 3, RAID 5 and RAID 6.

Course Outcome6 (CO6):
1. Illustrate the authentication mechanisms in IP SAN.
2. Employ the security threats in each domain and describe the controls that can be applied.
3. Implement the security mechanisms Zoning, LUN masking, and Port Binding for improving SAN security.

Concept Map



Syllabus

Storage System: Introduction - Evolution of storage architecture - Key Data center elements – Host, connectivity, storage, and application in both classic and virtual environments - RAID implementations – techniques - RAID levels - impact of RAID on application performance - Components of Intelligent Storage Systems - Provisioning and Intelligent Storage System

Storage Networking Technologies: Fibre Channel SAN - components - Connectivity options - topologies - Access protection mechanism – zoning - FC protocol stack – Addressing - SAN-based virtualization – VSAN - IP SAN - iSCSI and FCIP protocols for Storage access over IP network - FCoE and its components - Network Attached Storage (NAS) – NAS Hardware devices – NAS Software Components – NAS Connectivity options - NAS operations – Applying the NAS Solution – File level virtualization in NAS – Integration of NAS and SAN - CAS –Object based storage - Unified Storage platform.

Business Continuity: Information availability and Business Continuity - Business Continuity terminologies - Business Continuity Planning – Solutions - Clustering and Multipathing architecture - Single Points of Failure.

Backup and Recovery: Methods, targets and topologies - Data Deduplication and backup in virtualized environment - Fixed Content and Data Archive – Replication - Local Replication - Remote Replication - Three-Site Remote Replication - Continuous Data Protection

Monitoring and Management: Monitoring and managing storage infrastructure components in classic and virtual environments - Information lifecycle management (ILM) and Storage Tiering - Cloud service management

Security Mechanisms: Security threats and countermeasures in various domains –
Security solutions for FC-SAN, IP-SAN and NAS environments - Security in virtualized and cloud environments

Learning Resources

1. Information Storage and Management: Storing, Managing, and Protecting Digital Information in Classic, Virtualized, and Cloud Environments, EMC Education Services, John Wiley and Sons, 2012.
2. Storage Networks: The Complete Reference, Robert Spalding, McGraw Hill Education,2017.
3. Introduction to Storage Area Networks, Jon Tate, Pall Beck, Hector Hugo Ibarra, Shanmuganathan Kumaravel, Libor MiklasTata, IBM Redbooks, 2018.
4. Disaster Recovery and Business Continuity", Thejendra BS, IT Governance Publishing, 3rd Edition, 2016.
5. Storage Virtualization A Complete Guide, Gerardus Blokdyk,5STARCooks, 2019.
6. Network Storage: Tools and Technologies for Storing Your Company's Data By James O'Reilly, Morgan Kaufmann, 2016.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1	**Storage System**		
1.1	Datacenter Elements - Evolution of storage Architecture	2	CO1
1.2	RAID implementation - RAID levels - Impact of RAID on application performance	2	CO1
1.3	Intelligent Storage Systems - Components	1	CO1
2	**Storage Networking Technologies**		
2.1	Fibre Channel Storage Area Network	2	CO2
2.2	Internet Protocol Storage Area Network	2	CO2
2.3	Network Attached Storage	1	CO2
2.4	Content Access Storage	1	CO2
2.5	FCoE – Components	2	CO2
3	**Business Continuity**		
3.1	Single Points of Failure	2	CO3
3.2	Business Continuity Solutions	2	CO3
3.3	Clustering and Multipathing Architecture	1	CO3
4	**Backup and Recovery**		
4.1	Backup and Recovery Methods,	1	CO4
4.2	Data Deduplication and backup in virtualized environment	1	CO4
4.3	Local Replication	1	CO4
4.4	Remote Replication	1	CO4
5	**Monitoring and Management**		
5.1	Information Availability and its measurement	2	CO5
5.2	Resolving single points of failure in storage infrastructure	2	CO5
5.3	Disaster Recovery	1	CO5
6	**Security Mechanisms**		
6.1	Security threats and countermeasures	2	CO6
6.2	Security Mechanisms for FC SAN, VSAN	2	CO6
6.3	Security Mechanisms for IP SAN	2	CO6
6.4	Security Mechanisms for NAS	1	CO6
6.5	Security in Virtualized and Cloud environments	1	CO6

Course Designers:

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2. Dr.G.S.R.Emil Selvan emil@tce.edu

18CSPP0	**ROBOTIC PROCESS AUTOMATION (Common to CSE, IT and ECE Departments)**

Category	L	T	P	Credit
PE	3	-	-	3

Preamble

Robotic process automation design and development course offers comprehensive knowledge and professional level skills focussed on developing and deploying software robots to achieve automation. The course introduces RPA platform and enables a student to use RPA software to automate business processes.

Prerequisite

Knowledge of Webapp development

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Describe operation of basic computing and programming concepts. (Understand)	10
CO2	Explain business and management aspect of robotic process automation. (Understand)	15
CO3	Automate business processes using various functionalities and features of RPA tool. (Apply)	20
CO4	Identify the process for image, text and data tables automation. (Apply)	20
CO5	Develop robots for email automation and exception handling. (Apply)	15
CO6	Deploy robots independently for process automation. (Apply)	20

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	Guided Response	1.1, 1.2, 4.1.1, 4.1.2
CO2	TPS2	Understand	Respond	Guided Response	1.1, 1.2, 4.1.1, 4.1.2
CO3	TPS3	Apply	Value	Mechanism	1.1, 1.2, 2.1.1, 2.1.5, 4.1.1, 4.1.2, 4.4.1, 4.4.3
CO4	TPS3	Apply	Value	Mechanism	1.1, 1.2, 1.3, 2.1.1, 4.1.1, 4.1.2
CO5	TPS3	Apply	Value	Mechanism	1.1, 1.2, 1.3, 2.1.1, 3.1.1, 4.1.1, 4.1.2
CO6	TPS3	Apply	Value	Mechanism	1.1, 1.2, 1.3, 2.1.1, 3.1.1, 4.1.1, 4.1.2

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L									L		L		L

CO 2	M	L									L		L		L
CO 3	S	M	L	M	S	L	L	L			M	L	M	M	L
CO 4	S	M	L	M	S	L	L	L			M	L	M	M	L
CO 5	S	M	L	M	S	L	L	L			M	L	M	M	L
CO 6	S	M	L	M	S	L	L	L			M	L	M	M	L

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Assignment			Terminal Examination
	1	**2**	**3**	1	2	3	
Remember	20	20	20	-	-	-	20
Understand	40	40	40	30	30	30	40
Apply	40	40	40	70	70	70	40
Analyse							
Evaluate							
Create							

Assessment Pattern: Psychomotor

Psychomotor Skill	Miniproject/Assignment/Practical Component
Perception	
Set	
Guided Response	30
Mechanism	70
Complex Overt Responses	
Adaptation	
Origination	

Sample Questions for Course Outcome Assessment**

** (2 to 3 at the cognitive level of course outcome)

Course Outcome 1(CO1):

1. What are the basic programming concepts?
2. What is the difference between HTML and XML?
3. What are the 5 stages of SDLC?

Course Outcome 2(CO2):

1. What are the RPA tools?
2. What are bots in RPA?
3. How do I create a RPA bot?

Course Outcome 3(CO3):

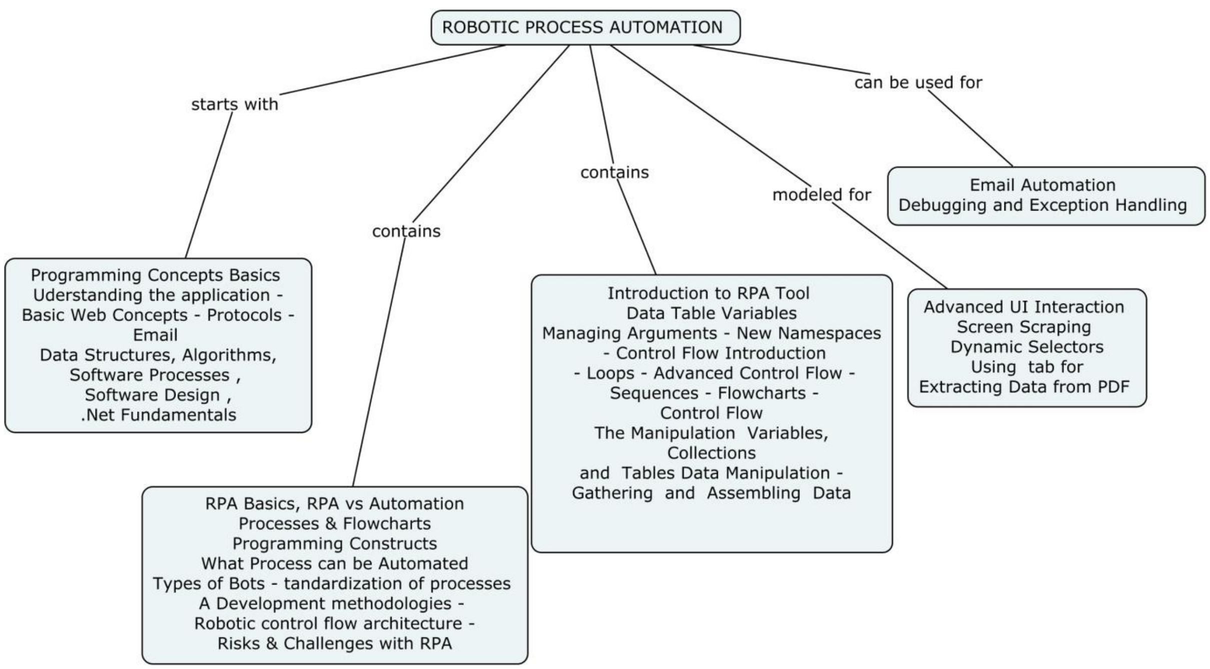
1. Propose possible Risks & Challenges with RPA software testing
2. Which tool is best for RPA?

Course Outcome 4 (CO4):
1. What is Citrix automation?
2. What is MetaBot in Automation Anywhere?
3. Propose a method to automate two-dimensional data using DataTable

Course Outcome 5 (CO5):
1. How does automated Email works.
2. Propose a method to automate Emails

Course Outcome 6(CO6):
1. What can Robotic Process Automation do?
2. Which automation robots exhibit decision making capabilities?
3. How to deploy independent bots for profess automation

Concept Map



Syllabus

PROGRAMMING BASICS & RECAP

Programming Concepts Basics - Understanding the application - Basic Web Concepts - Protocols - Email Clients - Data Structures - Data Tables - Algorithms - Software Processes - Software Design - Scripting - .Net Framework - .Net Fundamentals - XML - Control Structures and functions - XML - HTML - CSS - Variable & Arguments.

RPA CONCEPTS

RPA Basics - History of Automation - What isRPA - RPA vs Automation - Processes & Flowcharts - Programming Constructs in RPA - What Process can be Automated - Types of Bots - Workloads which can be automated - RPA Advanced Concepts - Standardization of processes - RPA Development methodologies - Difference from SDLC - Robotic control flow architecture - RPA business case - RPA Team - Process Design Document/Solution Design Document - Industries best suited for RPA - Risks & Challenges with RPA - RPA and emerging ecosystem.

RPA TOOL INTRODUCTION & BASICS

Introduction to RPA Tool - The User Interface - Variables - Managing Variables - Naming Best Practices - The Variable Panel - Generic Value Varaibles - Text Variables - True Variables - True or False Variables - Number Variables - Array Variables - Date and Time Variables - Data Table Variables - Managing Arguments - Naming Best Practices - The Arguments Panel - Using Arguments - About Imported Namespaces - Importing New Namespaces - Control Flow Introduction - If Else Statements - Loops - Advanced Control Flow - Sequences - Flowcharts - About Control Flow - Control Flow Activities - The Assign Activity - The Delay Activity - The Do While Activity - The If Activity - The Switch Activity - The While Activity - The For Each Activity - The Manipulation - Data Manipulation Introduction - Scalar Variables, Collections and Tables - Text Manipulation – Data Manipulation - Gathering and Assembling Data

ADVANCED AUTOMATION CONCEPT AND TECHNIQUES

Recording and Advanced UI Interaction - Recording Introduction - Basic and Desktop Recording - Web Recording - Input/Output Methods - Screen Scraping - Data Scraping - Scraping Advanced Techniques - Selectors - Selectors – Defining and Assessing Selectors - Customization - Debugging - Dynamic Selectors - Partial Selectors - RPA Challenge - Image, Text& Advanced Citrix Automation - Introduction Retrieval - Advanced Citrix Automation Challenges -Best Practices - Using tab for Images - Starting Apps - Excel Data Tablets & PDF - Data Tables in RPA - Excel and Data Tables basics - Data Manipulation in excel - Extracting Data from PDF - Extracting a single piece of data - Anchors - Using anchors in PDF

EMAIL AUTOMATION & EXCEPTIONAL HANDLING

Email Automation - Email Automation - Incoming Email Automation – Sending Email automation - Debugging and Exception Handling - Debugging Tools – Strategies for Solving issues – Catching errors.

Learning Resources

1. Tripathi, Alok Mani. "Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool–UiPath". Packt Publishing Ltd, 2018.
2. Frank Casale, Rebecca Dilla, Heidi Jaynes, Lauren Livinston, "Introsuction to robotic process automation: A promer", Institute of robotic process automation, 2015
3. Murdoch, Richard. "Robotic Process Automation: Guide to Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant." *Middletown, DE. Omakustanne* (2018).
4. https://www.uipath.com/rpa/robotic-process-automation

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1.	**PROGRAMMING BASICS & RECAP**		
1.1	Programming Concepts Basics, Understanding the application	1	CO1
1.2	Basic Web Concepts ,Protocols	1	CO1
1.3	Email Clients, Data Structures	1	CO1
1.4	Data Tables, Algorithms , Software Processes	1	CO1
1.5	Software Design, Scripting, Net Framework,.Net Fundamentals	1	CO1

1.6	XML - Control Structures and functions	1	CO1
1.7	HTML - CSS - Variable & Arguments.	1	CO1
2.	**RPA CONCEPTS**		
2.1	RPA Basics - History of Automation	1	CO2
2.2	RPA Vs Automation - Processes & Flowcharts	1	CO2
2.3	Programming Constructs in RPA Types of Bots - RPA Advanced Concepts	2	CO2
2.4	RPA Development methodologies, RPA business case	1	CO2
2.5	RPA Team - Process Design, RPA and emerging ecosystem.	1	CO2
3.	**RPA TOOL INTRODUCTION & BASICS**		
3.1	Introduction to RPA Tool - The User Interface - Variables -	1	CO3
3.2	Managing Variables - Naming Best Practices - The Variable Panel	1	CO3
3.3	Managing Arguments - Naming Best Practices - The Arguments Panel	1	CO3
3.4	Using Arguments - About Imported Namespaces - Importing New Namespaces -	1	CO3
3.5	Control Flow Introduction , Flowcharts	2	CO4
3.6	Control Flow Activities - The Assign Activity - The Delay Activity -	1	CO4
3.7	Data Manipulation Introduction - Scalar Variables, Collections and Tables -	1	CO4
3.8	Text Manipulation – Data Manipulation - Gathering and Assembling Data	1	CO4
4.	**ADVANCED AUTOMATION CONCEPT AND TECHNIQUES**		
4.1	Recording and Advanced UI Interaction - Recording	1	
4.2	Introduction - Basic and Desktop Recording - Web Recording - Input/Output Methods	1	CO4
4.3	- Screen Scraping - Data Scraping - Scraping Advanced Techniques -	1	CO4
4.4	Customization - Debugging - Dynamic Selectors - Partial Selectors -	2	CO4
4.5	RPA Challenge - Image, Text& Advanced Citrix Automation -	1	CO4
4.6	Introduction Retrieval - Advanced Citrix Automation Challenges -	1	CO6
4.7	Best Practices - Using tab for Images - Starting Apps - Excel Data Tablets & PDF - Data Tables in RPA - Excel and Data Tables basics	1	CO6
4.8	Data Manipulation in excel - Extracting Data from PDF - Extracting a single piece of data	1	CO6
5.	**EMAIL AUTOMATION & EXCEPTIONAL HANDLING**		
5.1	Email Automation - Email Automation - Incoming Email Automation –.	1	CO5

5.2	Sending Email automation - Debugging and Exception Handling -	2	CO5
5.3	Debugging Tools – Strategies for Solving issues – Catching errors	2	CO5

Course Designers:

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18CSPQ0	APPLIED MACHINE LEARNING

Category	L	T	P	Credit
PEES	3	0	0	3

Preamble

Machine Learning is the broad discipline of teaching computers to perform tasks without explicitly programming them. Now-a-days machine learning is employed to perform a variety of tasks like house price prediction, image classification, playing games etc. In this course students will learn a spectrum of machine learning algorithms with a sound math-based theoretical background along with the technical know-how of applying these algorithms to perform a variety of tasks to build applications.

Prerequisite

Linear Algebra and Calculus
Probability and Statistics
Programming in python

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Construct algorithms to learn linear regression models to predict the value of a continuous-valued output given a training data consisting of uni-variate/multi-variate input features.	20
CO2	Develop learning algorithms based on logistic regression, to predict discrete-valued output given a training data comprising of features and corresponding class labels.	15
CO3	Construct algorithms based on neural networks to perform simple learning tasks and construct algorithms for Support Vector Machines.	15
CO4	Analyse the different machine learning model which has been built, assess the performance of the model.	15
CO5	Develop unsupervised learning algorithms to learn patterns from given training set of un labelled data points	10
CO6	Construct reinforcement learning algorithms for modelling trial and error based adaptive learning for environments where an explicit control instruction cannot be provided.	10
CO7	Construct implementations to program solutions for real-world machine learning problems like Predicting house prices, Classifying movie reviews, Image classification, Digit Recognition, object recognition using the toolbox provided by Python and other Artificial Intelligence frameworks	15

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value		1.3, 2.3.2, 2.4.3, 2.4.6, 3.2.3, 4.4.3
CO2	TPS3	Apply	Value		1.3, 2.3.2, 2.4.3, 3.2.3, 4.4.3
CO3	TPS3	Apply	Value		1.3, 2.3.1, 2.3.2, 2.4.3, 3.1.1, 3.2.3,2.4.6, 4.4.3
CO4	TPS4	Analyse	Organise	Complex Overt Responses	1.3, 2.2.4, 2.3.1, 2.3.2, 2.4.4, 2.4.6, 4.4.3
CO5	TPS3	Apply	Value		1.3,2.2.3,2.4.6, 4.4.3
CO6	TPS3	Apply	Value		1.3, 2.2.3,2.4.6, 4.4.3
CO7	TPS3	Apply	Value		1.3, 2.2.3, 2.3.1, 2.4.6, 3.1.1, 3.2.3, 4.4.3

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PS03
CO1	S	M	L		M			M	M			M	M	L	M
CO2	S	M	L		M			M	M			M	M	L	M
CO3	S	M	L		M			M	M			M	M	L	M
CO4	S	S	M	L	M	M		M	M	M		M	M	M	M
CO5	S	M	L		M			M	M			M	M	L	M
CO6	S	M	L		M			M	M			M	M	L	M
CO7	S	M	L		**S**	M		M	M	M		M	M	M	M

S - Strong; M - Medium; L - Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Assignment			Terminal Examination
	1	2	3	1	2	3	
Remember	20	20	20	-	-	-	20
Understand	20	20	20	-	-	-	20
Apply	60	20	60	100	60	100	50

Analyse	-	40	-	-	40	-	10
Evaluate	-	-	-	-	-	-	-
Create	-	-	-	-	-	-	-

Assessment Pattern: Psychomotor

Psychomotor Skill	Miniproject~~/Assignment~~/~~Practical Component~~
Perception	-
Set	-
Guided Response	-
Mechanism	80
Complex Overt Responses	20
Adaptation	-
Origination	-

Sample Questions for Course Outcome Assessment

Course Outcome (CO1):

1. Consider a data set in which each data point t_n is associated with a weighting factor $r_n > 0$, so that the sum-of-squares error function becomes:

$$E_D(w) = \frac{1}{2}\sum_{n=1}^{N} r_n\left(t_n - w^T\phi(x_n)\right)^2$$

Construct an expression for the solution w* that minimizes this error function. Give two alternative interpretations of the weighted sum-of-squares error function in terms of (i) data dependent noise variance and (ii) replicated data points.

2. Construct a linear regression model to fit the given house-price prediction training data. The task is to predict the price of a house given its features as input. Your model should generalize well to the test dataset.

3. We have seen that, as the size of a data set increases, the uncertainty associated with the posterior distribution over model parameters decreases. Make use of the matrix identity:

$$\left(\mathbf{M} + \mathbf{v}\mathbf{v}^T\right)^{-1} = \mathbf{M}^{-1} - \frac{(\mathbf{M}^{-1}\mathbf{v})\left(\mathbf{v}^T\mathbf{M}^{-1}\right)}{1 + \mathbf{v}^T\mathbf{M}^{-1}\mathbf{v}}$$

to show that the uncertainty $\sigma_N^2(x)$ associated with the linear regression function satisfies $\sigma_N^2(x) \leq \sigma_{N+1}^2(x)$

Course Outcome (CO2):

1. Show that for a linearly separable data set, the maximum likelihood solution for the logistic regression model is obtained by finding a vector **w** whose decision boundary $\mathbf{w}^T\boldsymbol{\varphi}(\mathbf{x}) = 0$ separates the classes and then taking the magnitude of **w** to infinity.

2. Using the expression for the derivative of the logistic sigmoid, construct an expression for the derivative of the error function for the logistic regression model.

3. Consider a binary classification problem in which each observation $\mathbf{x}_n$ is known to belong to one of two classes, corresponding to $t = 0$ and $t = 1$, and suppose that the procedure for collecting training data is imperfect, so that training points are sometimes mislabelled. For every data point

$\mathbf{x}_n$, instead of having a value t for the class label, we have instead a value π_n representing the probability that $t_n = 1$. Given a probabilistic model $p(t = 1|\boldsymbol{\varphi})$, construct an expression for the log likelihood function appropriate to such a data set.

Course Outcome 3 (CO3)

1. Consider a binary classification problem in which the target values are $t \in \{0, 1\}$, with a network output $y(\mathbf{x},\mathbf{w})$ that represents $p(t = 1|\mathbf{x})$, and suppose that there is a probability ϵ that the class label on a training data point has been incorrectly set. Assuming independent and identically distributed data, write down the error function corresponding to the negative log likelihood. Verify that the error function is obtained when $\epsilon = 0$. Note that this error function makes the model robust to incorrectly labelled data, in contrast to the usual error function.

2. Show that maximizing likelihood for a multiclass neural network model in which the network outputs have the interpretation $y_k(\mathbf{x},\mathbf{w}) = p(t_k = 1|\mathbf{x})$ is equivalent to the minimization of the cross-entropy error function.

Course Outcome 4 (CO4)

1. Consider two classifiers to solve a handwritten digit recognition problem. Compare the predictive accuracy of the two classifiers and determine the better of the two using statistical methods.

2. Consider a classification problem in which the loss incurred when an input vector from class C_k is classified as belonging to class C_j is given by the loss matrix L_{kj}, and for which the loss incurred in selecting the reject option is λ. Find the decision criterion that will give the minimum expected loss. Verify that this reduces to the reject criterion discussed in class when the loss matrix is given y $L_{kj} = 1 - I_{kj}$. Determine the relationship between λ and the rejection threshold θ?

3. Assess how confidence intervals are helpful in gauging the goodness of the test error approximation.

Course Outcome 5 (CO5)

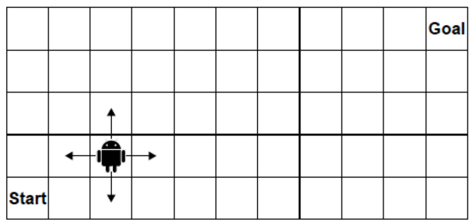
1.Consider the K-means algorithm discussed in class. Show that as a consequence of there being a finite number of possible assignments for the set of discrete indicator variables rnk, and that for each such assignment there is a unique optimum for the $\{\mu_k\}$, the K-means algorithm must converge after a finite number of iterations.

2.What could be the possible reason(s) for producing two different dendrograms using agglomerative clustering algorithm for the same dataset?

3.Which of the following metrics, do we have for finding dissimilarity between two clusters in hierarchical clustering? Single-link,Complete-link, Average-link

Course Outcome 6 (CO6)

1. Consider the following scenario: An agent is situated in a 11x5 grid environment as illustrated in the figure below and has to learn the shortest path from all possible positions to the goal area. For your experiments please use the following reward scheme: After each action, the agent is rewarded 0 if the action ends in the target area and -1 otherwise. At the beginning of each episode, the agent is placed on a randomly chosen position. Possible actions are moving one cell in one of the four cardinal directions. If an agent tries to leave the world, it remains on its position. An episode ends either if the agent has reached the goal region or after i_{max} iterations. Use an appropriate exploration strategy.



Solve the following:

a. What is the impact of the given reward function? How does it influence the strategy (policy) of the agent for finding the goal?

b. Describe the elements of the underlying MDP
(i) What is the state set?
(ii) What is the action set?
(iii) Give a formal definition of the described reward function.
(iv) How does the state transition function look like (informally)?

c. Is it sufficient to let the agent learn for a single episode only, or should the agent learn for several episodes in a row? Give reasons for your answer.

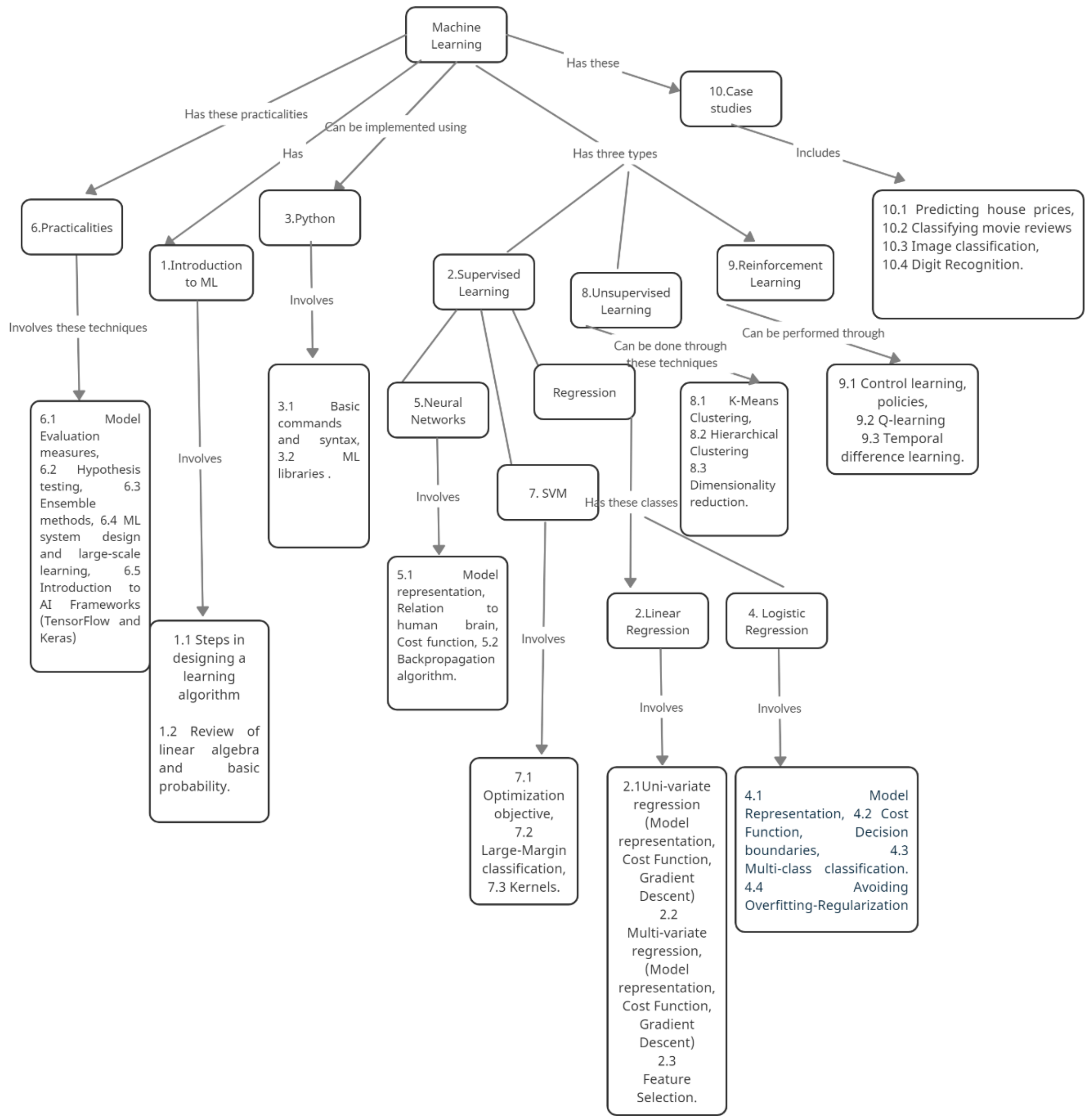
2. Illustrate the basic principles of Q Learning algorithm.

Course Outcome 7 (CO7)

1. Construct and implement a neural network in Python to predict the value of an input handwritten digit. The training set will be provided as a set of images containing handwritten digits.

2. Construct and implement a logistic regression based mail classification system to categorize an incoming email into one of the following: Personal, Work, Movies, Social Circles, Promotions and Spam.

Concept Map



Syllabus

Introduction to Machine Learning: Steps in designing a learning algorithm, Review of linear algebra and basic probability. Python: Review of python, ML libraries and Toolboxes, Introduction to AI Frameworks (TensorFlow and Keras)

Linear Regression: Uni-variate regression (Model representation, Cost Function, Gradient Descent), Multi-variate regression(Model representation), Feature Selection.

Logistic Regression: Model Representation, Cost Function, Decision boundaries, Multi-class classification. Avoiding Overfitting-Regularization.

Neural Networks: Model representation, Relation to human brain, Cost function, Feed Forward Neural Networks, Backpropagation algorithm.

Support Vector Machines: Optimization objective, Large-Margin classification, Kernels,

Practicalities: Model Evaluation measures, Hypothesis testing, Ensemble methods, ML system design and large-scale learning.

Unsupervised Learning: K Means Clustering, Hierarchical Clustering, Gaussian Mixture Model, Expectation Maximization algorithm - Dimensionality reduction.

Reinforcement Learning: Control learning, policies, Q-learning, Temporal-difference learning.

Case Studies: Predicting house prices, Classifying movie reviews, Digit Recognition, Image classification, Creating customer groups based on the purchasing patterns.

Learning Resources

1. Madan Gopal , “Applied Machine Learning” McGraw Hill, 2018
2. Anuradha Srinivasaraghavan and Vincy Joseph “Machine Learning” WILEY 2019
3. Manaranjan Pradhan and U Dinesh Kumar, “Machine Learning using Python” WILEY 2019
4. Ethem Alpaydin, “Introduction to Machine Learning”, PHI, Third edition, 2015.
5. Christopher M.Bishop, “Pattern recognition and machine learning”, Springer, 2007.
6. Jerome H. Friedman, Robert Tibshirani, and Trevor Hastie, “The Elements of Statistical Learning”, Springer, 2011. (Available for download on the author’s web-page: http://statweb.stanford.edu/~tibs/ElemStatLearn/)
7. Tom M. Mitchell, “Machine learning”, McGraw Hill, 1997.
8. Kevin Murphy, “Machine Learning - A Probabilistic Perspective, Adaptive Computation and Machine Learning”, MIT Press, 2012.
9. R. S. Sutton and A. G. Barto, “Reinforcement Learning - An Introduction”, MIT Press, 2018

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcomes
1.	Introduction to Machine Learning		
1.1	Steps in designing a learning algorithm	1	CO1
1.2	Review of linear algebra and basic probability.	1	CO1
1.3	Review of Python	1	CO1
1.4	ML libraries	1	CO1
1.5	Introduction to AI Frameworks (TensorFlow and Keras)	2	CO1
2.	Linear Regression		

Module No.	Topic	No. of Hours	Course Outcomes
2.1	Uni-variate regression (Model representation, Cost Function and Gradient Descent)	1	CO1
2.2	Multi-variate regression (Model representation)	1	CO1
2.3	Feature Selection	1	CO1
3	Logistic Regression		
3.1	Model Representation	1	CO2
3.2	Cost Function, Decision boundaries	1	CO2
3.3	Multi-class classification	1	CO2
3.4	Avoiding Overfitting-Regularization	1	CO2
4	Neural Networks		
4.1	Model representation, Relation to human brain,	1	CO3
4.2	Cost function, Feed forward neural networks	1	CO3
4.3	Backpropagation algorithm	1	CO3
5	Support Vector Machines		
5.1	Optimization objective	1	CO3
5.2	Large-Margin classification	1	CO3
5.3	Kernels	1	CO3
6	Practicalities		
6.1	Model Evaluation measures	1	CO4
6.2	Hypothesis testing	1	CO4
6.3	Ensemble methods	1	CO4
6.4	ML system design and large-scale learning.	1	CO4
7	Unsupervised Learning		
7.1	K Means Clustering	1	CO5
7.2	Hierarchical Clustering	1	CO5

Module No.	Topic	No. of Hours	Course Outcomes
7.3	Gaussian Mixture Model,	1	CO5
7.4	Expectation Maximisation algorithm	1	CO5
7.5	Dimensionality reduction.	1	CO5
8	Reinforcement Learning		
8.1	Control learning, policies	1	CO6
8.2	Q-learning	1	CO6
8.3	Temporal-difference learning	1	CO6
9	Case Studies		
9.1	Predicting house prices	1	CO7
9.2	Classifying movie reviews	1	CO7
9.3	Digit Recognition	1	CO7
9.4	Image classification	2	CO7
9.5	Creating customer groups based on the purchasing patterns.	1	CO7

Course Designers:

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18CSPR0	SERVICE - ORIENTED ARCHITECTURE

Category	L	T	P	Credit
PEES	3	0	0	3

Preamble

Service-Oriented Architecture (SOA) is a revolutionary computing platform that is being adopted world-wide and has earned the support of every major software provider. It is the main approach for dealing with the interoperability of systems in heterogeneous environments. The student obtains clear understanding of what constitutes SOA along with step-by-step guidance for realizing its successful implementation. The Student will be able to apply SOA principles to real time needs and develop enterprise applications using those principles. This course gives the basics of architectural styles for designing Service-Oriented Architecture based web applications with web services and REST principles.

Prerequisite

Basics of Cloud computing systems

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Develop web services using the design principles of SOA	15
CO2	Apply SOA standards, WS-* framework to the SOA based web service	20
CO3	Model REST architecture based web services using the design principles of REST	20
CO4	Compare the web service design principles of SOA and REST architecture	10
CO5	Model the given services of the web application as a Monolithic service	15
CO6	Develop the monolithic design of a web service into web service based on Micro service architecture	20

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value	Mechanism	1.3,2.1.2,3.1.2,4,3.2.4,.2.2,4.3.3
CO2	TPS3	Apply	Value	Mechanism	1.3,2.1.2,3.1.2,4,3.2.4,.2.2,4.3.3
CO3	TPS3	Apply	Value	Mechanism	1.3,2.1.2,3.1.2,4,3.2.4,.2.2,4.3.3
CO4	TPS2	Understand	Respond	Guided Response	1.3,3.2.3,4.3.2
CO5	TPS3	Apply	Value	Mechanism	1.3,2.1.2,3.1.2,4,3.2.4,.2.2,4.3.3
CO6	TPS3	Apply	Value	Mechanism	1.3,2.1.2,3.1.2,4,3.2.4,.2.2,4.3.3

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L		L			L	L	L	L	L	M		L
CO2	S	M	L		L			L	L	L	L	L	M		L
CO3	S	M	L		L			L	M	M	L	L	M		L
CO4	M	L						L		L			L		
CO5	S	M	L		L			L	M	M	L	L	M		L
CO6	S	M	L		L			L	M	M	L	L	M		L

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Assignment			Terminal Examination
	1	2	3	1	2	3	
Remember	30	20	20	-	-	-	20
Understand	40	40	30	50	50	40	40
Apply	30	40	50	50	50	60	40
Analyse	-	-	-	-	-	-	-
Evaluate	-	-	-	-	-	-	-
Create	-	-	-	-	-	-	-

Assessment Pattern: Psychomotor

Psychomotor Skill	Miniproject /Assignment
Perception	-
Set	-
Guided Response	40
Mechanism	60
Complex Overt Responses	-
Adaptation	-
Origination	-

Sample Questions for Course Outcome Assessment**

Course Outcome 1(CO1):

1. How the services are reusable?
2. Discuss about Application architecture, Enterprise architecture and Service Oriented Architecture.
3. Distinguish between the autonomy and statelessness design principle of web services.
4. How can we increase SOA's quality of service level?

Course Outcome 2(CO2):

1. Develop web services for a car washing company handling administrative tasks deploying SOA principles like endpoint references and message information headers.
2. Develop web services with an understanding of the underlying SOA principles like service descriptions, messaging, activity management, composition, interoperability and security for an online ticket reservation system.

3. Develop a web service for an enterprise handling online shopping to receive notifications from the Logistics Company notification service.

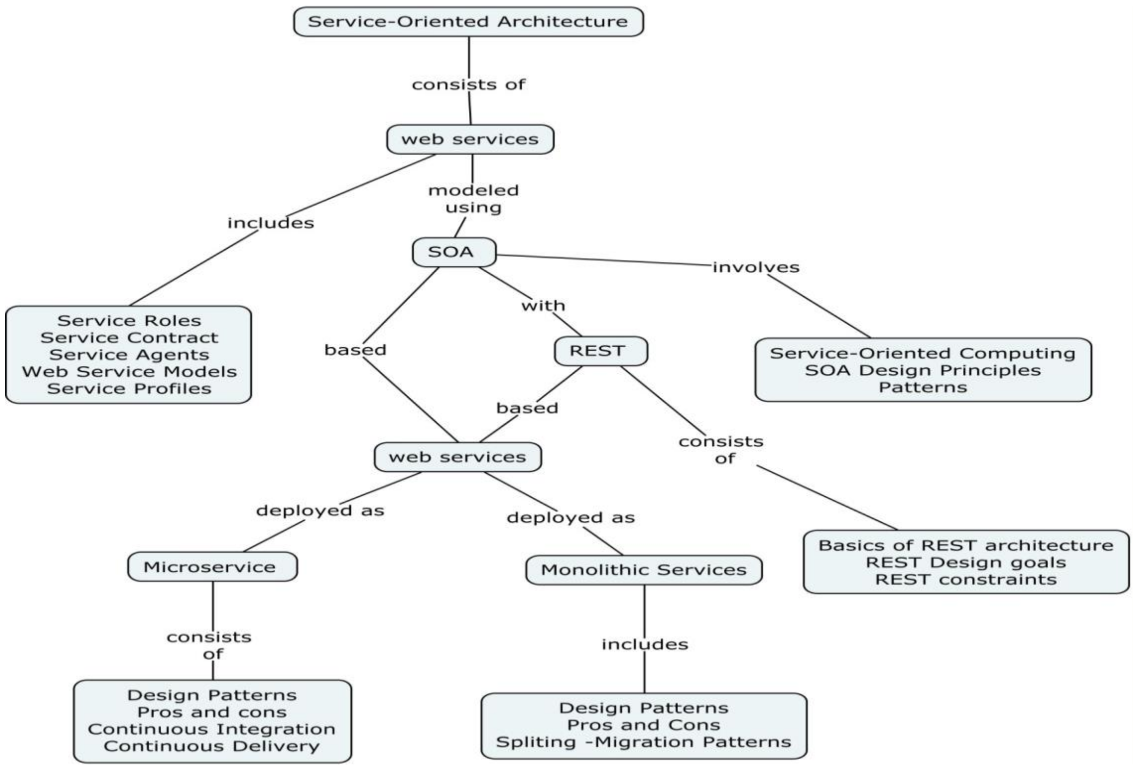
Course Outcome 3(CO3):
1. Illustrate the best practices to create a standard URI for a web service.
2. What are the architectural constraints of REST?
3. List the differences between SOA and REST.

Course Outcome 4 (CO4):
1. Identify the HTTP methods supported by REST and illustrate its application in the web service design.
2. Develop a REST based web service for an enterprise running an automated online shop containing web services for listing the products availability in the shop and ordering of the products.
3. Identify the caching architectural constraints of the REST design

Course Outcome 5 (CO5):
1. What is Monolithic architecture?
2. Identify the primary security issues arise in the web service based applications.
3. What is the difference between Monolithic, SOA and Micro service architectures?

Course Outcome 6(CO6):
1. How does the Micro service architecture work?
2. Why containers are used in Micro services?
3. Develop the calculator as a web application using Monolithic and Micro service design. Illustrate the pros and cons of the Monolithic and Micro service design of web application.

Concept Map



Syllabus

Introduction to Web Services: Service, Service Provider, Service Consumer, Service Contract, Service Agent, Service Composition, Basics of SOA - Service-Oriented Computing, Service-Oriented Architecture, Web Services, Cloud computing, IT resources, Service Models and Service Profiles, SOA Service case study.

Web services Framework: SOA service model, Services, Service Registry, Service descriptions, Messaging with Simple Object Access Protocol, WS-* standards, SOA design patterns, WS-* Service Case Study in SOA.

REST design and its goals: Basics of REST architecture, REST constraints - Client-Server, Stateless, Cache, Interface on uniform contract, Layered system and Code on Demand, Goals of the REST Architectural style - Performance, Scalability, Simplicity, Modifiability, Visibility, Portability and Reliability, Services in REST, Service Case Study in REST

Service-Oriented Design with REST: SOA with REST, design goals, design principles and constraints of SOA comply with REST, REST service capabilities, REST service contracts and Late Binding, Uniform Contract Modelling, REST Service and Inventory Modelling, REST Service Design considerations, REST Service Contract Design

Service Modelling: Service design goals, Monolithic Service design pattern, pros and cons of monolithic services, Single process monolith and distributed monolithic design, challenges in monolithic design of services, splitting the monoliths - migration patterns for split, Micro services - basics and design benefits, Continuous integration, mapping continuous integration to micro service, pipelines and continuous delivery, Migration from monolithic to micro service design – case study.

Learning Resources

1. SOA with REST: Principles, Patterns & Constraints for Building Enterprise Solutions with REST, Herbjorn Wilhelmsen, Cesare Pautasso, David Booth, Thomas Erl, Benjamin Carlyle, Raj Balasubramanian, 2012, Publisher(s): Pearson, ISBN: 9780132869904.
2. Monolith to Microservices, Sam Newman, 2019, O′Reilly Media.
3. Service-Oriented Architecture & Microservices Architecture for Enterprise, Cloud, Big Data and Mobile by Shankar Kambhampaty, Wiley 2018.
4. Building Micro services Designing Fine Grained Systems by Sam Newman O'Reilly, 2015.
5. https://cloud.google.com/solutions/migrating-a-monolithic-app-to-microservices-gke
6. https://developer.ibm.com/depmodels/microservices/articles/challenges-and-patterns-for-modernizing-a-monolithic-application-into-microservices/

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1.	**Introduction to Web Services(7)**		
1.1	Service, Service Provider, Service Consumer, Service Contract, Service Agent, Service Composition	1	CO1
1.2	Basics of SOA - Service-Oriented Computing and Service-Oriented Architecture	1	CO1
1.3	Web Services, Cloud computing and IT resources	1	CO1
1.4	Service Models and Service Profiles	1	CO1
1.5	SOA Service case study	2	CO1
2.	**Web services Framework(5)**		
2.1	SOA service model, Services, Service Registry and Service descriptions	1	CO2
2.2	Messaging with Simple Object Access Protocol	2	CO2
2.3	WS-* standards	2	CO2
2.4	SOA design patterns, WS-* Service Case Study in SOA	2	CO2
3.	**REST design and its goals (5)**		
3.1	Basics of REST architecture, REST constraints - Client-Server, Stateless, Cache, Interface on uniform contract, Layered system and Code on Demand	2	CO3
3.2	Goals of the REST Architectural style - Performance, Scalability, Simplicity, Modifiability, Visibility, Portability and Reliability	2	CO3
3.3	Services in REST, Service Case Study in REST	2	CO3
4.	**Service-Oriented Design with REST (6)**		
4.1	Uniform Contract Modelling, REST Service and Inventory Modelling	1	CO3
4.2	SOA with REST, design goals, design principles and constraints of SOA comply with REST	2	CO4
4.3	REST service capabilities, REST service contracts and Late Binding	1	CO4
4.4	REST Service Design considerations and REST Service Contract Design, SOA based service contract	1	CO4
5.	**Service Modelling (13)**		

5.1	Service design goals, Monolithic Service design, pros and cons of monolithic services	1	CO5
5.2	Single process monolith and distributed monolithic design, challenges in monolithic design of services	2	CO5
5.3	splitting the monoliths - migration patterns for split	2	CO5
5.4	Micro services - basics and design benefits	1	CO6
5.5	Continuous integration, mapping continuous integration to micro service, pipelines and continuous delivery	2	CO6
5.6	Migration from monolithic to micro service design patterns	2	CO6
5.7	Case study – web application design from monolithic to micro service pattern	2	CO6

Course Designers:

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18CSPS0	BIG DATA ANALYTICS

Category	L	T	P	Credit
PEES	3	0	0	3

Preamble

This course aims at facilitating students to explore and understand the Big data platform and its technology foundations. Students can work on big data technologies and able to process and analyse data effectively. Also, they can understand methods and techniques for mining over massive data such as data streams and do analytics over different data formats.

Prerequisite

Basics of Database Management Systems

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage in %
CO1	Explain the concepts related to big data.	10
CO2	Utilize the hadoop and map reduce technologies for processing and analysing huge data	30
CO3	Use NoSQL distributed database and HBase for handling large scale data	15
CO4	Select the suitable methods and techniques for mining data stream.	20
CO5	Experiment with variants of analytical techniques to handle different types of data.	15
CO6	Develop a complete data analytics solution for the given problem using certain analytical techniques or tools.	10

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	-	1.3, 3.2.3
CO2	TPS3	Apply	Value	-	1.3, 2.1.1, 2.1.2, 2.1.5, 3.1.2,3.2.4, 4.3.3,4.4.3
CO3	TPS3	Apply	Value	-	1.3, 2.1.1, 2.1.2, 2.1.5, 3.1.2,3.2.4, 4.3.3,4.4.3
CO4	TPS3	Apply	Value	-	1.3, 2.1.1, 2.1.2, 2.1.5, 3.1.2,3.2.4, 4.3.3,4.4.3
CO5	TPS3	Apply	Value	-	1.3, 2.1.1, 2.1.2, 2.1.5, 3.1.2,3.2.4, 4.3.3,4.4.3
CO6	TPS4	Analyse	Organize	-	1.3, 2.1.1, 2.1.2, 2.1.5, 3.1.2,3.2.4, 4.3.3,4.5.3

Mapping with Programme Outcomes and Programme Specific Outcome

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO 1	M	L										L	L		
CO 2	S	M	L		L	L		L	M	M		M	M	L	M
CO 3	S	M	L		L	L		L	M	M		M	M	L	M
CO 4	S	M	L		L	L		L	M	M		M	M	L	M
CO 5	S	M	L		L	L		L	M	M		M	M	L	M
CO 6	S	S	M	L	M	M	L	L	M	M		M	S	M	M

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Assignment			Terminal Examination
	1	2	3	1	2	3	
Remember	20	20	20	-	-	-	20
Understand	30	30	30	-	-	-	30
Apply	50	50	50	100	100	70	50
Analyse		-		-	-	30	-
Evaluate	-	-	-	-	-	-	-
Create	-	-	-	-	-	-	-

Assessment Pattern: Psychomotor

Psychomotor Skill		Miniproject /Assignment/~~Practical Component~~
Perception		-
Set		-
Guided Response		-
Mechanism		-
Complex Overt Responses		-
Adaptation		-
Origination		-

Sample Questions for Course Outcome Assessment

Course Outcome1 (CO1):

1. List out the major technologies used for handling big data.
2. Describe the characteristics of Big data.

Course Outcome2 (CO2):

1. Consider that the input dataset contains set of different color boxes. Implement a Map-reduce solution to determine the count of each color box. Provide the pseudo code for the mapper and reducer tasks.
2. Consider a Hadoop cluster with one name node and two racks named R1 and R2 in a data center D1. Each rack has 4 nodes and they are uniquely identified as R1N1, R1N2 and so on. The replication factor is set to 3 and the HDFS block size is set to 64 MB by default. File is sample.txt of size 194MB. Illustrate the anatomy of file read and write in hadoop for the above scenario.
3. Consider that there are two tables, where the first contains an employee's personal information primary keyed on SSN and the second table includes the employee's income again keyed on SSN. Compute average income in each city and this computation requires a JOIN operation on these two tables. Provide a Map-reduce solution for this scenario.

Course Outcome3 (CO3):

1. Consider that there are two tables such as Visits (user, url, time) and Pages (url, category, pagerank). Write a SQL query and an equivalent Pig script to find the top 10 most visited pages in each category.
2. State CAP theorem and BASE property.
3. Differentiate NoSQL with Relational databases.

Course Outcome4 (CO4):

1. Consider the following stream consists of elements from universal set and it has particular length 'n', Stream Data = {a, b, c, b, d, a, c, d, a, b, d, c, a, a, b}. Illustrate the AMS method of calculating second moments and show how the AMS method can be extended for calculating higher order moments.
2. Illustrate with an example, the method of computing the surprise number and k^{th} moment.
3. Discuss the different sampling methods used for processing the stream data.

Course Outcome5 (CO5):

1. Calculate the regression coefficient and obtain the lines of regression for the following data

X	1	2	3	4	5	6	7
Y	9	8	10	12	11	13	14

2. Identify the suitable data modelling methods for analyzing the twitter data and illustrate the steps involved in it.

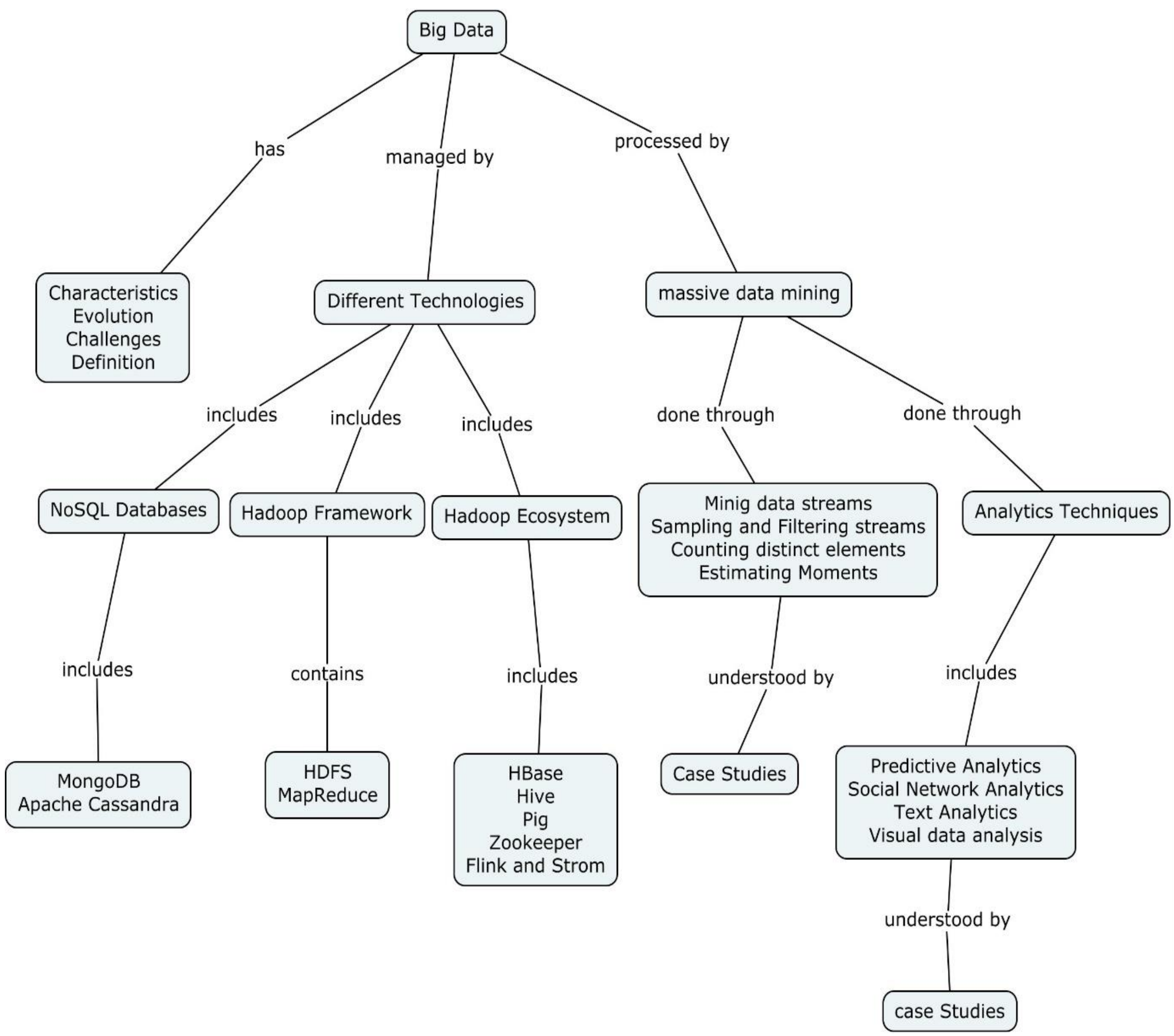
3. Given a dataset called Iris.csv, select the suitable visualization method to process and analyze data.

Course Outcome6 (CO6):

CO6 will be evaluated through Mini-Project.

To perform big data analytics in real world applications – The results can be analysed and evaluated using tools. (Assignment / Mini Project)

Concept Map



Syllabus

Big Data Introduction: Types of Digital Data-Characteristics of Data – Evolution of Big Data - Definition of Big Data - 3Vs of Big Data – Business Intelligence versus Big Data – Big data Integration - Data warehouse and Hadoop Environment. - Challenges with Big Data - Failover and Reliability, security and privacy

Big Data Technologies:
Hadoop Framework: History of Hadoop – Hadoop Overview – RDBMS versus Hadoop – Use case of Hadoop – HDFS – Processing Data with Hadoop – Managing resources and applications with YARN – Interacting with Hadoop Eco System

Map Reduce Programming: Mapper, Reducer, Combiner, Partitioner, Searching, sorting and Compression-**Hadoop Eco System:** Introduction to Hadoop ecosystem technologies - Co-ordination: Zookeeper - Databases: HBase, Hive - Scripting language: Pig, Streaming: Flink, Storm.
NoSQL databases: Types of data - scaling databases - CAP Theorem and BASE properties - MongoDB, Apache Cassandra – Features of Cassandra – CQL data types – Key spaces – CRUD operations.

Massive Data Mining: Data Streams Concepts – Stream Data Model and Architecture - Stream Computing - Sampling Data in a Stream – Filtering Data Streams – Counting Distinct Elements in a Stream – Estimating Moments – Counting Oneness in a Window – Decaying Window - Real Time Analytics Platform(RTAP) Applications – Case Study - Stock Market Predictions.

Analytics on Big Data: Defining big data analytics, Classification of Analytics – Challenges in Big data analytics - Analytics techniques – Predictive Analytics – Regression, Social Network analysis, Understanding text data analytics - Sentiment analysis, Visualizations - Visual data analysis techniques, Interaction techniques
Case studies: Big data analytics in Health care, Medical Imaging, Retail, Finance and E-Commerce.

Learning Resources

1. Seema Acharya, Subhashini Chellappan, “Big Data and Analytics”, Wiley Publication, 2015.
2. Judith Hurwitz, Alan Nugent, Dr. Fern Halper, Marcia Kaufman, “Big Data for Dummies”, John Wiley & Sons, Inc., 2013.
3. Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Paul Zikopoulos, “Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data”, McGrawHill Publishing, 2012.
4. Anand Rajaraman and Jeffrey David Ullman, “Mining of Massive Datasets”, CUP, 2012.
5. Hrushikesha Mohanty, Prachet Bhuyan, Deepak Chenthati, “Big Data – A Primer”, Springer, 2015.
6. Frank J. Ohlhorst, “Big Data Analytics: Turning Big Data into Big Money”, Wiley, 1st Edition, 2013.
7. Tom White, “Hadoop: The Definitive Guide”, O’Reilly Publications, 2011.

8. Kyle Banker, “Mongo DB in Action”, Manning Publications Company, 2012.
9. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012.
10. Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.
11. Alan Gates, "Programming Pig", O'Reilley, 2011.
12. http://bigdatauniversity.com/bdu-wp/bdu-course/big-data-fundamentals

Course Contents and Lecture Schedule

Module No.	Topic	No. of Lectures	Course Outcome
1	**Introduction to Big Data (4)**		
1.1	Types of Digital Data	1	CO1
1.2	Characteristics of Data		
1.3	Evolution of Big Data		
1.4, 1.5	Definition of Big Data, 3Vs of Big Data	1	CO1
1.6	Challenges with Big Data - Failover and Reliability, security and privacy	1	CO1
1.7,1.8	Business Intelligence versus Big Data ,Big data Integration - Data warehouse and Hadoop Environment	1	CO1
2	**Big Data Technologies (10)**		
2.1	**Hadoop Framework:** History of Hadoop	1	CO2
2.2	Hadoop Overview	1	CO2
2.2, 2.3	RDBMS versus Hadoop, Use case of Hadoop		
2.4	HDFS	1	CO2
2.5	Processing Data with Hadoop		
2.6	Managing resources and applications with YARN,	1	CO2
2.7	Interacting with Hadoop Eco System		
2.8	**Map Reduce Programming -** Mapper, Reducer, Combiner	1	CO2
2.9	Partitioner, Searching, Sorting and Compression	1	CO2
2.10	**Hadoop Eco System:** Introduction to Hadoop ecosystem technologies - Co-ordination: Zookeeper	1	CO2
2.11	Databases: HBase, Hive	1	CO2
2.12	Scripting language: Pig	1	CO2
2.13	Streaming: Flink, Storm	1	CO2

Module No.	Topic	No. of Lectures	Course Outcome
3	**NoSQL databases (6)**		
3.1	Types of data, scaling databases	1	CO3
3.2	CAP Theorem and BASE properties	1	CO3
3.3	MongoDB	1	CO3
3.4	Apache Cassandra – Features of Cassandra	1	CO3
3.5	CQL data types	1	CO3
3.6	Keyspaces – CRUD operations	1	CO3
4	**Massive Data Mining (7)**		
4.1	Data Streams Concepts	1	CO4
4.2	Stream Data Model and Architecture		
4.3	Stream Computing - Sampling Data in a Stream	2	CO4
4.3	Filtering Data Streams	1	CO4
4.4, 4.5	Counting Distinct Elements in a Stream, Estimating Moments	1	CO4
4.6	Counting Oneness in a Window, Decaying Window	1	CO4
4.7	Real Time Analytics Platform(RTAP) Applications – Case Study - Stock Market Predictions.	1	CO4
5	**Analytics on Big Data (6)**		
5.1	Defining big data analytics	1	CO5
5.2, 5.3	Classification of Analytics, Challenges in Big data analytics	1	CO5
5.4	Analytics techniques – Predictive Analytics – Regression	1	CO5
5.5	Social Network analysis	1	CO5
5.6	Understanding text data analytics - Sentiment analysis	1	CO5
5.7	Visualizations - Visual data analysis techniques, Interaction techniques	1	CO5
6	**Case Studies (3)**		
6.1	Big data analytics in Health care, Medical Imaging	1	CO6
6.2	Big data analytics in Retail and Finance	1	CO6

Module No.	Topic	No. of Lectures	Course Outcome
6.3	Big data analytics in E-Commerce	1	CO6
	Total	**36**	

Course Designer:

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18CSPT0	ALGORITHMIC PARADIGMS

Category	L	T	P	Credit
PEES	3	0	0	3

Preamble

Algorithm design and analysis is a fundamental and important part of computer science. This course introduces students to advanced techniques for the design and analysis of algorithms, and explores a variety of applications. In this course, survey of many techniques that can be apply broadly in the design of efficient algorithms, and study their application in a wide range of application domains and computational models

Prerequisite

- Data Structures and Algorithms
- Design and Analysis of Algorithms

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Develop linear programming using polynomial time algorithms	10
CO2	Solve string-matching problems using string algorithms including Rabin-Karp, Knuth Morris Pratt, and Boyer Moore.	15
CO3	Examine the approximation ratio of approximation algorithms for combinatorial optimization problems.	25
CO4	Estimate the expected running time of Las Vegas algorithm and the probability of Monte Carlo randomized algorithm.	15
CO5	Solve Computational Geometry problems including Convex Hull, Line-segment Intersection, Sweep Lines, Voronoi Diagrams, Range Trees and Seidel's Low-dimensional LP Algorithms.	20
CO6	Compute distinct and frequent elements using sketching method.	10

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value	Mechanism	1.2, 2.1.1
CO2	TPS3	Apply	Value	Mechanism	1.2, 2.1.1,3.1
CO3	TPS4	Analyse	Organise	Complex Overt Responses	1.2, 2.1.1,2.1.3,3.1
CO4	TPS4	Analyse	Organise	Complex Overt Responses	1.2, 2.1.1,2.1.3,3.1
CO5	TPS3	Apply	Value	Mechanism	1.2, 2.1.1,3.1
CO6	TPS3	Apply	Value	Mechanism	1.2, 2.1.1, 3.1,4.5.3

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L		L	L		L	L	L		L	M	L	L
CO2	S	M	L		L	L		L	L	L		L	M	L	L
CO3	S	S	M	L	L	L		L	L	L		L	S	L	L
CO4	S	S	M	L	L	L		L	L	L		L	S	L	L
CO5	S	M	L		L	L		L	L	L		L	M	L	L
CO6	S	M	L		L	L		L	L	L		L	M	L	L

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Assignment			Terminal Examination
	1	2	3	1	2	3	
Remember	10	10	10	-	-	-	10
Understand	10	10	10	-	-	-	10
Apply	80	-	80	100	-	100	50
Analyse		80			100	-	30
Evaluate							
Create							

Assessment Pattern: Psychomotor

Psychomotor Skill	Assignments
Perception	
Set	
Guided Response	
Mechanism	70
Complex Overt Responses	30
Adaptation	
Origination	

Sample Questions for Course Outcome Assessment**

Course Outcome 1 (CO1):

1. Suppose that a farmer has a piece of farm land, say L km2, to be planted with either wheat or barley or some combination of the two. The farmer has a limited amount of fertilizer, F kilograms, and insecticide, P kilograms. Every square kilometer of wheat requires F1 kilograms of fertilizer and P1 kilograms of insecticide, while every square kilometer of barley requires F2kilograms of fertilizer and P2 kilograms of insecticide. Let S1 be the selling price of wheat per square kilometer, and S2 be the selling price of barley. If we denote the area of land planted with wheat and barley by x1 and x2 respectively, then profit

can be maximized by choosing optimal values for x1 and x2. Express the given problem as linear programming problem in the standard form

2. Use the simplex method to find the maximum value of

$$z = 2x_1 - x_2 + 2x_3$$

subject to the constraints

subject to the constraints

$$\begin{aligned} 2x_1 + \quad x_2 \qquad\quad &\le 10 \\ x_1 + 2x_2 - 2x_3 &\le 20 \\ x_2 + 2x_3 &\le \ 5 \end{aligned}$$

where $x_1 \ge 0, x_2 \ge 0,$ and $x_3 \ge 0.$

3. Explain different ways to formulate the Problems as Linear Programs.
4. Formulate the given problem as linear programming problem: A prison is trying to decide what to feed its prisoners. They would like to offer some combination of milk, beans, and oranges. Their goal is to minimize cost, subject to meeting the minimum nutritional requirements imposed by law. The cost and nutritional content of each food, along with the minimum nutritional requirements are shown below.

	Milk (gallons)	Navy Beans (cups)	Oranges (large Calif. Valencia)	Minimum Daily Requirement
Niacin (mg)	3.2	4.9	0.8	13.0
Thiamin (mg)	1.12	1.3	0.19	1.5
Vitamin C (mg)	32.0	0.0	93.0	45.0
Cost ($)	2.00	0.20	0.25	

Course Outcome 2 (CO2):

1. Given two strings s and t, compute is the longest substring that occurs in both of them. For example if a="boogie" and b="ogre" then the answer is "og".
2. Given a string s, find the longest substring that is a palindrome (or a Watson-crick palindrome).
3. How would you modify Rabin-Karp to search for a given pattern with the additional proviso that the middle character is a "wildcard" (any text character at all can match it).

Course Outcome 3 (CO3):

1. Given an undirected graph G = (V, E), a vertex cover of G is a subset V‟ ⊆ V such that, for every edge (u,v) ⊆ E, we have either u ⊆ V‟ or v ⊆ V‟. Find the smallest possible vertex cover?
2. Show that Set Cover is NP-complete by making use of Vertex Cover.
3. An instance of Set Cover is given by a ground set U = x1, x2,...,xn, a collection of m subsets Si ⊆ U of that ground set, and an integer k. Can you select a collection C of at most k of these subsets such that taken together, they “cover” all of U? In other words, is there a 1 set C ⊆ {1, 2,...,m} such that |C| ≤ k and

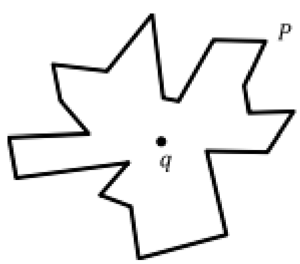
$$\bigcup_{i \in C} S_i = U.$$

Course Outcome 4 (CO4):

1. Consider a Monte Carlo algorithm A for a problem n whose expected running time is at most T(n) on any instance of size n and that produces a correct solution with probability y(n). Suppose further that given a solution ton, we can verify its correctness in time t(n). Show how to obtain a Las Vegas algorithm that always gives a correct answer to n and runs in expected time at most (T(n) + t(n))/y(n).
2. Let 0 < E2 < E1 < 1. Consider a Monte Carlo algorithm that gives the correct solution to a problem with probability at least 1 - E1, regardless of the input. How many independent executions of this algorithm suffice to raise the probability of obtaining a correct solution to at least 1 - E2, regardless of the input?
3. Show that there exists a set of line segments for which no binary planar partition can avoid breaking up some of the segments i nto pieces, if each segment is to lie in a different region of the partition.

Course Outcome 5 (CO5):

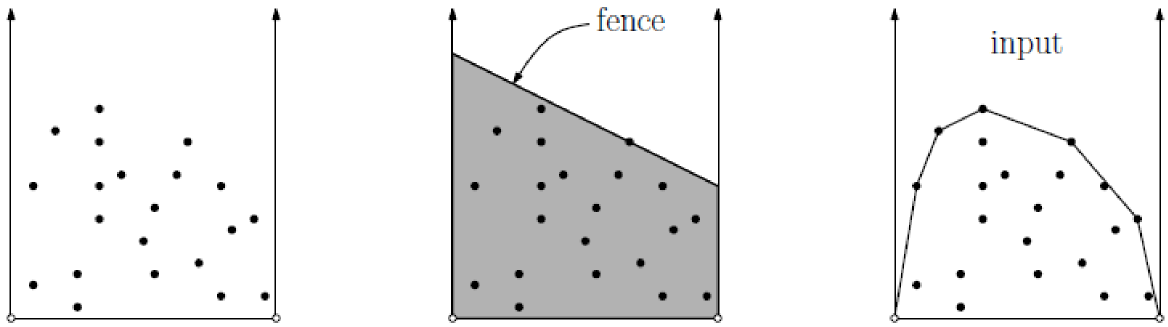
1. Intersect the unit sphere in 3-space with a general quadratic surface. Show that the convex hull of the resulting curve C is a spectrahedron.
2. A polygon P is star-shaped if there exists a point q inside the polygon such that for every point p in the polygon P, the line pq is contained within P. You are given the polygon P as a counter clockwise list of n vertices (the position of q is not known). Give an O(n) algorithm to compute the convex hull of P (vertices listed in counter clockwise order). Prove the correctness of your algorithm.



A star-shaped polygon

3. Draw the Voronoi diagram of 10 points all on a line. Draw separately the Voronoi diagram of 10 points all on a circle. What do these two diagrams have in common?

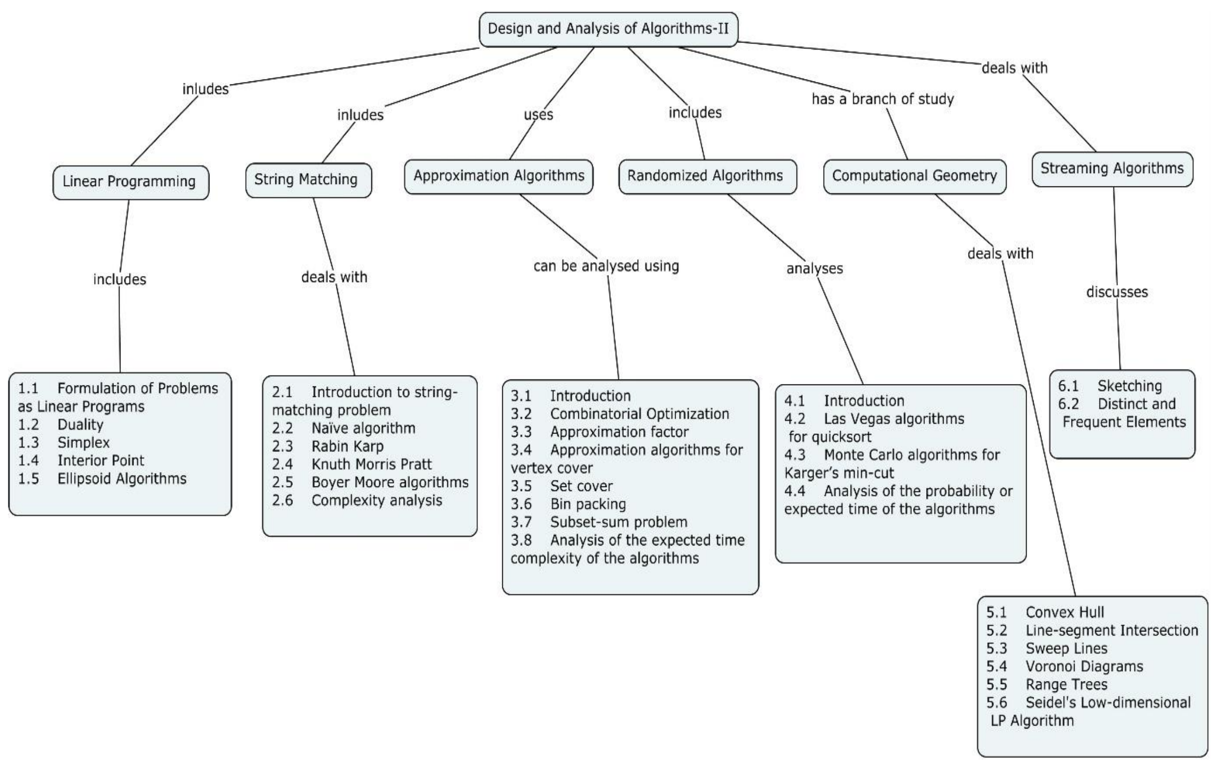
4. A farmer has an orchard where various trees have been planted. Let P = {p1, . . . , pn} denote the coordinates of these trees. (The trees are very skinny, so each can be modelled by a single point.
Maybe they are palm trees and the farmer sells coconuts.) The farm is bordered on east and west by roads running north-south and on the south by a road running east-west (see Figure below). The farmer wants to erect a straight-line fence to bound the north side of his orchard (to keep out those pesky coconut-eating armadillos). Since the city charges him tax based on the area of the farm, he wants to erect the fence to minimize the enclosed area (shaded in the figure).
Present an efficient algorithm to determine where the fence should be placed. Assuming that the upper hull of the points has already been computed (including the lower left and right corners of the property), show that it is possible to determine where to put the fence in O(log n) time. (Hint: Begin by determining what geometric properties the area-minimizing line must satisfy. You will need to include a proof of this in your solution.)



Course Outcome 6 (CO6): (Mini Project)

1. Approximate the number of triangles in a graph. The stream consists of edges of an underlying graph G, the goal is to approximately count the number T3 of triangles in G. This number relates the clustering coefficient, and the connectivity coefficient in a network, and can be used to analyse topologies of networks.
2. Describe a suite of algorithms for constructing low-rank approximations of an input matrix from a random linear image, or sketch, of the matrix.

Concept Map



Syllabus

Linear Programming - Formulation of Problems as Linear Programs. Duality. Simplex, Interior Point, and Ellipsoid Algorithms.

String Matching - Introduction to string-matching problem, Naïve algorithm, Rabin Karp, Knuth Morris Pratt, Boyer Moore algorithms and complexity analysis.

Approximation Algorithms - Introduction, Combinatorial Optimization, approximation factor, Approximation algorithms for vertex cover, set cover, bin packing, subset-sum problem. Analysis of the expected time complexity of the algorithms.
Randomized Algorithms – Introduction, Las Vegas algorithms for quicksort and Monte Carlo algorithms for Karger's min-cut. Analysis of the probability or expected time of the algorithms
Computational Geometry - Convex Hull. Line-segment Intersection. Sweep Lines. Voronoi Diagrams. Range Trees. Seidel's Low-dimensional LP Algorithm.
Streaming Algorithms - Sketching. Distinct and Frequent Elements.

Learning Resources

1. T.H. Cormen, C.E. Leiserson, R.L. Rivest, C. Stein. "Introduction to Algorithms", MIT Press, 3rd edition, 2009.
2. R:Brassard, G., Bratley, P. "Fundamentals of Algorithmics" Prentice Hall, 1996.
3. Vijay V. Vazirani, "Approximation Algorithms", Course Notes, Georgia Institute of Technology, 2000
4. R. Motwani and P. Raghavan, "Randomized Algorithms", Cambridge University Press, 1995.
5. D.Harel, "Algorithmics :The spirit of computing", Springer Publisher, 2012
6. David R. Anderson/Dennis J. Sweeney/Thomas A. Williams/Jeffrey D. Camm/James J Cochran," An introduction to Management Science-Quantitative Approaches to Decision Making",Cengage,14th edition,2019

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1	**Linear Programming**		
1.1	Formulation of Problems as Linear Programs	1	CO1
1.2	Duality	1	CO1
1.3	Simplex	1	CO1
1.4	Interior Point	1	CO1
1.5	Ellipsoid Algorithms	1	CO1
2	**String Matching**		
2.1	Introduction to string-matching problem	1	CO2
2.2	Naïve algorithm	1	CO2
2.3	Rabin Karp	1	CO2
2.4	Knuth Morris Pratt	1	CO2
2.5	Boyer Moore algorithms	1	CO2
2.6	Complexity analysis	1	CO2
3	**Approximation Algorithms**		
3.1	Introduction	1	CO3
3.2	Combinatorial Optimization		CO3
3.3	Approximation factor	1	CO3
3.4	Approximation algorithms for vertex cover	1	CO3
3.5	Set cover	1	CO3
3.6	Bin packing	2	CO3
3.7	Subset-sum problem	1	CO3

3.8	Analysis of the expected time complexity of the algorithms	1	CO3
4	**Randomized Algorithms**		
4.1	Introduction	1	CO4
4.2	Las Vegas algorithms for quicksort	2	CO4
4.3	Monte Carlo algorithms for Karger's min-cut	2	CO4
4.4	Analysis of the probability or expected time of the algorithms	1	CO4
5	**Computational Geometry**		
5.1	Convex Hull	1	CO5
5.2	Line-segment Intersection	1	CO5
5.3	Sweep Lines	1	CO5
5.4	Voronoi Diagrams	2	CO5
5.5	Range Trees	1	CO5
5.6	Seidel's Low-dimensional LP Algorithm	1	CO5
6	**Streaming Algorithms**		
6.1	Sketching	2	CO6
6.2	Distinct and Frequent Elements	2	CO6
	Total	36	

Course Designers:

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18CSPU0	EDGE COMPUTING

Category	L	T	P	Credit
PE	3	0	0	3

Preamble

This course provides knowledge and abilities on how IoT and Edge Computing are used to meet application demands in Industrial intelligence. The objective of this course is to make students to understand computing and communication technologies used for IoT, Edge and Cloud Computing. This course also includes middleware architecture between Edge & Cloud and adding intelligence at the edge. At the end of the course students should be able to implement Edge-Cloud Systems for an application opportunity.

Prerequisite

- Algorithms
- Data Structure
- Network Programming

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Implement Computation and Communication specification in the Internet of Things Systems based on application demands	15
CO2	Explain architectures, entities used in Edge Computing along with its benefits and challenges	15
CO3	Implement the networking and routing protocols for communication and processing occurs in the Edge to cloud scenario	20
CO4	Develop application packaging and orchestration for distributed clusters in an edge cloud environment	30
CO5	Implement the tool for analyse the data at the edge to know the real-time insights and provide resolution to the problems in various domains	10
CO6	Design physical and logical workspace for the real time Edge-Fog- Cloud environment	10

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value	Mechanism	1.3,2.3.1,3.2.1,4.1.1
CO2	TPS2	Understand	Respond	Guided Response	1.3,2.3.1
CO3	TPS3	Apply	Value	Mechanism	1.3,2.1.1,3.2.1,4.1.1
CO4	TPS3	Apply	Value	Mechanism	1.3,2.1.1,3.2.1,4.1.1
CO5	TPS3	Apply	Value	Mechanism	1.3,2.1.1,3.2.1,4.1.1
CO6	TPS3	Apply	Value	Mechanism	1.3,2.1.1,3.2.1,4.1.1

***CO6 assessed through MiniProject, Assignment

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L		M			M	L	L		L	M	L	L
CO2	M	L			L			L				L	L		
CO3	S	M	L		M	M	L	M	L	L		L	M	L	L
CO4	S	M	L		M	M	L	M	L	L		L	M	L	L
CO5	S	M	L		M	M	L	M	L	L		L	M	L	L
CO6	S	M	L	L	S	S	M	S	M	M	L	M	M	M	M

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Assignment			Terminal Examination
	1	2	3	1	2	3	
Remember	20	20	20	-	-	-	20
Understand	30	20	20	-	-	-	20
Apply	50	60	60	100	100	100	60
Analyse	-	-		-	-	-	-
Evaluate	-	-	-	-	-	-	-
Create	-	-	-	-	-	-	-

Assessment Pattern: Psychomotor

Psychomotor Skill	Miniproject /Assignment/Practical Component
Perception	-
Set	-
Guided Response	-
Mechanism	100
Complex Overt Responses	-
Adaptation	-
Origination	-

Sample Questions for Course Outcome Assessment

Course Outcome 1 (CO1):

1. What are IOT components? Explain each in detail
2. Explain the advantages and disadvantages of IoT
3. Design a IOT system for Home Automated Scenario using suitable computation and communication factors.

Course Outcome 2 (CO2):

1. Explain in detail about the characteristics of Edge Computing.
2. List the attributes of networking component used in edge computing
3. Describe the benefits and drawback of edge computing with suitable example

Course Outcome 3 (CO3):

1. Identify the appropriate routing functions used in edge processing that are distributed geographically
2. Implement the protocol used in (i) long range and high data rate (ii) long range and low data rate (iii) Medium range and high data rate (iv) Medium range and medium data rate (v) short range and medium data rate for smart building environment
3. Design Cloud and Fog Topologies used in Healthcare implants

Course Outcome 4 (CO4)

1. Apply the appropriate middleware architecture in context monitoring and prediction
2. Design a methodologies for creating clusters of lightweight Edge clouds
3. Illustrate security requirements and managements

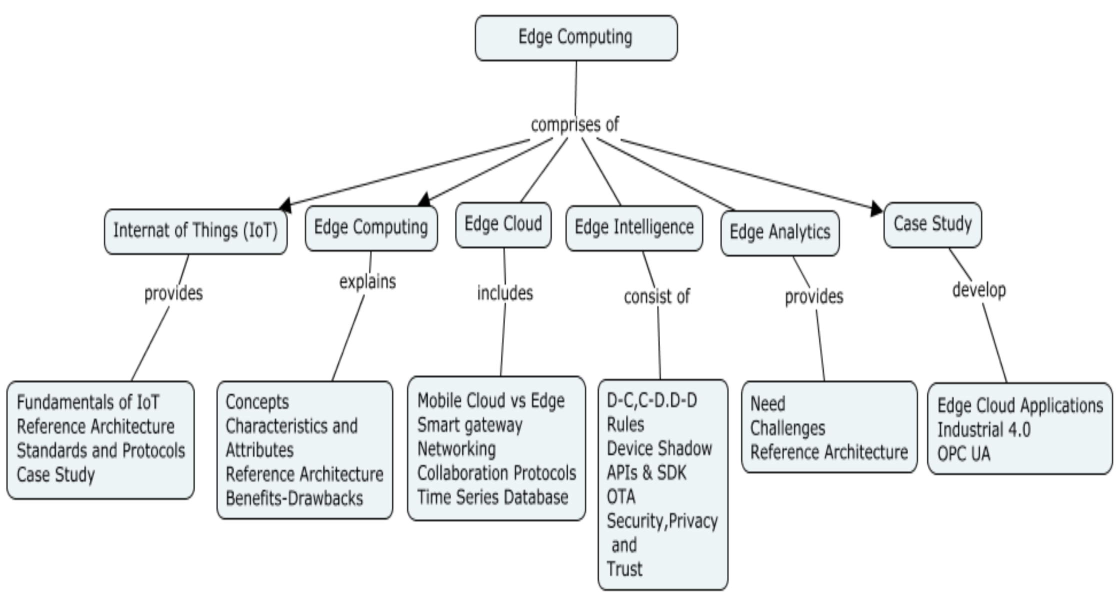
Course Outcome 5 (CO5)

1. Illustrate the capabilities needed at edge devices for running analytics at the edge device
2. Identify the stages of data analysis techniques used in video surveillance camera generated data set for object identification.
3. Analyse the challenges involved in centralized IoT architecture and provide the solutions for the same

Course Outcome 6 (CO6)

1. Create Physical workspace for in-house energy management
2. Design and Develop logical workspace for automated car parking
3. Design Edge-Fog-Cloud architecture for Smart Home.

Concept Map



Syllabus

Internet of Things: Fundamentals of IoT- IoT Reference Architecture-Sensors, Endpoints and Power Systems- IoT Standards and Protocols-MQTT, CoAP, AMQT, STOMP Case Study: Cisco Packet Tracer **Edge Computing:** Concepts, Characteristics and Attributes –Reference

Architecture-Multi View, Concept View, Function View, Deployment View -Benefits-Drawbacks **Edge Cloud**- Mobile Cloud Computing vs Edge Computing, Smart Gateway-IoT Hub, Event Hub-Networking-5G/LTE, Collaboration Protocols-Time Series Database **Edge Intelligence**- Device-Device, Device-Cloud, Cloud-Device-Rules-Device Shadow-IoT APIs & SDK-OTA- Remote Diagnostics- Security, Privacy and Trust **Edge Analytics** - The Need for Edge Analytics - Challenges in Centralized IoT - Edge Analytics Architecture - **Case Study:** Edge Cloud Applications – Connected Buildings, Plant, Hospitals-Industrial 4.0-OPC UA

Learning Resources

1. Rajkumar Buyya, Satish Narayana Srirama, Fog and Edge Computing: Principles and Paradigms, Wiley 2019
2. Perry lea, IoT and Edge Computing for Architects: Implementing Edge and IoT Systems from Sensors to Clouds with Communication Systems, Analytics, and Security, Packet Publishing, 2020, 2nd Edition
3. Fadi Al-Turjman,Edge Computing From Hype to Reality, EAI/Springer Innovations in Communication and Computing,2019
4. Jie Cao,Quan Zhang,Weisong Shi, Edge Computing: A Primer, SpringerBriefs in Computer Science, 2018
5. Edge Computing Consortium : https://ecconsortium.eu/
6. AWS IoT: Developing and Deploying an Internet of Things: https://courses.edx.org/courses/course-v1:AWS+OTP AWSD5+1T2019/course/
7. IoT Networks and Protocols : https://courses.edx.org/courses/course-v1:CurtinX+IOT3x+3T2020/course/
8. Packet Tracer: http://static-pt-assets.s3.amazonaws.com/tutorials71.htm#stub

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1	**Internet of Things (5)**		
1.1	Fundamentals of IoT	1	CO1
1.2	IoT Reference Architecture -Sensors, Endpoints and Power Systems	1	CO1
1.3	IoT Standards and Protocols-MQTT, CoAP, AMQT, STOMP	2	CO1
1.4	Case Study: Cisco Packet Tracer	1	CO1
2	**Edge Computing (5)**		
2.1	Concepts, Characteristics and Attributes	1	CO2
2.2	Reference Architecture	1	CO2
2.3	Multi View, Concept View, Function View, Deployment View	2	CO2
2.4	Edge-Benefits-Drawbacks	1	CO2
3	**Edge Cloud (8)**		
3.1	Mobile Cloud Computing vs Edge Computing	1	CO3
3.2	Smart Gateway-IoT Hub, Event Hub	2	CO3
3.3	Networking-5G/LTE	2	CO3
3.4	Collaboration Protocols	2	CO3
3.5	Time Series Database	1	CO3
4	**Edge Intelligence (10)**		
4.1	Device-Device, Device-Cloud, Cloud-Device	1	CO4
4.2	Rules	2	CO4

4.3	Device Shadow	2	CO4
4.4	IoT APIs & SDK	2	CO4
4.5	OTA, Remote Diagnostics	1	CO4
4.6	Security, Privacy and Trust	2	CO4
5	**Edge Analytics (4)**		
5.1	The Need for Edge Analytics	1	CO5
5.2	Challenges in Centralized IoT	1	CO5
5.3	Edge Analytics Architecture	2	CO5
6	**Case Study (4)**		
6.1	Edge Cloud Applications		CO6
6.1.1	Connected Buildings, Plant, Hospitals	2	CO6
6.1.2	Industrial 4.0	1	CO6
6.1.3	OPC UA	1	CO6
	Total	**36**	

Course Designers:

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18CSPV0	SOFTWARE DEFINED NETWORKING

Category	L	T	P	Credit
PE	3	0	0	3

Preamble

This course presents the need, basic principles, fundamental mechanisms and technical challenges of the emerging software-defined networking (SDN).

Prerequisite

Data Communication and Networks

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Explain the need and usage of control and data planes	15
CO2	Employ the Openflow Protocols standard for communication with network components and SDN Controllers	15
CO3	Demonstrate virtualization of network functions	20
CO4	Discover Network topological information using SDN controllers	15
CO5	Construct SDN network Framework for real time applications	20
CO6	Use programmability over modern network element Interfaces	15

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	Guided Response	1.3
CO2	TPS3	Apply	Value	Mechanism	1.3,2.1.1
CO3	TPS3	Apply	Value	Mechanism	1.3,2.1.1,3.1.1
CO4	TPS3	Apply	Value	Mechanism	1.3,2.1.1
CO5	TPS3	Apply	Value	Mechanism	1.3,2.1.1,3.1.1
CO6	TPS3	Apply	Value	Mechanism	1.3,2.1.1,3.1.1

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	-										L		
CO2	S	M	L		L			L	L	L			M		L
CO3	S	M	L		L			L	L	L			M		L
CO4	S	M	L		L			L	L	L			M		L
CO5	S	M	L		L			L	L	L			M		L
CO6	S	M	L		L			L	L	L			M		L

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Assignment			Terminal Examination
	1	2	3	1	2	3	
Remember	40	20	20		-	-	20
Understand	40	40	20				20
Apply	20	40	60	100	100	100	60
Analyse							
Evaluate							
Create							

Assessment Pattern: Psychomotor

Psychomotor Skill	~~Miniproject~~/Assignment/~~Practical Component~~
Perception	
Set	
Guided Response	
Mechanism	100
Complex Overt Responses	
Adaptation	
Origination	

Sample Questions for Course Outcome Assessment**

** (2 to 3 at the cognitive level of course outcome)

Course Outcome 1(CO1):

1. Differentiate Control and Data Plane
2. Why the separation of Control and Data Planes are important?
3. List the protocols used in Control and Data Planes

Course Outcome 2 (CO2):

1. Outline the OpenFlow port abstraction and the various types of OpenFlow ports supported
2. Demonstrate the Packet Replication Mechanisms in Openflow
3. Discuss the Core features of SDN: abstractions, structured state, and state semantics

Course Outcome 3 (CO3):

1. Identify the issues that may results from Network virtualization in terms of the virtualization technique used
2. Describe end to end correctness in network virtualization and develop a suitable algorithm to implement the same
3. Discuss in detail the security issues that could result due to network virtualization and give some corrective measures for the same

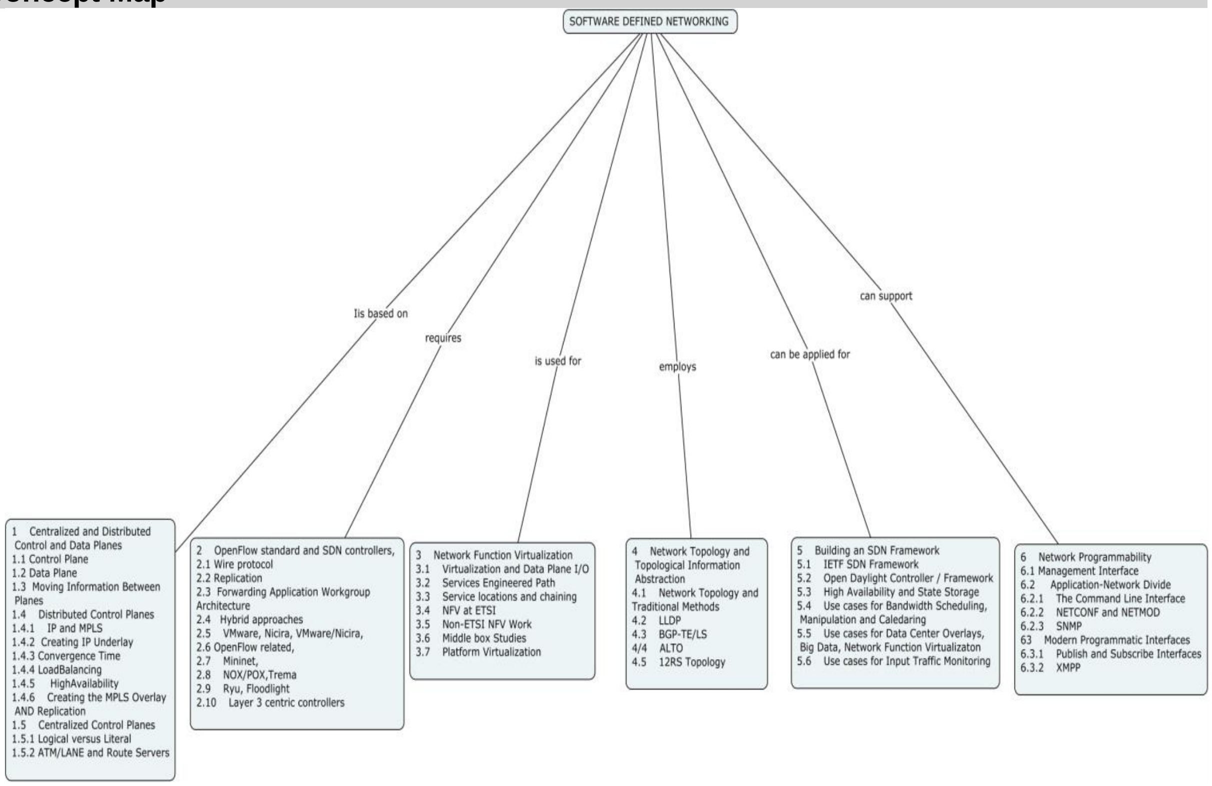
Course Outcome 4 (CO4):

1. Compare available open-source and commercial controllers and hence justify the suitable controller based on Performance considerations for any real world application.
2. Examine the use of LLDP as a switch port discovery protocol by an SDN Controller.
3. Identify a suitable routing Protocol that standardizes the topology information for applications that do not interact directly. Also examine if the above protocol can be combined with one or more protocols to enhance the scalability of the application.

Course Outcome 5 (CO5):
1. Demonstrate the usage of SDN framework for Data centre application.
2. With a suitable use case illustrate the application of SDN for traffic monitoring.

Course Outcome 6 (CO6):
1. Discuss how Google's Protocol Buffers are better than the traditional XML and JSON.
2. List out and describe the common forms of filtering available in Message Processing.
3. Discuss how Publish and Subscribe Interfaces are better than other Programmatic Interfaces.

Concept Map



Syllabus

Centralized and Distributed Control and Data Planes Control Plane**,** Data Plane**,** Moving Information Between Planes**,** Distributed Control Planes**,** IP and MPLS**,** Creating IP Underlay**,** Convergence Time**,** Load Balancing**,** High Availability**,** Creating the MPLS Overlay AND Replication, Centralized Control Planes, Logical versus Literal, ATM/LANE and Route Servers

OpenFlow standard and SDN controllers Wire protocol, Replication, Forwarding Application Workgroup , Architecture, Hybrid approaches, VMware, Nicira,VMware/Nicira, OpenFlow related, Mininet, NOX/POX,Trema ,Ryu, Floodlight, Layer 3 centric controllers

Network Function Virtualization Virtualization and Data Plane I/O, Services Engineered Path, Service locations and chaining,NFV at ETSI,MiddleboxStudies ,Platform Virtualization

Network Topology and Topological Information Abstraction Network Topology and Traditional Methods**,** LLDP**,** BGP-TE/LS**,** ALTO**,** I2RS Topology

Building an SDN Framework IETF SDN Framework, Open Daylight Controller / Framework ,High Availability and State Storage ,Use cases for SDN

Network Programmability Management Interface, Application-Network Divide, The Command Line Interface, NETCONF and NETMOD, SNMP, Modern Programmatic Interfaces, Publish and Subscribe Interfaces, XMPP, Google‘s Protocol Buffers, Thrift, JSON,I2RS

Learning Resources

1. Thomas D Nadeau andken Gray,- SDN: Software Defined Networks: An Authoritative Review of Network Programmability Technologies,O‘Reillypublication, First Edition,2014
2.FEI HU , “Network Innovation through OpenFlow and SDN: Principles and Design”, CRC Press, Taylor & Francis Group, 2014
3.Azodolmolky, Siamak, “Software Defined Networking with OpenFlow”, Packt Publishing Ltd. , 2013.
4. Goransson, Paul, Chuck Black, Timothy Culver, “Software Defined Networks: A Comprehensive Approach”, Morgan Kaufmann, 2016.
5.https://swayam.gov.in/nd1_noc20_cs23/preview
6. https://www.coursera.org/learn/sdn

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1	**Centralized and Distributed Control and Data Planes**		
1.1 1.2 1.3	Control Plane Data Plane Moving Information Between Planes	1	CO1
1.4 1.4.1	Distributed Control Planes IP and MPLS	1	CO1
1.4.2 1.4.3 1.4.4 1.4.5	Creating IP Underlay Convergence Time Load Balancing High Availability	1	CO1
1.4.6	Creating the MPLS Overlay AND Replication	1	CO1
1.5 1.5.1 1.5.2	Centralized Control Planes Logical versus Literal ATM/LANE and Route Servers	1	CO1
2	**OpenFlow standard and SDN controllers**,		
2.1 2.2	Wire protocol Replication	1	CO2
2.3 2.4	Forwarding Application Workgroup Architecture, Hybrid approaches	1	CO2
2.5	VMware, Nicira, VMware/Nicira,	1	CO2
2.6 2.7	OpenFlow related, Mininet,	1	CO2
2.8 2.9 2.10	NOX/POX, Trema Ryu, Floodlight Layer 3 centric controllers	1	CO2
3	**Network Function Virtualization**		
3.1	Virtualization and Data Plane I/O	1	CO3

3.2	Services Engineered Path	1	CO3
3.3	Service locations and chaining	1	CO3
3.4	NFV at ETSI	1	CO3
3.5	Non-ETSI NFV Work	1	CO3
3.6	Middle box Studies	1	CO3
3.7	Platform Virtualization	1	CO3
4	**Network Topology and Topological Information Abstraction**		
4.1	Network Topology and Traditional Methods	2	CO4
4.2	LLDP	1	CO4
4.3	BGP-TE/LS	1	CO4
4/4	ALTO	1	CO4
4.5	12RS Topology	1	CO4
5	**Building an SDN Framework**		
5.1	IETF SDN Framework	1	C05
5.2	Open Daylight Controller / Framework	2	C05
5.3	High Availability and State Storage	2	C05
5.4	Use cases for SDN	2	C05
6	**Network Programmability**		
6.1 6.2	Management Interface Application-Network Divide	1	CO6
6.2.1	The Command Line Interface	1	CO6
6.2.2	NETCONF and NETMOD	1	CO6
6.2.3	SNMP	1	CO6
63	Modern Programmatic Interfaces	1	CO6
6.3.1 6.3.2	Publish and Subscribe Interfaces XMPP	1	CO6
	Total	36	

Course Designers:

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18CSPW0	REINFORCEMENT LEARNING

Category	L	T	P	Credit
PEES	3	0	0	3

Preamble

The elective course is intended for students interested in artificial intelligence. Reinforcement learning is a paradigm that aims to model the trial-and-error learning process that is needed in many problem situations where explicit instructive signals are not available. The goal of the course is to introduce the basic mathematical foundations of reinforcement learning and cover latest methods used to create agents that can solve a variety of complex tasks.

Prerequisite

- Basic knowledge of Algorithms
- Basic knowledge of Probability theory

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Describe the core principles of Reinforcement Learning and formulate the Learning tasks	20
CO2	Perform Planning using techniques like Dynamic Programming, Monte Carlo methods	25
CO3	Perform prediction and control using Temporal difference methods	15
CO4	Apply reinforcement learning algorithms using function approximation	15
CO5	Explore current advanced techniques and applications in Reinforcement Learning	10
CO6*	Identify suitable learning tasks and solve using appropriate reinforcement learning techniques	15

* The course outcome is assessed through Mini-project.

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	-	1.1, 2.1.1
CO2	TPS3	Apply	Value	-	1.2, 2.1.1, 2.1.2, 2.5.1, 3.2.3
CO3	TPS3	Apply	Value	-	1.2, 2.1.1, 2.1.2, 2.5.1, 3.2.3
CO4	TPS3	Apply	Value	-	1.2, 2.1.1, 2.1.2, 2.5.1, 3.2.3
CO5	TPS2	Understand	Respond	-	1.1, 2.1.1
CO6	TPS3	Apply	Value	-	2.1.1, 2.1.2, 2.5.1, 3.2.3

Mapping with Programme Outcomesand Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L											L		
CO2	S	M	L					M					M		

CO3	S	M	L					M					M		
CO4	S	M	L					M					M		
CO5	M	L										M	L		
CO6	S	M	L		M	M		M	M	M		M	M	M	L

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Assignment			Terminal Examination
	1	**2**	**3**	1	2	3	
Remember	20	10	20	-	-	-	-
Understand	20	10	20	-	-	-	20
Apply	60	80	60	100	100	100	80
Analyse	-	-	-	-	-	-	-
Evaluate	-	-	-	-	-	-	-
Create	-	-	-	-	-	-	-

Assessment Pattern: Psychomotor

Psychomotor Skill	**~~Miniproject/Assignment/Practical Component~~**
Perception	-
Set	-
Guided Response	-
Mechanism	-
Complex Overt Responses	-
Adaptation	-
Origination	-

Sample Questions for Course Outcome Assessment**

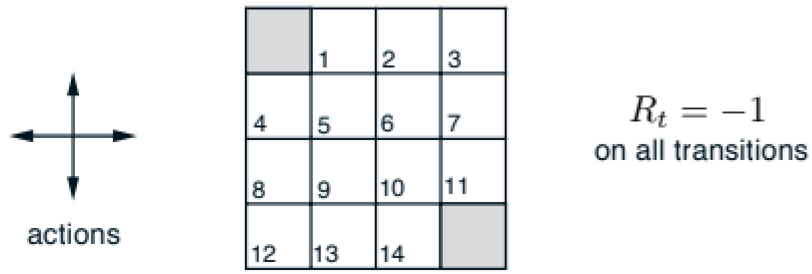
** (2 to 3 at the cognitive level of course outcome)

Course Outcome1 (CO1):

1. Credit assignment problem is the issue of assigning a correct mapping of rewards accumulated to the actions. What is the reason for credit assignment problem in RL?
2. State your inference for the following Assertion and Reason
   Assertion: Taking exploratory actions is important for RL agents
   Reason: If the rewards obtained for actions are stochastic, an action which gave a high reward once, might give lower reward next time
3. List the five elements of Reinforcement Learning Systems.
4. State the various methods for solving Reinforcement Learning problems.

Course Outcome2 (CO2):

1. Define a Markov Decision Process.
2. State the policy evaluation in Dynamic Programming technique.
3. Consider the following 4 x 4 grid world.



Apply off-policy Monte Carlo function approximation for the same.

4. Jack manages two locations for a nationwide car rental company. Each day, some number of customers arrives at each location to rent cars. If Jack has a car available, he rents it out and is credited \$10 by the national company. If he is out of cars at that location, then the business is lost. Cars become available for renting the day after they are returned. To help ensure that cars are available where they are needed, Jack can move them between the two locations overnight, at a cost of \$2 per car moved. We assume that the number of cars requested and returned at each location is Poisson random variables, meaning that the probability that the number is n is $\frac{\lambda^n}{n!}e^{-\lambda}$, where λ is the expected number. Suppose λ is 3 and 4 for rental requests at the first and second locations and 3 and 2 for returns. To simplify the problem slightly, we assume that there can be no more than 20 cars at each location (any additional cars are returned to the nationwide company, and thus disappear from the problem) and a maximum of five cars can be moved from one location to the other in one night. We take the discount rate to be 0.9 and formulate this as a continuing finite MDP, where the time steps are days, the state is the number of cars at each location at the end of the day, and the actions are the net numbers of cars moved between the two locations overnight. Find the optimal policy using Dynamic Programming Policy iteration method.

Course Outcome3 (CO3):

1. Place yourself now in the role of the predictor of returns for an unknown Markov reward process. Suppose you observe the following eight episodes:

A; 0;B; 0	B; 1
B; 1	B; 1
B; 1	B; 1
B; 1	B; 0

   This means that the first episode started in state A, transitioned to B with a reward of 0, and then terminated from B with a reward of 0. The other seven episodes were even shorter, starting from B and terminating immediately. Given this batch of data, what would you say are the optimal predictions, the best values for the estimates V (A) and V (B)? Everyone would probably agree that the optimal value for V (B) is 3/4, because six out of the eight times in state B the process terminated immediately with a return of 1, and the other two times in B the process terminated immediately with a return of 0.
   For the given data, what is the optimal value for the estimate V (A) given this data?
2. TD methods converge more quickly than Monte-Carlo method. Illustrate the statement with appropriate case scenario.
3. Design an off-policy version of the TD(0) update that can be used with arbitrary target policy π and covering behaviour policy *b*, using at each step *t* the importance sampling ratio $p_{t:t}$

Course Outcome 4 (CO4):

1. Does Policy Gradient Theorem hold for average reward formulation? Justify your answer.
2. Consider the current state is *s* and the action recommended by the policy, *a1*, is executed. Find the setting for the following reasoning:
   Reasoning: Rewards obtained by playing *a1* in *s* should not be attributed to actions other than *a1* played in state *s* previously.
3. Consider the following trajectory s3, s2, s1, s2, s2, s4, s5, s6
   Find the eligibility value $E_8(s2)$*, for state s2,* after the 8th time step if accumulating trace is used.
4. In off-policy TD(λ), if π is the policy whose *Q*-values are to be estimated, μ is the behaviour policy, and $\rho_t = \frac{\pi(s_t, a_t)}{\rho(s_t, a_t)}$, represent the eligibility trace update.

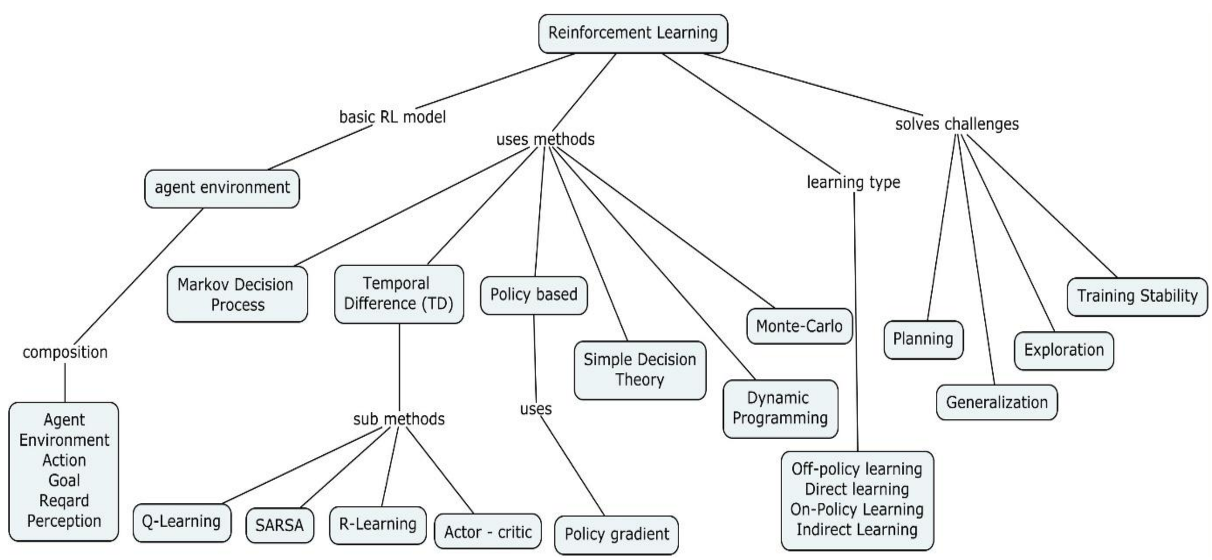
Course Outcome 5 (CO5):

1. What type of solution is expected when we try to find the optimal solution consistent with the hierarchical structure of the problem?
2. In Hierarchy of Abstract Machines (HAM) how does the core MDP state changes?
3. Describe the learning steps in Deep reinforcement learning.
4. In POMDPs suggest a good estimate of the return of a trajectory, given the current belief state and the solution to the underlying MDP.

Course Outcome6 (CO6):

This course outcome is assessed through Mini-project

Concept Map



Syllabus

Review on Probability and Statistics, Linear Algebra. Introduction – Early History of Reinforcement Learning (RL), Elements of RL, scope and limitations, Bellman Equations, Policy and Value functions. Bandit algorithms– Optimistic Initial Values, Upper-Confidence-Bound Action Selection, Gradient Bandit Algorithms. Markov Decision Process (MDP)–The Agent-Environment Interface, Goals and Rewards, Returns and Episodes. Dynamic Programming –Policy Evaluation, Policy Improvement, Policy and Value Iteration. Monte Carlo –Prediction, Estimation of Action Values, Monte Carlo Control, Off-policy Prediction, Incremental Implementation. Temporal Difference methods - TD(0), SARSA, Q-Learning. Function approximation – Eligibility traces, Linear Squares TD (LSTD), Monte Carlo Policy gradient method. Recent trends: Deep RL, Hierarchical RL, Partially observable MDP – Applications and case studies: TD Gammon, Checker's player, Alpha Go.

Learning Resources

1. Richard S. Sutton and Andrew G. Barto, *Reinforcement Learning - An Introduction*, second edition, The MIT Press - Cambridge, 2018
2. Aurélien Géron, *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems*, second edition, O'Reilly Media, 2019
3. NPTEL course on *Reinforcement Learning*https://nptel.ac.in/courses/106/106/106106143/
4. Lilian Weng, *A (Long) Peek into Reinforcement Learning*, Github post,19 Feb 2018 https://lilianweng.github.io/lil-log/2018/02/19/a-long-peek-into-reinforcement-learning.html

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1.	**Introduction (5)**		
1.1	Review on Probability and Statistics, Linear algebra	2	CO1
1.2	Early History of Reinforcement Learning	1	CO1
1.3	Elements of RL	1	CO1
1.4	Scope and limitations		CO1
1.5	Bellman Equations	1	CO1
1.6	Policy and Value functions		CO1
2.	**Bandit algorithms (2)**		
2.1	Optimistic Initial Values	1	CO1
2.2	Upper-Confidence-Bound Action Selection		CO1
2.3	Gradient Bandit Algorithms	1	CO1
3.	**Markov Decision Process (MDP) (2)**		
3.1	The Agent–Environment Interface	1	CO1
3.2	Goals and Rewards	1	CO1
3.3	Returns and Episodes		CO1
	Mini-project – Review 1 (Selection of Learning task)	1	CO6
4.	**Dynamic Programming (3)**		
4.1	Policy Evaluation	1	CO2
4.2	Policy Improvement		CO2
4.3	Policy Iteration	1	CO2
4.4	Value Iteration	1	CO2
5.	**Monte Carlo (5)**		
5.1	Prediction	1	CO2
5.2	Estimation of Action Values	1	CO2
5.3	Monte Carlo Control	1	CO2
5.4	Off-policy Prediction	1	CO2
5.5	Incremental Implementation	1	CO2
6.	**Temporal Difference methods (5)**		
6.1	TD(0)	2	CO3
6.2	SARSA	2	CO3

6.3	Q-Learning	1	CO3
7.	**Function approximation (5)**		
7.1	Eligibility traces	1	CO4
7.2	Linear Squares TD (LSTD)	1	CO4
7.3	Monte Carlo Policy gradient method	1	CO4
7.4	REINFORCE algorithm	2	CO4
	Mini-project – Review 2(Design and Development)	2	CO6
8	**Recent trend (4)**		
8.1	Deep RL, Hierarchical RL	1	CO5
8.2	Partially observable MDP	1	CO5
8.3	Applications and case studies	2	CO5
	Mini-project – Review 3 (Documentation and submission)	2	CO6
	Total No. of hours	36	

Course Designers:

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18CSPY0	NATURAL LANGUAGE PROCESSING AND TEXT ANALYTICS

Category	L	T	P	Credit
PE	3	0	0	3

Preamble:

The course will give a brief introduction to the human languages and language processing, machine learning and statistical methods for language understanding and text analytics, sentiment analysis and opinion mining, information access and text mining, conversational agents, machine translation, computational semantics, computational linguistic creativity with suitable use cases.

Students should have a basic and hands-on understanding of the currently used frameworks and methods for text analytics and natural language understanding, in particular the application of machine learning methods to text analytics.

Prerequisite:

Intermediate-level capability with Python (familiarity in using functions and classes). Familiarity with basic use of Pandas Data Frames and numpy arrays. Introductory statistics and machine learning

Course Outcomes:

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Describe the human language processing concepts and application for text analytics	15
CO2	Utilize and apply the machine learning and statistical methods for language understanding	20
CO3	Explore the techniques for sentiment analysis and opinion mining	20
CO4	Illustrate context-aware text analytics and perform text visualization	15
CO5	Demonstrate techniques for information access and conversational agents	15
CO6*	Identify suitable techniques for solving Natural Language and Text Analytics case studies.	15

* The course outcome is accessed through Mini-project.

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond		1.3,2.1.1,2.1.2
CO2	TPS3	Apply	Value	Mechanism	1.3,2.1.1,2.1.2,3.2.3
CO3	TPS3	Apply	Value	Mechanism	1.3,2.1.1,2.1.2,3.2.3
CO4	TPS3	Apply	Value	Mechanism	1.3,2.1.5,2.5.1,3.2.3
CO5	TPS3	Apply	Value	Mechanism	1.3,2.1.5,2.5.1

CO6	TPS3	Apply	Value	Mechanism	1.3,2.1.5,2.5.1,3.2.3

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L											L		
CO2	S	M	L		L								M	L	
CO3	S	M	L										M		
CO4	S	M	L		L								M	L	
CO5	S	M	L		L								M	L	
CO6	S	M	L		M	M		M	M	M		M	M	M	M

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Assignment			Terminal Examination
	1	**2**	**3**	1	2	3	
Remember	20	10	20	-	-	-	-
Understand	20	10	20	-	-	-	20
Apply	60	80	60	100	100	100	80
Analyse	-	-	-		-	-	-
Evaluate	-	-	-	-	-	-	-
Create	-	-		-	-	-	-

Assessment Pattern: Psychomotor

Psychomotor Skill	**Miniproject /~~Assignment/Practical Component~~**
Perception	
Set	
Guided Response	20
Mechanism	80
Complex Overt Responses	
Adaptation	
Origination	

Sample Questions for Course Outcome Assessment**

** (2 to 3 at the cognitive level of course outcome)

Course Outcome 1(CO1):
1. List the main challenges associated with the textual data.
2. State the main principles of a data lake.
3. Define Linguistics.
4. Explain the triangle of reference model.

5. Compare the 3 categories of speech acts.
6. List the major categories of the Parts of Speech.
7. Explain the logistic regression model for breast cancer dataset and discuss on the confusion matrix for the model predictions on the test dataset.
8. List the advanced feature representations for text classifiers.

Course Outcome 2(CO2):
1. Explain the important ways of cleaning and pre-processing textual data.
2. Apply the Bag of Words model for a snippet, “It was the best of times. It was the worst of times. It was the age of wisdom. It was the age of foolishness”.
3. Explain the technique which was originally developed as a metric for ranking search engines.
4. Demonstrate the Agglomerative hierarchical clustering and the role of selection of the linkage criterion for a dummy data.
5. Explain the Skip-Gram model architecture with neat diagram.
6. Explain newer advanced feature engineering techniques with classification models.

Course Outcome 3(CO3):
1. Define Synsets.
2. Explain the popular technique used in the information extraction to identify and segment named entities.
3. Apply the popular framework sklearn_crfsuite to develop NER tagger.
4. Build and train a DNN model for GloVe based features and evaluate the model performance.
5. Apply bag-of-key phrases techniques for predicting sentiments.
6. How to perform model tuning for various text data feature extraction?
7. List few applications of text categorization and classification.

Course Outcome 4 (CO4):
1. Explain the technique to extract the entities?
2. List the challenges in n-gram feature extraction model.
3. Compute the resulting 4-grams for the sentence “The President of the United States”.
4. Illustrate the way to quickly understand relationship between entities.
5. Apply character co-occurrence dispersion plots to analyse which characters interact the most within the “Wizard of Oz”.
6. Discuss the technique for identifying the most informative features from a dataset.

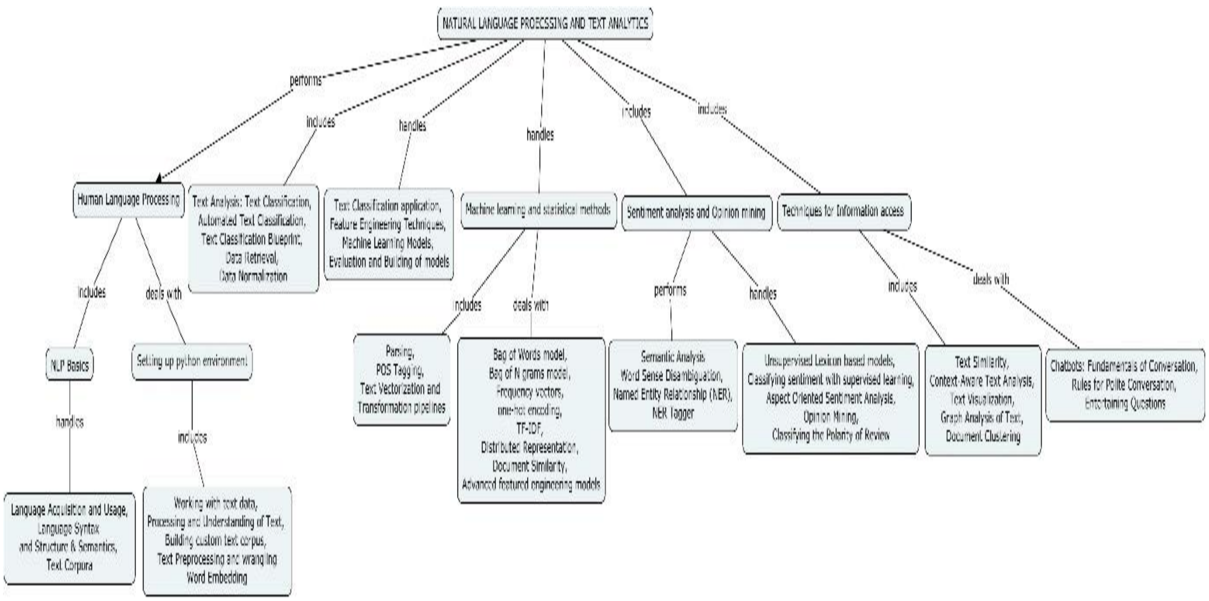
Course Outcome 5 (CO5):
1. How to build the bag of character vectors for a set of sample terms?

	a	b	e	g	h	i	l	n	p	r	t	v
Believe	0	1	3	0	0	1	1	0	0	0	0	1
beleive	0	1	3	0	0	1	1	0	0	0	0	1
bargain	2	1	0	1	0	1	0	1	0	1	0	0
Elephant	1	0	2	0	1	0	1	1	1	0	1	0

2. Define the Cosine Distance and relate it with the similarity score.
3. Compute the similarity between terms using various similarity and distance metrics.
4. How vectorization is helpful for computing similarities between documents?
5. Explain the ways to use Penn Treebank II Tags to detect questions most relevant to kitchen helper bot.

Course Outcome 6 (CO6):
This course outcome is assessed through Mini-project

Concept Map



Syllabus

A review of NLP, Language as a Data: Computational model of Language, **NLP Basics**, Language Acquisition and Usage, Language Syntax and Structure & Semantics, Text Corpora, Main Applications of NLP, Python for NLP, **Setting up python environment**, working with text data, Processing and Understanding of Text, Building custom text corpus, Text Preprocessing and wrangling. **Understanding text syntax and structure**: Importance of Machine Learning concepts, Parsing, POS Tagging, Text Vectorization and Transformation pipelines: Word Embedding, Words in space, Bag of Words model, Bag of N grams model, Frequency vectors, one-hot encoding, TF-IDF, Distributed Representation, Document Similarity, Advanced featured engineering models. **Classification of Text Analysis**: Text Classification, Automated Text Classification, Text Classification Blueprint, Data Retrieval, Data Normalization, Building Train and Test Datasets, Building Text Classification application, Feature Engineering Techniques, Machine Learning Models, Performance Metrics, Evaluation and Building of models. **Semantic Analysis**: Exploring WordNet, Word Sense Disambiguation, Named Entity Relationship, Building an NER Tagger from scratch, Build an End-to-End NER Tagger, Analyzing Semantic Representation. **Sentiment Analysis**: Setting up Dependencies, Getting the data, Text pre-processing and normalization, Unsupervised Lexicon based models, Classifying sentiment with supervised learning, Traditional and Advanced supervised models, Analyzing sentiment causation, Aspect Oriented Sentiment Analysis. **Opinion Mining**: Text Gathering (customer reviews), Feature Extraction and Selection, Classifying the Polarity of Review, Opinion Score Calculation, Evaluation. Text Similarity, Context-Aware Text Analysis, Text Visualization, Graph Analysis of Text, Document Clustering, **Chatbots**: Fundamentals of Conversation, Rules for Polite Conversation, Entertaining Questions, learning to Help and Conclusion.

Learning Resources

1. Benjamin Bengfort, Rebecca Bilbro, and Tony Ojeda, Applied Text Analytics with Python, First Edition, O'Reilly Media, June 2018.
2. Dipanjan Sarkar, Text Analytics with Python, Second Edition, Apress, 2019
3. "IIT-TUDA: System for Sentiment Analysis in Indian Languages using Lexical Acquisition",https://download.hrz.tudarmstadt.de/pub/FB20/Dekanat/Publikationen/LangTech/KumarEtAl_MIKE2015.pdf
4. Source Code for "Text Analytics with Python", https://github.com/Apress/text-analytics-w-python-2e
5. Sohail, S. S., Siddiqui, J., & Ali, R. (2018). Feature-Based Opinion Mining Approach (FOMA) for Improved Book Recommendation. *Arabian Journal for Science and Engineering*, *43*(12), 8029-8048.
6. Anoop, V. S., & Asharaf, S. (2018). Aspect-Oriented Sentiment Analysis: A Topic Modeling-Powered Approach. Journal of Intelligent Systems, 29(1), 1166-1178.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1	**Language and Computation (5)**		
1.1	A review of NLP, Language as a Data: Computational model of Language, NLP Basics	1	CO1
1.2	Language Acquisition and Usage, Language Syntax and Structure & Semantics	1	CO1
1.3	Text Corpora, Main Applications of NLP, Python for NLP,	1	CO1
1.4	Setting up python environment, working with text data,	1	CO1
1.5	Processing and Understanding of Text, Building custom text corpus, Text Preprocessing and wrangling	1	CO1
2	**Preprocessing and Understanding of Text (7)**		
2.1	Understanding text syntax and structure: Importance of Machine Learning concepts, Parsing,	1	CO2
2.2	Transformation pipelines: Word Embedding, Words in space	1	CO2
2.3	Bag of Words model, Bag of N grams model	1	CO2
2.4	Frequency vectors, one-hot encoding, TF-IDF	1	CO2
2.5	Distributed Representation, Document Similarity	1	CO2
2.6	Advanced featured engineering models.	1	CO2
	Mini-project – Review 1 (Selection of Problem & Design)	1	CO6
3	**Classification of Text Analysis (5)**		
3.1	Text Classification,	1	CO3
3.2	Automated Text Classification, Classification Blueprint	1	CO3
3.3	Data Retrieval, Data Normalization,	1	CO3
3.4	Building Train and Test Datasets, Building Text Classification application	1	CO3
3.5	Machine Learning Models, Evaluation and Building of models	1	CO3
4	**Semantic Analysis & Opinion Mining (7)**		

4.1	Exploring Word Net, Word Sense Disambiguation	1	CO4
4.2	Named Entity Relationship, Building an NER Tagger from scratch, Build an End-to-End NER Tagger, Analyzing Semantic Representation.	1	CO4
4.3	Sentiment Analysis: Setting up Dependencies, Getting the data, Classifying sentiment with supervised learning, Text pre-processing and normalization	1	CO4
4.4	Unsupervised Lexicon based models, Traditional and Advanced supervised models, Analyzing sentiment causation, Aspect Oriented Sentiment Analysis	1	CO4
4.5	Opinion Mining: Text Gathering (customer reviews), Feature Extraction and Selection,	1	CO4
4.6	Classifying the Polarity of Review, Opinion Score Calculation, Evaluation	1	CO4
	Mini-project – Review 2 (Development and Testing)	1	CO6
5	**Context-Aware Text Analysis (6)**		
5.1	Text Similarity	1	CO5
5.2	Grammar based feature extraction	1	CO5
5.3	n-gram feature and models	1	CO5
5.4	Text Visualization Model Diagnostics	1	CO5
5.5	Graph Analysis of Text	1	CO5
5.6	Extracting Graphs from text, Entity Resolution	1	CO5
6	**Clustering for Text Similarity (6)**		
6.1	Document Clustering, Clustering by Document Similarity	1	CO6
6.2	Modeling Document Topics	1	CO6
6.3	Chatbots: Fundamentals of Conversation, Rules for Polite Conversation	1	CO6
6.4	Entertaining Questions, Learning to Help and Conclusion.	1	CO6
	Mini-project Review 3 (Documentation and Submission)	2	CO6
	TOTAL	36	

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18CSPZ0	SOFTWARE TESTING

Category	L	T	P	Credit
PE	3	0	0	3

Preamble

This course is to encourage students to learn and practice the disciplined approach of software testing. Students will learn the concepts of black-box, white-box testing strategies and various testing techniques. Students will apply these testing techniques to small programs and components (functions and classes) and use evaluative techniques such as coverage and mutation testing using various software testing tools.

Prerequisite

NIL

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Describe the key techniques and processes involved in software testing.	10
CO2	Identify suitable tests to be carried out for given specification	20
CO3	Design test cases for given software using appropriate test generation methods.	20
CO4	Construct a test suite to meet the given adequacy criteria involving coverage and mutation score.	20
CO5	Prepare a test plan for given software specification	15
CO6	Develop scripts to automate the testing of a given software using appropriate testing tools	15

*** Weightage depends on Bloom's Level, number of contact hours

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	-	1.2,4.1.1,4.1.2
CO2	TPS2	Understand	Respond	-	1.2,2.1.1,2.1.2
CO3	TPS3	Apply	Value	-	1.2,4.3.1,4.3.2
CO4	TPS3	Apply	Value	-	1.2, 4.3.1,4.3.2
CO5	TPS3	Apply	Value	-	1.2,3.2.3, 4.1.1,4.1.2
CO6	TPS3	Apply	Value	-	1.2, 3.1.1,3.1.2, 4.3.1,4.3.2

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	-	-	L			L				L	L	-	-
CO2	M	L	-	-	L			L				L	L	-	-
CO3	S	M	L	-	M			L	L			M	M	L	L

CO 4	S	M	L	-	M			L	L			M	M	L	L
CO 5	S	M	L	-	M			L	L	M	M	M	M	L	L
CO 6	S	M	L	-	S			L	S	S		S	M	M	S

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	**Continuous Assessment Tests**			**Assignment**			**Terminal Examination**
	1	**2**	**3**	1	2	3	
Remember	20	20	20	-	-	-	-
Understand	20	20	20	-	-	-	40
Apply	60	60	60	100	100	100	60
Analyse	-	-	-	-	-	-	-
Evaluate	-	-	-	-	-	-	-
Create	-	-	-	-	-	-	-

Assessment Pattern: Psychomotor

Psychomotor Skill	**Assignment**
Perception	-
Set	-
Guided Response	-
Mechanism	-
Complex Overt Responses	-
Adaptation	-
Origination	-

Sample Questions for Course Outcome Assessment**

Course Outcome 1 (CO1):

1. State any two principles of software testing. (Remember)
2. What are the major sources of defects? Explain them in detail (Understand)
3. Explain about various defect classes and defect repository in detail. (Understand)

Course Outcome 2 (CO2):

1. List the steps to be performed in Integration Testing Process. (Remember)
2. Explain about Usability and Accessibility testing (Understand)
3. Discuss about Ad hoc Testing in detail (Understand)

Course Outcome 3 (CO3):

1. Explain the various Black Box Testing Techniques. (Understand)
2. Consider a date validation program. Assuming that you have no access to the code, develop a set of test cases using any of the black box techniques. Present your result in the form of a table. (Apply)
3. Using Boundary value analysis, design the black-box test suite for a software that computes the square root of an input integer which can assume values in the range of 0 to 5000. (Apply)

Course Outcome 4 (CO4):

1. Differentiate dead and live mutant? (Remember)

2. Discuss strengths and limitations of test adequacy based on program mutation. (Understand)
3. Compute the path coverage for the following code and generate test cases that are adequate to path coverage. (Apply)
    1. int x,y,p;
    2. Input(x,y)
    3. P=g(x)
    4. If(x<0)
    5. P = g(y)
    6. If (p=0)
    7. q=g(x)
    8. else
    9. q=g(x*y)
    10. end

Course Outcome 5 (CO5):

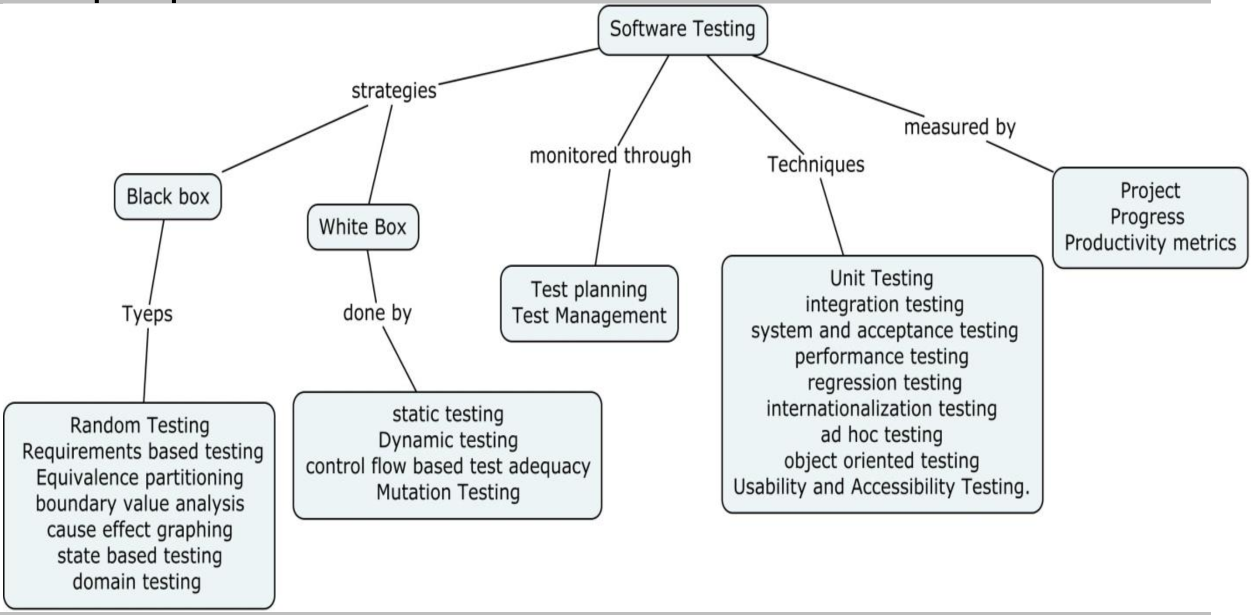
1. List various skills needed by a test specialist. (Remember)
2. Explain about various components of test plan. (Understand)
3. Prepare a test plan to test ATM software (Apply)

Course Outcome 6 (CO6):

1. List the skills needed by a tester for test automation. (Remember)
2. Discuss about software test automation process in detail. (Understand)
3. Write a test suite for the code given below using JUNIT. (Apply)

```
main()
 {
   float a,b,c;
   scanf ( “%f%f%f,&a,&b,&c);
   If (a>b)
       {  If (a>c)
                printf(“%f\n”,a);
         else
               printf(“%f\n”,c);
         } else
             If (c>b)
                printf(“%f\n”,c);
         else
               printf(“%f\n”,b);
       }}
```

Concept Map



Syllabus

Introduction: Testing as an Engineering Activity, Principles of Testing, V-model concepts, Tester's Role in a Software Development Organization, Origins of Defects, Cost of defects, Defect Classes, The Defect Repository and Test Design, Developer/Tester Support of Developing a Defect Repository, Defect Prevention strategies.

Testing strategies and techniques: Testing strategies, Unit Testing, integration testing, system and acceptance testing, performance testing, regression testing, internationalization testing, ad hoc testing, object oriented testing, Usability and Accessibility Testing.

Black Box Approach to Test Case Design: Random Testing, Requirements based testing, Equivalence partitioning, boundary value analysis, cause effect graphing, state based testing, domain testing

White Box Approach to Test design: Test Adequacy Criteria, static testing vs. structural testing, adequacy criteria based on control flow, principles of mutation testing, equivalent mutants, fault detection using mutation, Test assessment using mutation

Test Management: People and organizational issues in testing, Organization structures for testing teams, testing services, Test Planning, Test Plan Components, Test Plan Attachments, Locating Test Items, test management, test process, Reporting Test Results, Introducing the test specialist – Skills needed by a test specialist, Building a Testing Group.

Test Automation: Software test automation, skill needed for automation, scope of automation, design and architecture for automation, requirements for a test tool, challenges in automation, Test metrics and measurements, project, progress and productivity metrics

Learning Resources

1. Aditya P. Mathur "Foundations of Software Testing", Second Edition ,Pearson Education, 2014.
2. Srinivasan Desikan, Gopalaswamy Ramesh, "Software testing – principles and practices", First Edition ,Pearson Education, 2009
3. Roger S. Pressman, Software Engineering A Practitioner's Approach, Seventh Edition, Mcgraw Hill International Edition.,2010

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome

1	**Introduction**		
1.1	Testing as an Engineering Activity, Principles of Testing, V-model concepts, Tester's Role in a Software Development Organization	2	CO1
1.2	Origins of defects, Cost of defects, Defect Classes, The Defect Repository and Test Design, Developer/Tester Support of Developing a Defect Repository, Defect Prevention strategies.	2	CO1
2	**Testing strategies and techniques**		
2.1	Testing strategies, Unit Testing, integration testing	2	CO2
2.2	System and acceptance testing, performance testing	2	CO2
2.3	Regression testing, internationalization testing, ad hoc testing	1	CO2
2.4	Object oriented testing, Usability and Accessibility Testing	1	CO2
2.5	Introduction to the concepts of risk and its mitigation; configuration management.	2	CO2
3	**Black Box Approach to Test Case Design**		
3.1	Random Testing, Requirements based testing	2	CO3
3.2	Equivalence partitioning, boundary value analysis	2	CO3
3.3	Cause effect graphing	2	CO3
3.4	State based testing, domain testing	2	CO3
4	**White Box Approach to Test design**		
4.1	Test Adequacy Criteria, static testing vs. structural testing	2	CO4
4.2	Adequacy criteria based on control flow	2	CO4
4.3	Principles of mutation testing, equivalent mutants, fault detection using mutation, Test assessment using mutation	2	CO4
5	**Test Management**		
5.1	People and organizational issues in testing, Organization structures for testing teams, testing services	1	CO5
5.2	Test Planning, Test Plan Components, Test Plan Attachments, Locating Test Items	2	CO5
5.3	Test management, test process, Reporting Test Results,	1	CO5
5.4	Introducing the test specialist – Skills needed by a test specialist, Building a Testing Group	1	CO5
6	**Test Automation**		
6.1	Software test automation, skill needed for automation, scope of automation	1	CO6
6.2	Design and architecture for automation, requirements for a test tool, Challenges in automation	2	CO6
6.3	Test metrics and measurements, project, progress and productivity metrics	2	CO6
	Total Hours	**36**	

Course Designer:

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18CSRA0	INTERACTIONS DESIGN FOR XR

Category	L	T	P	Credit
PE	2	1	0	3

Preamble

Students will able to create a virtual environment and interact with it using devices, including the concepts and technologies for VR interaction.

Prerequisite

Nil

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Describe how VR systems work and list the applications of VR	15
CO2	Understand the design and implementation of the hardware that enables VR systems to be built.	20
CO3	create 3D graphics objects and to lay them out to create an environment.	20
CO4	Interact with a VR world, including the concepts and technologies of VR interaction.	15
CO5	Build simple, interactive mobile applications with augmented reality functions.	15
CO6	Discuss the applications of VR in Business, Manufacturing, Architecture and Construction and Entertainment	15

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	Guided Response	1.3
CO2	TPS2	Understand	Respond	Guided Response	1.3,2.1.1,2.1.2
CO3	TPS3	Apply	Value	Mechanism	1.3, 2.1.1,2.1.2,4.4.1
CO4	TPS3	Apply	Value	Mechanism	1.3, 2.1.1,2.1.2,4.4.1
CO5	TPS3	Apply	Value	Mechanism	1.3, 2.1.1,2.1.2,4.4.1
CO6	TPS3	Apply	Value	Mechanism	1.3, 2.1.1,2.1.2,4.4.1

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	M	L											M		
CO2	M	L			M	L							M		
CO3	S	M	L		S	M			S	S		M	M	M	L

CO4	S	M	L		S	M			S	S		M	M	M	L
CO5	S	M	L		S	M			S	S		M	M	M	L
CO6	S	M	L		S	M			S	S		S	M	M	M

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Assignment			Terminal Examination
	1	**2**	**3**	1	2	3	
Remember	20	20	20	-	-	-	20
Understand	60	40	40	-			50
Apply	20	40	40				30
Analyse							
Evaluate							
Create							

Assessment Pattern: Psychomotor

Psychomotor Skill	Mini project /Assignment/Practical Component
Perception	
Set	
Guided Response	30
Mechanism	70
Complex Overt Responses	
Adaptation	
Origination	

Sample Questions for Course Outcome Assessment**

** (2 to 3 at the cognitive level of course outcome)

Course Outcome 1(CO1):
1. Differentiate VR, AR, XR.
2. List out the benefits of VR.
3. Discuss different levels of immersion?
4. Discuss the direct Effects of VR Simulations on Users.

Course Outcome 2(CO2):
1. How do head mounted displays work?
2. What is a binocular view?
3. List out the 4 key elements of virtual reality experience

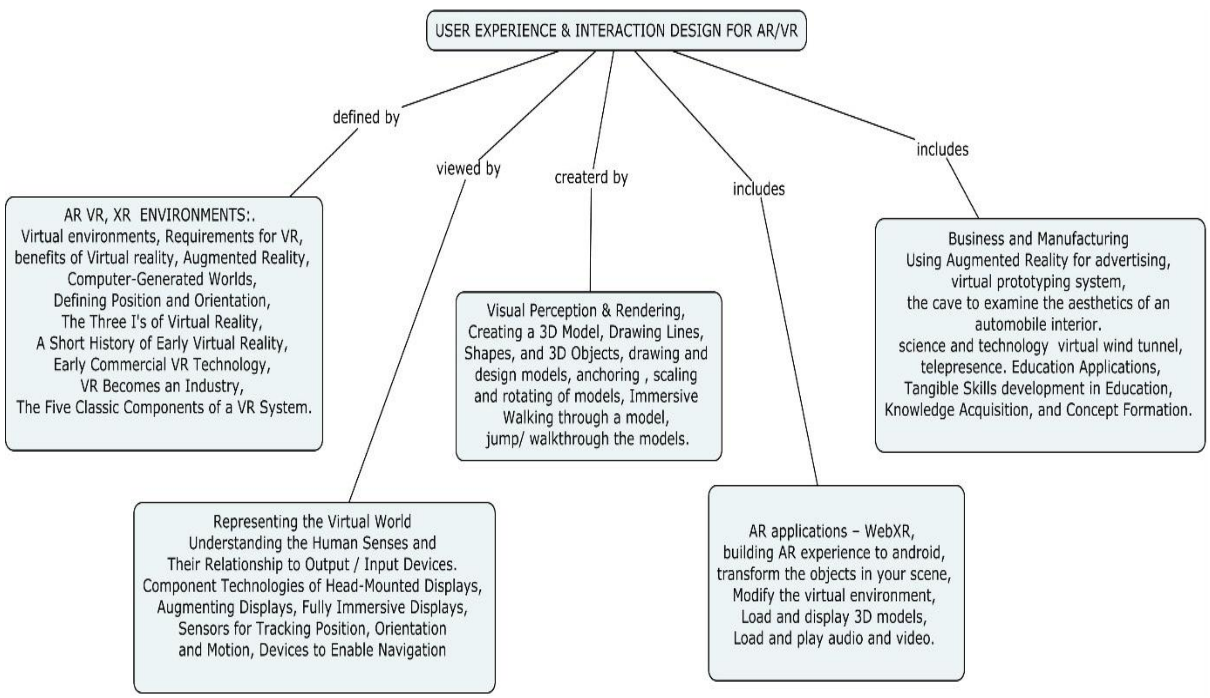
Course Outcome 3(CO3):
1. What is a Scene graph?
2. Google Cardboard is an example of what kind of reality?
3. List some uses of Unreal Engine.

Course Outcome 4 (CO4):
1. how to improve product prototyping in VR?
2. how pre market launch is made in MR?

Course Outcome 5 (CO5):
1. How can augmented reality improve engineering instruction?
2. How can the Virtual reality used to create spaces that are too elaborate or fantastical to construct in real life and are scary and perilous.
3. Who to replace any practical training, refresher training, using the applications for Virtual Reality.

Course Outcome 6(CO6):
1. In what ways VR/AR is usefull for Public Safety and Military operations?
2. What is virtual health care?
3. What is virtual patient monitoring?

Concept Map



Syllabus

AR VR, XR ENVIRONMENTS Virtual environments, Requirements for VR, benefits of Virtual reality, Augmented Reality, Computer-Generated Worlds, Defining Position and Orientation, The Three I's of Virtual Reality, A Short History of Early Virtual Reality, Early Commercial VR Technology, VR Becomes an Industry, The Five Classic Components of a VR System.

Representing the Virtual World Understanding the Human Senses and Their Relationship to Output / Input Devices. Component Technologies of Head-Mounted Displays, Augmenting Displays, Fully Immersive Displays, Sensors for Tracking Position, Orientation, and Motion, Devices to Enable Navigation

Visual Perception & Rendering - Creating a 3D Model, Drawing Lines, Shapes, and 3D Objects, drawing and design models, anchoring, scaling, and rotating of models, Immersive Walking through a model, jump/ walkthrough the models.

AR applications – WebXR, **building** AR experience to android, transform the objects in your scene, Modify the virtual environment, Load and display 3D models, Load and play audio and video.

Business and Manufacturing Using Augmented Reality for advertising, virtual prototyping system, the cave to examine the aesthetics of an automobile interior. **science and technology virtual** wind tunnel, telepresence. **Education Applications**, Tangible Skills development in Education, Knowledge Acquisition, and Concept Formation.

Lab Content:
Create components, integrate color or textures, use the 3D Warehouse to import images.
create a VR walk-through of your SketchUp Model
An AR application to move a character off it's marker and control it's animation.

Total : 36

Learning Resources

1. Alan B. Craig, William R. Sherman, Jeffrey D. Will, "Developing Virtual Reality Applications", 2017.
2. Matjaz Mihelj, Domen Novak, Samo Begus, "Virtual Reality Technology and Applications", 1st Edition, Springer Netherlands, 2014.
3. Grigore C. Burdea, Philip Coiffet, "Virtual Reality Technology", 2nd Edition, Wiley India, 2006
4. William R.Sherman, Alan B.Craig, "Understanding Virtual Reality – Interface, Application, Design", The Morgan Kaufmann Series, 2003.
5. John Vince, "Introduction in Virtual Reality", Springer, 2004.
6. Gerard Jounghyun Kim, "Designing Virtual Reality Systems, the Structured Approach", Springer London, 2005. Course Contents and Lecture Schedule
7. Steve Aukstakalnis, "Practical Augmented Reality", Addision Wesley 2017.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1	**AR VR, XR ENVIRONMENTS**		CO1
1.1	Virtual environments, Requirements for VR,	1	CO1
1.2	benefits of Virtual reality, Augmented Reality, Computer-Generated Worlds,	1	CO1
1.3	Defining Position and Orientation, The Three I's of Virtual Reality, A Short History of Early Virtual Reality,	1	CO1
1.4	Early Commercial VR Technology, VR Becomes an Industry,	1	CO1
1.5	The Five Classic Components of a VR System .	1	CO1
2	**Representing the Virtual World**		CO2

2.1	Understanding the Human Senses and Their Relationship to Output / Input Devices.	1	CO2
2.2	Component Technologies of Head-Mounted Displays,	1	CO2
2.3	Augmenting Displays, Fully Immersive Displays,	1	CO2
2.4	Sensors for Tracking Position,	1	CO2
2.5	Orientation, and Motion, Devices to Enable Navigation	1	CO2
3	**Visual Perception & Rendering**		
3.1	Creating a 3D Model, Drawing Lines, Shapes,	2	CO4
3.2	3D Objects, drawing and design models,	2	CO4
3.3	anchoring , scaling , and rotating of models,	1	CO4
3.4	Immersive Walking through a model, jump/ walkthrough the models	1	CO3
4.1	**AR applications** WebXR, building AR experience to android	2	CO5
4.2	transform the objects in your scene, Modify the virtual environment,	2	CO5
4.3	Load and display 3D models,	2	CO5
4.4	Design an Augmented Reality experience that can be used to visualize products and narratives, at any time from your mobile phone	2	CO3
5.1	**Business and Manufacturing** Using Augmented Reality for advertising,	1	CO6
5.2	virtual prototyping system, the cave to examine the aesthetics of an automobile interior.	1	CO6
5.3	**science and technology** virtual wind tunnel, telepresence.	1	CO6
5.4	**Education Applications**, Tangible Skills development in Education, Knowledge Acquisition, and Concept Formation	1	CO6
	Lab activities		
1	Create 3D objects and transforms to lay out a 3D scene	2	CO3
2	Create a VR walk-through of your SketchUp Model	2	CO3
3	An AR application to move a character off its marker and control its animation.	4	CO3
	Total	36	

Course Designers:

1. Dr.N.Shivakumar shiva@tce.edu

18CSRB0	CYBER PENETRATION AND DEFENSE

Category	L	T	P	Credit
PE	3	0	0	3

Preamble

The objective of cyber penetration is to evaluate the security of a system and identify vulnerabilities in target systems, networks or system infrastructure. The process entails finding and attempting to exploit vulnerabilities to determine whether unauthorized access or other malicious activities are possible.

Prerequisite

Problem solving methods

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Apply the evolution of cyber penetration, system/network fundamentals and cryptography	20
CO2	Apply foot printing and scanning procedures to assess the system security	10
CO3	Apply tools/programs to extract system information of the target machine	10
CO4	Apply tools or programs to gain access to a target system without human intervention and with human intervention	20
CO5	To apply tools/programs to stall the infrastructure or taking over a legitimate session	20
CO6	To assess the vulnerability of mobile devices and to detect the quantum of intrusion	20

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value	Guided Response	1.2, 2.1.2, 4.5.3
CO2	TPS3	Apply	Value	Guided Response	1.2, 2.1.2, 4.5.3
CO3	TPS3	Apply	Value	Guided Response	1.2, 2.1.2, 4.5.3
CO4	TPS3	Apply	Value	Guided Response	1.2, 2.1.2, 4.5.3
CO5	TPS3	Apply	Value	Guided Response	1.2, 2.1.2, 4.5.3
CO6	TPS3	Apply	Value	Guided Response	1.2, 2.1.2, 4.5.3

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO 1	S	M	L		L	L		S	L	L		L	M	L	L
CO 2	S	M	L		L	L		S	L	L		L	M	L	L
CO 3	S	M	L		L	L		S	L	L		L	M	L	L
CO 4	S	M	L		L	L		S	L	L		L	M	L	L
CO 5	S	M	L		L	L		S	L	L		L	M	L	L
CO 6	S	M	L		L	L		S	L	L		L	M	L	L

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Assignment			Terminal Examination
	1	2	3	1	2	3	
Remember	10	10	10	-	-	-	10
Understand	30	30	10	-	-	-	10
Apply	60	60	80	100	100	100	80
Analyse							
Evaluate							
Create							

Assessment Pattern: Psychomotor

Psychomotor Skill	Assignments
Perception	
Set	
Guided Response	100
Mechanism	
Complex Overt Responses	
Adaptation	
Origination	

Sample Questions for Course Outcome Assessment****

Course Outcome 1 (CO1):

1. If you have been contracted to perform an attack against a target system, you are what type of hacker?
   A. White hat B. Gray hat C. Black hat D. Red hat
2. Which of the following describes an attacker who goes after a target to draw attention to a cause?
   A. Terrorist B. Criminal C. Hacktivist D. Script kiddie
3. What level of knowledge about hacking does a script kiddie have?
   A. Low B. Average C. High D. Advanced
4. Which of the following does an ethical hacker require to start evaluating a system?
   A. Training B. Permission C. Planning D. Nothing

5. A white-box test means the tester has which of the following? A. No knowledge B. Some knowledge C. Complete knowledge D. Permission

Course Outcome 2 (CO2):

1. What is the role of social engineering?
   A. To gain information about computers
   B. To gain information about social media
   C. To gain information from human beings
   D. To gain information about posts and cameras
2. What is EDGAR used to do?
   A. Validate personnel
   B. Check financial filings
   C. Verify a website
   D. Gain technical details
3. Which of the following can be used to tweak or fine-tune search results?
   A. Archiving
   B. Operators
   C. Hacking
   D. Refining

Course Outcome 3(CO3)

1. Which of the following would confirm a user named chell in SMTP?
   A. vrfychell B. vrfy –u chell C. expnchell D. expn –u chell
2. VRFY is used to do which of the following?
   A. Validate an email address B. Expand a mailing list C. Validate email server D. Test a connection

Course Outcome 4 (CO4)

1. NTLM provides what benefit versus LM?
   A. PerformanceB. SecurityC. Mutual authenticationD. SSL
2. ADS requires what to be present?
   A. SAMB. DomainC. NTFSD. FAT

Course Outcome 5 (CO5)

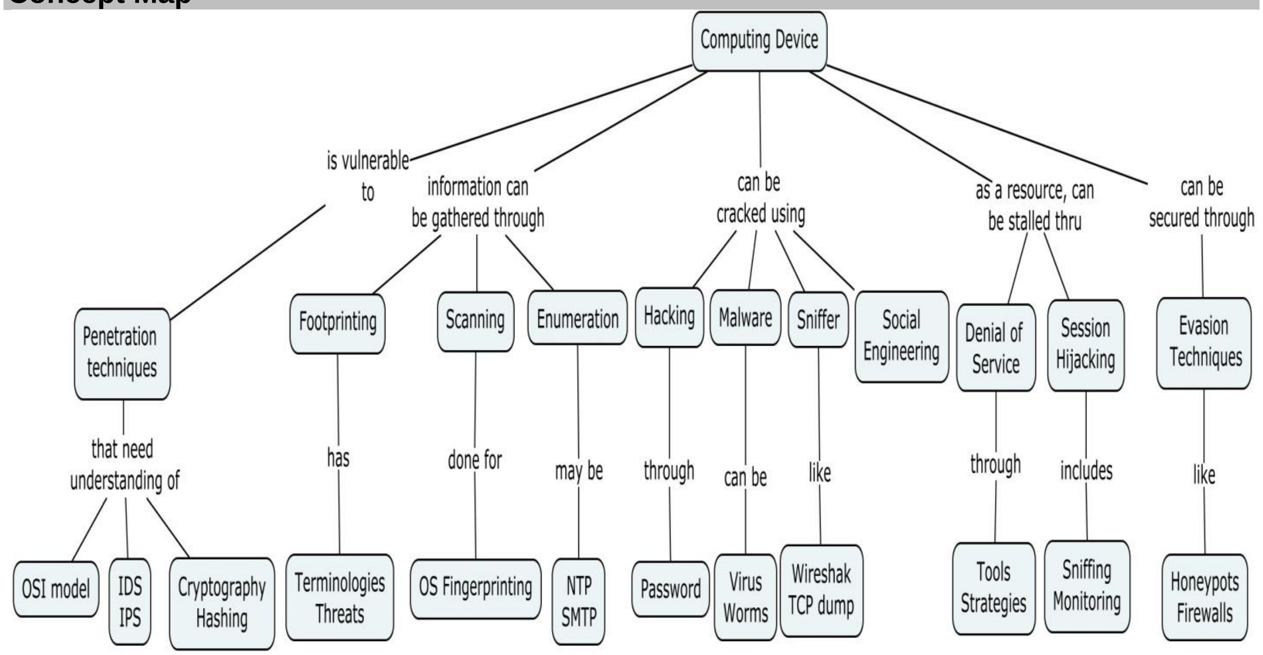
1. What command-line utility can you use to craft custom packets with specific flags set?
   A. Nmap
   B. Zenmap
   C. Ping
   D. hping3
2. What protocol is used to carry out a fraggle attack?
   A. IPX
   B. TCP
   C. UDP
   D. ICMP
3. What is the key difference between a smurf and a fraggle attack?
   A. TCP vs. UDP
   B. TCP vs. ICP
   C. UDP vs. ICMP
   D. TCP vs. ICMP

Course Outcome 6(CO6):

1. Jennifer has captured the following URL: www.snaz22enu.com/&w25/session=22525. Sherealizes that she can perform a session hijack. Which utility would she use?
   A. Shark
   B. DroidSheep

   C. Airmon
   D. Droid
2. Jennifer is concerned about her scans being tracked back to her tablet. What could she useto hide the source of the scans?
   A. Sniffing
   B. SandroProxy
   C. FaceNiff
   D. Blind scanning
3. What option would you use to install software that's not from the Google Play store?
   A. Install from unknown sources.
   B. Install unsigned sources.
   C. Install from unknown locations.
   D. Install from unsigned services.

Concept Map



Syllabus

Introduction to Ethical Hacking- Evolution -System Fundamentals-Exploring Network Topologies - Working with the OSI Model - Dissecting the TCP/IP Suite- IP Sub netting - Hexadecimal vs. Binary - Exploring TCP/IP Ports - Understanding Network Devices - Working with MAC Addresses - Intrusion Prevention and Intrusion Detection Systems - Network Security - Knowing Operating Systems - Backups and Archiving- Cryptography - Foot printing - Scanning - Checking for Live Systems - Checking the Status of Ports - The Family Tree of Scans - Enumeration - LDAP and Directory Service Enumeration - Enumeration Using NTP - SMTP Enumeration - System Hacking - Malware - Sniffers - Social Engineering - Gathering information - Denial of Service - Session Hijacking - Web Servers and Applications - SQL Injection - Hacking Wi-Fi and Bluetooth - Mobile Device Security - Evasion - Honey pots, IDSs, and Firewalls - **Case Studies**.

Learning Resources

1. Sean Philip Oriyano , "Certified Ethical Hacker Version 9 ", Sybex, 2016
2. Patrick Engebretson , "The Basics of Hacking and Penetration Testing" Syngress, 2017
3. Rafay Baloch , "Ethical Hacking and Penetration Testing Guide" CRC Press 2014

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures	Course Outcome
1	**Introduction to Ethical Hacking**		
1.1	Evolution	1	CO1
2	**System Fundamentals**		
2.1	Exploring Network Topologies -Working with the OSI Model - Dissecting the TCP/IP Suite	2	CO1
2.2	IP Sub netting - Hexadecimal vs. Binary - Exploring TCP/IP Ports - Understanding Network Devices - Working with MAC Addresses	2	CO1
2.3	Intrusion Prevention and Intrusion Detection Systems - Network Security - Knowing Operating Systems - Backups and Archiving	2	CO1
2.4	Cryptography - Issues applications	1	CO1
2.5	Understanding hashing	1	CO1
3	**Foot printing**		
3.1	Terminology - Threat -Process	1	CO2
4	**Scanning**		
4.1	Checking for Live Systems - Checking the Status of Ports - The Family Tree of Scans -	1	CO2
4.2	OS Fingerprinting - Countermeasures - Vulnerability Scanning - Mapping the Network - Using Proxies	2	CO2
5	**Enumeration**		
5.1	LDAP and Directory Service Enumeration	2	CO3
5.2	Enumeration Using NTP - SMTP Enumeration	2	CO3
6	**System hacking**	1	CO4
7	**Malware**	1	CO4
8	**Sniffers**	1	CO4
9	**Social Engineering**		
9.1	Gathering information	1	CO4
9.2	Common threat, Identity theft	2	CO4
10	**Denial of Service**		
10.1	DoS, DDoS tools and defense	2	CO5
10.2	DoS Pen-Testing Considerations	2	CO5
11	**Session Hijacking** - strategies	2	CO5
12	**Hacking Wi-Fi and Bluetooth**	1	CO6
13	**Mobile Device Security**		
13.1	Mobile OS Models and Architectures -Goals of Mobile Security	2	CO6
13.2	Device Security Models - Countermeasures	1	CO6
14	**Evasion** :Honeypots, IDSs, and Firewalls	1	CO6
15	**Case Studies**	2	
Total		36	

Course Designers:

1. Dr. S.Prasanna sprcse@tce.edu

18CSRC0	HUMAN COMPUTER INTERACTION

Category	L	T	P	Credit
PE	3	0	0	3

Preamble

The objective of this course is to introduce the basic theories and concepts of human-computer interaction (HCI). HCI is an interdisciplinary field, that combines theories and methodologies from a variety of disciplines, including computer science, cognitive psychology, and human factors, among others. Through a thinking process, students will gain knowledge in components of human perception, cognition, and learning as they apply to the design, implementation, and evaluation of interfaces.

Prerequisite

Nil

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Make use of the basic principles and requirements of human-computer interaction, user interface design, and various HCI applications.	12
CO2	Apply theories and concepts associated with effective work design to real-world application.	22
CO3	Apply an interactive design process and universal design principles to design HCI systems.	20
CO4	Apply interactive software using guidelines from human factor theories.	12
CO5	Apply design skills to improve user experience and needs for web interface.	20
CO6	Analyze proposed engineering solutions, and comment on their suitability for modern HCI systems.	14

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value		1.2,2.3.1,2.3.2
CO2	TPS3	Apply	Value	-	1.2, 2.2, 2.3.1,2.3.2,3.1.4, 3.1.5
CO3	TPS3	Apply	Value	-	1.2,2.3.1, 2.3.2, 2.3.3, 4.4.1, 4.5.3, 4.5.5
CO4	TPS3	Apply	Value	-	1.2,4.3.4, 4.6.1
CO5	TPS3	Apply	Organise	-	2.5.4,4.3.4
CO6	TPS4	Analyze	Value	-	2.5.4,3.1.5,3.2.5

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L										M		
CO2	S	M	L										M		

CO3	S	M	L									L	M		
CO4	S	M	L		L	L						L	M	L	
CO5	S	M	L		L	M		L	L	L		L	M	L	L
CO6	S	S	M	L	L	M		L	L	L		L	S	L	L

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Assignment			Terminal Examination
	1	**2**	**3**	1	2	3	
Remember	20	20	20	-	-	-	20
Understand	30	20	20	-	-	-	20
Apply	50	60	60	100	60	60	60
Analyse	0	0	0	0	40	40	0
Evaluate	0	0	0	0	0	0	0
Create	0	0	0	0	0	0	0

Assessment Pattern: Psychomotor

Psychomotor Skill	Miniproject /Assignment/Practical Component
Perception	-
Set	-
Guided Response	-
Mechanism	-
Complex Overt Responses	-
Adaptation	-
Origination	-

Sample Questions for Course Outcome Assessment**

** (2 to 3 at the cognitive level of course outcome)

Course Outcome 1(CO1):

1. Relate the terms Human Computer Interaction and User Interface Design.
2. List some limitations of Human interaction with computers.
3. What are the psychological user responses to poor design?
4. Explain the principle of uniformity in user interface design.
5. Discuss about usability testing and laboratories.

Course Outcome 2(CO2):

1. Locate any one source that reports on empirical evidence on human limitations.
2. Sketch the interaction design process.
3. Show the interaction styles involved in Norman's model.
4. Classify Usability metrics.
5. Illustrate UIMS.

Course Outcome 3(CO3):

1. Show how the participatory design process utilizes a range of methods to help convey information between the user and designer.
2. Relate conversation and text-based communication systems.
3. Demonstrate the following: (a) 3D Mouse (b) 3D Displays.
4. Illustrate the process flow patterns.
5. Identify and write the teasing content to confirm the user's expectations

Course Outcome 4 (CO4):

1. Discover Fitt's Law.
2. State and Examine the Network of screens/states.
3. Classify and explain the summary of principles affecting robustness.
4. Show how speech and auditory interfaces differ.
5. Illustarte the visually pleasing composition.

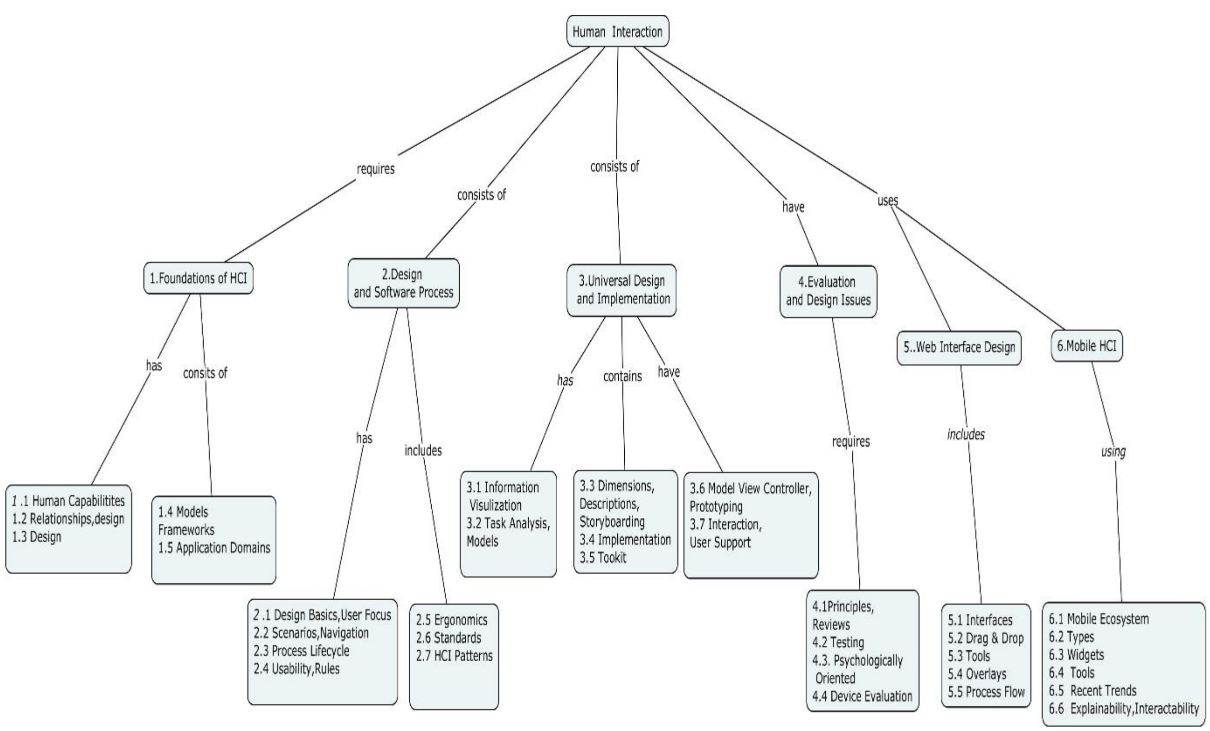
Course Outcome 5 (CO5):

1. Demonstrate Antipattern?
2. What is mutton? Discover why it is used?
3. Show what are the few things we should keep in mind when using Input Overlays.
4. Develop short notes on:
   a. Virtual Scrolling
   b. Virtual Paging
   c. Scrolled Paging.
5. Show some events available for cueing the user during a drag and drop interaction.

Course Outcome 6 (CO6):

1. Elaborate and classify the broader set of devices supports operating systems.
2. Analyze the Elements of Mobile Design.
3. Explain and analyze Tools in detail.
   a. Always-Visible Tools
   b. Hover-Reveal Tools
   c. Toggle-Reveal Tools
   d. Multi-Level Tools
4. Mention and point out some nice attributes for toggle selection.
5. Illustrate and compare the types of selection techniques in detail.

Concept Map



Syllabus

Foundations of HCI: Human capabilities: Psychology, Information Processing and Motor Systems - Computer Interaction Design - Relationship between HCI - User Experience design - Frameworks - Application domains: HCI Technology including Virtual Reality, Augmented Reality and 3D.

Design & Software Process: Interactive Design Basics – User Focus – Scenarios – Navigation – Screen Design & Layout - HCI in Software Process – Life Cycle – Usability Engineering - Design Rules – Interaction Models – Ergonomics - Principles for Usability – Standards – Guidelines – Golden Rules – HCI Patterns.

Universal Design & Implementation: Information Visualization – Task Analysis – Task Models – Dimensions - Descriptions – Storyboarding – Implementation support - User Interface Toolkits – Model View Controller – Prototyping - Multimodal Interaction - User Support.

Evaluation and Design Issues: Principles for Evaluation- Expert Reviews – Usability Testing – Survey Instruments – Acceptance Tests – Controlled Psychological Oriented Experiments - Evaluation of Spastic Devices Interaction Panels.

Web Interface Design: Designing Web Interfaces - Drag & drop - Contextual Tools - Overlays - Process Flow - Static & Dynamic Web contents, Case Studies.

Modern HCI: Mobile Ecosystem: Platforms, Application Frameworks - Types of Mobile Applications: Widgets, Applications - Mobile Design: Elements of Mobile Design, Tools, Recent Trends-Interaction with AI based systems- explainability, interactability.

Learning Resources

1. Alan Dix, Janet E.Finlay, Gregory D.Abowd, Russell Beale , "Human- Computer Interaction" (3rd Edition), Prentice-Hall, Inc, 2009, ISBN : 0130461091.
2. B. Shneiderman; Designing the User Interface, Addison Wesley, 5th Edition, 2014.
3. John M.Carrol, "Human Computer Interaction in the New Millenium", Pearson Education, 2002.
4. Don Norman, "The Design of Everyday Things", First Edition, Basic Books, 2013.
5. Henry A.Kissinger, Eric Schmidt, Daniel Huttenlocher, " The Age of A.I : and our Human Future" , John Murray, 2021, ISBN: 1529375975
6. http://cs.brown.edu/courses/cs295-7/
7. http://www.cs.tufts.edu/~jacob/250bci/
8. https://courses.isds.tugraz.at/hci/hci.pdf
9. http://iitg.ac.in/uelab/courses.html

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1.	**Foundations of HCI**		
1.1	Human capabilities: Psychology, Information Processing and Motor Systems	1	CO1
1.2	Computer Interaction Design, Relationship between HCI	1	CO1

1.3	User Experience design	1	CO1
1.4	Frameworks	1	CO1
1.5	Application domains: HCI Technologies, Virtual Reality, Augmented Reality and 3D.	1	CO1
2.	**Design & Software Process**		
2.1	Interactive Design Basics, User Focus	2	CO2
2.2	Scenarios, Navigation, Screen Design & Layout		CO2
2.3	HCI in Software Process, Life Cycle	1	CO2
2.4	Usability Engineering, Design Rules	1	CO2
2.5	Interaction Models, Ergonomics		CO2
2.6	Principles for Usability, Standards, Guidelines	2	CO2
2.7	Golden Rules, HCI patterns	2	CO2
3.	**Universal Design & Implementation**		
3.1	Information Visualization	1	CO3
3.2	Task Analysis, Task Models	1	CO3
3.3	Dimensions, Descriptions, storyboarding	1	CO3
3.4	Implementation Support		CO3
3.5	User Interface Toolkits	2	CO3
3.6	Model View Controller, Prototyping		CO3
3.7	Multimodal Interaction, User Support	2	CO3
4.	**Evaluation and Design Issues**		
4.1	Principles for Evaluation, Expert Reviews	2	CO4
4.2	Usability Testing, Survey Instruments		CO4
4.3	Acceptance Tests, Controlled Psychologically Oriented Experiments	1	CO4
4.4	Evaluation of Spastic Devices Interaction Panels	1	CO4
5.	**Web Interface Design**		
5.1	Designing Web Interfaces	2	CO5
5.2	Drag & drop		CO5
5.3	Contextual Tools	1	CO5
5.4	Overlays, Process Flow	1	CO5
5.5	Static & Dynamic Web contents	1	CO5
5.6	Case Studies	2	CO5
6.	**Modern HCI**		
6.1	Mobile Ecosystem: Platforms, Applications, Frameworks	1	CO6
6.2	Types of Mobile Applications		CO6
6.3	Widgets, Applications	1	CO6
6.4	Mobile Design: Elements of Mobile Design, Tools	1	CO6
6.5	Recent Trends-Interaction with AI based Systems	1	CO6
6.6	Explainability, Interactability	1	CO6
	Total Hours	**36**	

Course Designers:

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3. M. Manikandakumar mmrit@tce.edu

CURRICULUM AND DETAILED SYLLABI

FOR

B.E DEGREE (Computer Science and Engineering) PROGRAMME

INDUSTRY SUPPORTED COURSES

FOR THE STUDENTS ADMITTED FROM THE

ACADEMIC YEAR 2018 - 2019 ONWARDS

THIAGARAJAR COLLEGE OF ENGINEERING

(A Government Aided ISO 9001-2008 certified
Autonomous Institution affiliated to Anna University)

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18CS1A0	HETEROGENEOUS COMPUTING

Category	L	T	P	Credit
PE	1	0	0	1

Preamble

This course will walk the students through the power of the emerging high performance computing systems and let them learn three major parallel programming approaches such as OpenMP, Message Passing Interface and CUDA programming.

Prerequisite

C Programming

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Develop shared memory parallel program using OpenMP	30
CO2	Develop distributed memory parallel program using MPI	35
CO3	Develop data parallel program using CUDA	35

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value	Mechanism	1.3,2.3.2,2.5.1, 4.1.2, 4.3.3
CO2	TPS3	Apply	Value	Mechanism	1.3,2.3.2, 2.5.1, 4.1.2, 4.3.3
CO3	TPS3	Apply	Value	Mechanism	1.3,2.3.2, 2.5.1, 4.1.2, 4.3.3

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L		M	L		M				L	M	L	L
CO2	S	M	L		M	L		M				L	M	L	L
CO3	S	M	L		M	L		M				L	M	L	L

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Terminal Examination
Remember	10
Understand	30
Apply	60
Analyse	0
Evaluate	0
Create	0

Assessment Pattern: Psychomotor

Psychomotor Skill	~~**Miniproject**~~ **/Assignment/**~~**Practical Component**~~
Perception	--
Set	--
Guided Response	--
Mechanism	100
Complex Overt Responses	--
Adaptation	--
Origination	--

Sample Questions for Course Outcome Assessment**

** (2 to 3 at the cognitive level of course outcome)

Course Outcome 1(CO1):

1. Identify the type of applications is best suited for shared memory model?
2. What are the different metrics for assessing a parallel program?

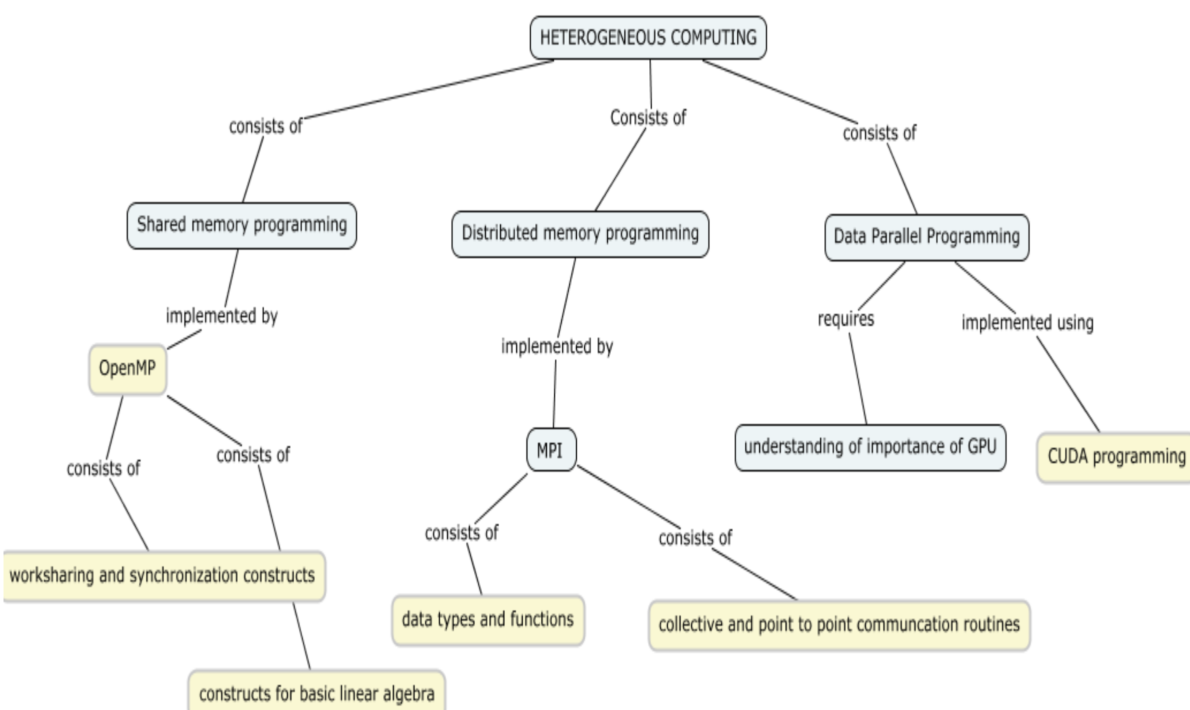
Course Outcome 2(CO2):

1. Write an example program to illustrate the usage of MPI_Barrier.
2. List the differences between collective and point to point communication

Course Outcome 3(CO3):

1. Explain about different kinds of memory in GPU.
2. Which algorithm performs better on the GPU? CPU bound or data bound?

Concept Map



Syllabus

Introduction to parallel programming paradigms

Introduction-shared memory programming- Distributed memory parallel programming- Data parallel programming model- Performance metrics.

Shared Memory Programming

Introduction to OpenMP- Constructs –Parallel, work sharing and Synchronization constructs- Basic linear algebra operations in OpenMP

Distributed memory Programming

MPI data types and tags- compiling MPI programs- MPI functions- Collective communication- Point to Point communication- MPI numerical Integration case studies

Data Parallel Programming

Importance of data parallelism for GPUs- introduction to CUDA-Memory and variable types- control flow- synchronizations- wrap shuffles-reduction operations

Learning Resources

1. https://computing.llnl.gov/tutorials/openMP/
2. https://www.dartmouth.edu/~rc/classes/intro_mpi/
3. https://docs.nvidia.com/cuda/cuda-c-programming-guide/index.html

Course Contents and Lecture Schedule

S.No	Topic	No. of Hours	Course Outcome
1	**Introduction to Parallel Programming (2)**		
1.1	What is Parallelization- Goals	1	CO1
1.2	Performance metrics for parallelization		CO1
1.3	Different parallel programming models		CO1
1.3.1	Shared memory model	1	CO1
1.3.2	Distributed memory model		CO2
1.3.3	Data parallel model		CO3
2	**Shared Memory programming (3)**		
2.1	Introduction to OpenMP and its constructs	1	CO1
2.1.1	Basic constructs of OpenMP		CO1
2.1.2	Synchronization constructs	1	CO1
2.1.3	Environment variable constructs		CO1
2.1.4	Basic linear algebra operations in OpenMP	1	CO1
3	**Distributed memory programming (5)**		
3.1	Introduction to MPI	1	CO2
3.1.1	MPI data types and tags- compiling MPI programs		CO2
3.1.2	MPI functions- Collective communication- Point to Point communication	2	CO2

3.1.3	MPI numerical Integration case study	2	CO2
4	**Data Parallel Programming (4)**		
4.1	Importance of data parallelism for GPUs	1	CO3
4.2	Introduction to CUDA-Memory and variable types-control flow- synchronizations- wrap shuffles-reduction operations	3	CO3
	Total No. of. hours	14	

Course Designers:

1.Mr.Ashok Chaudhry, Fujitsu Ashok.Chaudhary@ts.fujitsu.com
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18CS1B0	CYBER SECURITY	Category	L	T	P	Credit
		PE	1	-	-	1

Preamble
Cybersecurity is the body of technologies, processes, and practices designed to protect networks, computers, and data from attack, damage, and unauthorized access. Cyber security courses teach students to spot vulnerabilities, fend off attacks, and immediately respond to emergencies.

Prerequisite
Nil

Course Outcomes
On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Summarize the basics of identification and authentication in cyber security	20
CO2	Classify key compliance and threat intelligence in Enterprise & Infrastructure Security	30
CO3	Explain the knowledge of Cyber security Attacks	20
CO4	Develop a system for Cyber security Attacks Detection and Prevention	30

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	Guided Response	1.3,1.2,2.1.1,2.1.2,2.2.1, 2.5.1,4.1.2
CO2	TPS3	Apply	Value	Mechanism	1.3,2.1.1,4.4.1,2.3.1,2.5.1,4.1.2
CO3	TPS2	Understand	Respond	Guided Response	1.3,2.2.1, 2.5.1,4.1.2
CO4	TPS3	Apply	Value	Mechanism	1.3,2.1.1,2.1.2,2.5.1,4.1.2, 4.4.1,4.4.2, 4.4.3,4.5

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L		M	L		M				L	M	L	L
CO2	S	M	L		M	L		M				L	M	L	L
CO3	S	M	L		M	L		M				L	M	L	L
CO4	S	M	M		M	M		M				L	L	L	L

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Assignment	Terminal Examination
Remember		20
Understand	50	20
Apply	50	60

Analyse		-
Evaluate		-
Create		-

Assessment Pattern: Psychomotor

Psychomotor Skill	Miniproject /Assignment/~~Practical Component~~
Perception	
Set	
Guided Response	50
Mechanism	50
Complex Overt Responses	
Adaptation	
Origination	

Sample Questions for Course Outcome Assessment**

Course Outcome 1 (CO1):

1. What is cyber and cyber security?
2. Why threat assessment is is so hard in cyberspace?
3. What are the 4 main types of vulnerability?

Course Outcome 2 (CO2):

1. Analyze, evaluate and treatment of Cyber risks
2. Develop the methods using block chain solutions to manage security without requiring a cryptocurrency token?
3. Apply critical infrastructure protection standards to safeguard railway reservation system from security threats.

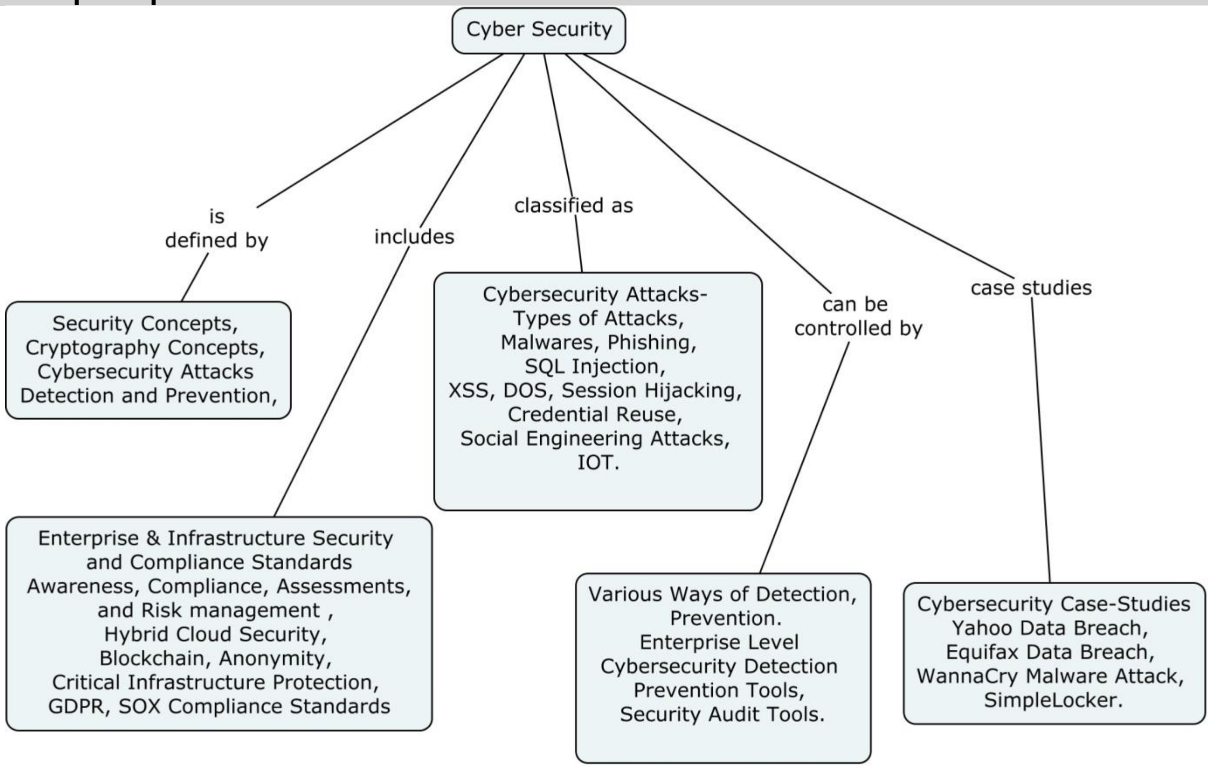
Course Outcome 3 (CO3):

1. What is security attack and explain its types?
2. What are the types of eavesdropping attacks?
3. Explain in detail the hazards due to session hijacking.

Course Outcome 4 (CO4):

1. Make use of the Cybersecurity Detection and Prevention Tools to block and tackle attacks
2. Analyze and recommend ways to improve security based on recent largest Cyber-attacks.
3. Elaborate major security lapses witnessed in malware attacks.

Concept Map



Syllabus

Introduction to Cybersecurity- Overview of Computing Security Concepts, Web Service Architecture, Cryptography Concepts, Cybersecurity Attacks, Firewall, Cybersecurity Attacks Detection and Prevention, Cyber security Case-Studies

Enterprise & Infrastructure Security and Compliance Standards- Security Awareness, Compliance, Assessments, and Risk, Hybrid Cloud Security, Blockchain, Anonymity, and Critical Infrastructure Protection, GDPR, SOX Compliance Standards

Cybersecurity Attacks- Types of Attacks, Malwares, Virtual Private Network, Phishing, SQL Injection, XSS, DOS, Session Hijacking, Credential Reuse, Social Engineering Attacks, IOT.

Detection and Prevention- Various Ways of Detection and Prevention, Enterprise Level Cybersecurity Detection and Prevention Tools, Security Audit Tools.

Cybersecurity Case-Studies- Largest Cyber attacks Case Studies such as Yahoo Data Breach, Equifax Data Breach, WannaCry Malware Attack, Simple Locker

Learning Resources

1. P.W. Singer, Allan Friedman, “Cybersecurity and Cyberwar: What Everyone Needs to Know”, Oxford University Press, ISBN 9780199364572
2. D. Frank Hsu, Dorothy Marinucci, “Advances in Cyber Security: Technology, Operation, and Experiences”, Fordham Univ Press, ISBN 9780823244560.

3. Atle Refsdal, Bjørnar Solhaug, Ketil Stølen, “Cyber-Risk Management”, Springer, ISBN 3319235702

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1.	**Introduction to Cybersecurity**		
1.1	Overview of Computing Security Concepts	1	CO1
1.2	Web Service Architecture, Cryptography Concepts	1	CO1
1.3	Firewall, Cybersecurity Attacks Detection and Prevention	1	CO1
2	**Enterprise & Infrastructure Security and Compliance Standards**		
2.1	Security Awareness, Compliance, Assessments, and Risk management	1	CO2
2.2	Hybrid Cloud Security, Blockchain, Anonymity	1	CO2
2.3	Critical Infrastructure Protection, GDPR, SOX Compliance Standards	1	CO2
3	**Cybersecurity Attacks**		
3.1	Types of Attacks, Malwares, Phishing, SQL Injection, VPN	1	CO3
3.2	XSS, DOS, Session Hijacking, Credential Reuse, Social Engineering Attacks, IOT.	2	CO3
4	**Detection and Prevention**		
4.1	Various Ways of Detection and Prevention.	1	CO4
4.2	Enterprise Level Cybersecurity Detection	1	CO4
4.3	Prevention Tools, Security Audit Tools.	1	CO4
5	**Cybersecurity Case-Studies**		
5.1	Largest Cyberattacks Case Studies such as Yahoo Data Breach, Equifax Data Breach, WannaCry Malware Attack, Simple Locker.	2	CO4

Course Designers:

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18CS1C0	CONTAINERIZATION TECHNOLOGIES (COMMON TO CSE AND IT DEPARTMETNS)

Category	L	T	P	Credit
PE	1	0	0	1

Preamble

This course provides an introduction to modern application development focusing on microservices and cloud-native application development. As part of the cloud-native development, this course introduces containerization using Docker and orchestration of containerized workloads using Kubernetes. This course also provides some hands-on experience of using Docker and Kubernetes.

Prerequisite

Nil

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Summarize monolithic, microservices and cloud native application architectures	20
CO2	Develop cloud native applications using microservices architecture	20
CO3	Run cloud Native applications using Docker containers	30
CO4	Use MiniKube and KinD, to perform operations such as creating a cluster, deploying containerized applications, managing and scaling them	30

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	Guided Response	1.3, 4.3.2
CO2	TPS3	Apply	Value	Mechanism	1.3, 4.3.2
CO3	TPS3	Apply	Value	Mechanism	1.3, 4.3.3, 4.4.3
CO4	TPS3	Apply	Value	Mechanism	1.3, 4.3.3., 4.4.3

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L											L		
CO2	S	M	L		S				L	L		S	M	M	L
CO3	S	M	L		S			S	L	L		S	M	M	M
CO4	S	M	L		S			S	L	L		S	M	M	M

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests (MiniProject)	Terminal Examination
Remember	10	10
Understand	10	10
Apply	80	80
Analyse	-	-
Evaluate	-	-
Create	-	-

Assessment Pattern: Psychomotor

Psychomotor Skill	Miniproject /~~Assignment/Practical Component~~
Perception	-
Set	-
Guided Response	20
Mechanism	80
Complex Overt Responses	-
Adaptation	-
Origination	-

Sample Questions for Course Outcome Assessment**

** (2 to 3 at the cognitive level of course outcome)

Course Outcome 1(CO1):

1. Suppose a company built on monolithic architecture handles numerous products. How the company can change its monolithic architecture to microservices and deploy those using containers?
2. What is Container Orchestration and why it is used?
3. Does the Cloud overtake the use of Containerization?

Course Outcome 2(CO2):

1. Identify the benefits and limitations of deploying applications on hosts and on containers?
2. Consider a scenario where there are 5-6 microservices for an application. Do they communicate with container orchestration or without container orchestration? Illustrate the effects.
3. How does Kubernetes simplify containerized Deployment?

Course Outcome 3(CO3):

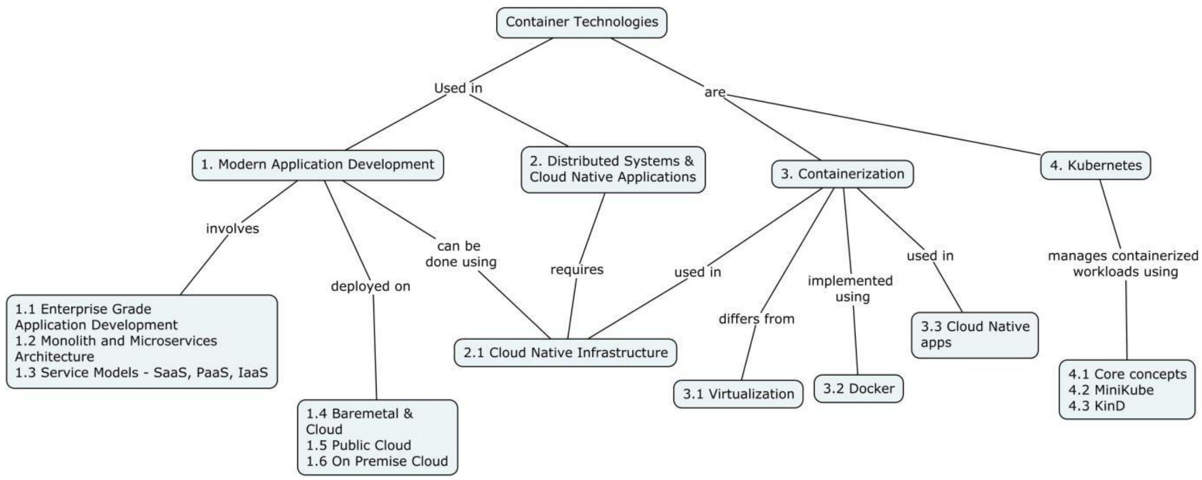
1. Consider a multinational company with a very much distributed system, with a large number of data centers, virtual machines, and many employees working on various tasks. How the company can manage all the tasks in a consistent way with Kubernetes?
2. How is Kubernetes different from Docker Swarm?
3. Is it a good strategy to run stateful applications on Docker?

Course Outcome 4 (CO4):

1. What will happen when Kubernetes is running on Minikube and running it locally?

2. Consider the Minikube tool. Show how to launch a One Pod in a particular namespace in Minikube.
3. Is there a way to make a Pod automatically come up when the host restarts? Illustrate the steps.

Concept Map



Syllabus

Modern Application Development : Enterprise Grade Application Development - Monolith vs Microservice - Bare Metal Metal vs Cloud - Service Models : SaaS - IaaS - PaaS - Public Cloud vs On-Premise Cloud - Virtualization - Types and benefits
Distributed Systems and Cloud-Native Applications: Cloud Native Applications - Role of distributed systems in Cloud Native Infrastructure and Applications
Containerization with Docker: Virtualization vs Containerization - Docker - Role of containers in Cloud Native Apps
Kubernetes as a platform to manage containerized workloads : Introduction to Kubernetes Kubernetes Core Concepts - Minikube and KinD

Learning Resources

1. Kubernetes Basics - https://kubernetes.io/docs/tutorials/kubernetes-basics/
2. Getting Started with Kubernetes - https://kubernetes.io/docs/setup/learning-environment/minikube/
3. Coursera - Architecting with Google Kubernetes Engine - https://www.coursera.org/programs/thiagarajar-college-of-engineering-madurai-on-coursera-1dp6x/browse?productId=4pOLFUT_EemgkwpQXmrE3A&productType=s12n&query=kubernetes&showMiniModal=true

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1.	**Modern Application Development**		
1.1	Enterprise Grade Application Development	1	CO1
1.2	Monolith vs Microservice		CO1

1.3	Bare Metal Metal vs Cloud - SaaS - IaaS - PaaS	1	CO2
1.4	Public Cloud vs On-Premise Cloud	1	CO2
1.5	Virtualization - Types and Benefits	1	CO3
2.	**Distributed Systems and Cloud-Native Applications**		
2.1	Basics of Cloud Native Applications	1	CO2
2.2	Role of distributed systems in Cloud Native Infrastructure and Applications	1	CO2
3.	**Containerization**		
3.1	Virtualization vs Containerization - Docker	2	CO3
3.2	Role of containers in Cloud Native Apps	2	CO3
4.	**Kubernetes as a platform to manage containerized workloads**		
4.1	Introduction to Kubernetes	1	CO4
4.2	Kubernetes Core Concepts	1	CO4
4.3	Hands-on experience using Minikube and KinD	2	CO4
	Total Hours	14	

Course Designers:

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3. Mrs. S. Thiruchadai Pandeeswari eshwarimsp@tce.edu

18CS1D0	CLOUD OBJECT STORAGE

Category	L	T	P	Credit
PE	1	-	-	1

Preamble

This course is intended for the Computer science students and enables them to learn about Cloud Object Storage and management of unstructured data. The syllabus emphasizes on object storage, service offerings of cloud platforms and features of cloud object storage. The course also provides sufficient depth in object storage provided by different cloud providers.

Prerequisite

Knowledge on information storage management

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Summarize the fundamentals of cloud object storage and cloud platforms.	20
CO2	Explain the storage services offered by cloud	20
CO3	Make use of Patterns/Anti-Patterns for Storage services for different use-cases	30
CO4	Experiment with key Cloud object storage services	30

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond		1.2, 2.4.6, 2.5.4, 3.2.2, 3.2.6
CO2	TPS2	Understand	Respond		1.2, 2.4.6, 2.5.4, 3.2.2, 3.2.6
CO3	TPS3	Apply	Value		1.2, 2.1.2, 2.1.5, 4.4.3, 4.5.3
CO4	TPS3	Apply	Value		1.2, 2.1.2, 2.1.5, 4.4.3, 4.5.3

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L			S					M			L	L	
CO2	M	L			S					M			L	L	
CO3	S	M	L		S				M	M		M	M	L	L
CO4	S	M	L		S				M	M		M	M	L	L

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Terminal Examination
Remember	20
Understand	20
Apply	60

Analyse	
Evaluate	
Create	

Assessment Pattern: Psychomotor

Psychomotor Skill	~~Miniproject /~~Assignment/~~Practical Component~~
Perception	-
Set	-
Guided Response	40
Mechanism	60
Complex Overt Responses	-
Adaptation	-
Origination	-

Sample Questions for Course Outcome Assessment**

** (2 to 3 at the cognitive level of course outcome)

Course Outcome 1 (CO1)

1. What is Cloud Storage? (Remember)
2. Illustrate the working of cloud storage. (Understand)
3. Explain the key benefits of cloud object storage. (Understand)

Course Outcome 2 (CO2)

1. What are the types of Cloud Storage? How many and what are they? (Remember)
2. What are the fundamental requirements of Cloud Storage? (Remember)
3. Illustrate the various ways in which cloud storage can be used. (Understand)

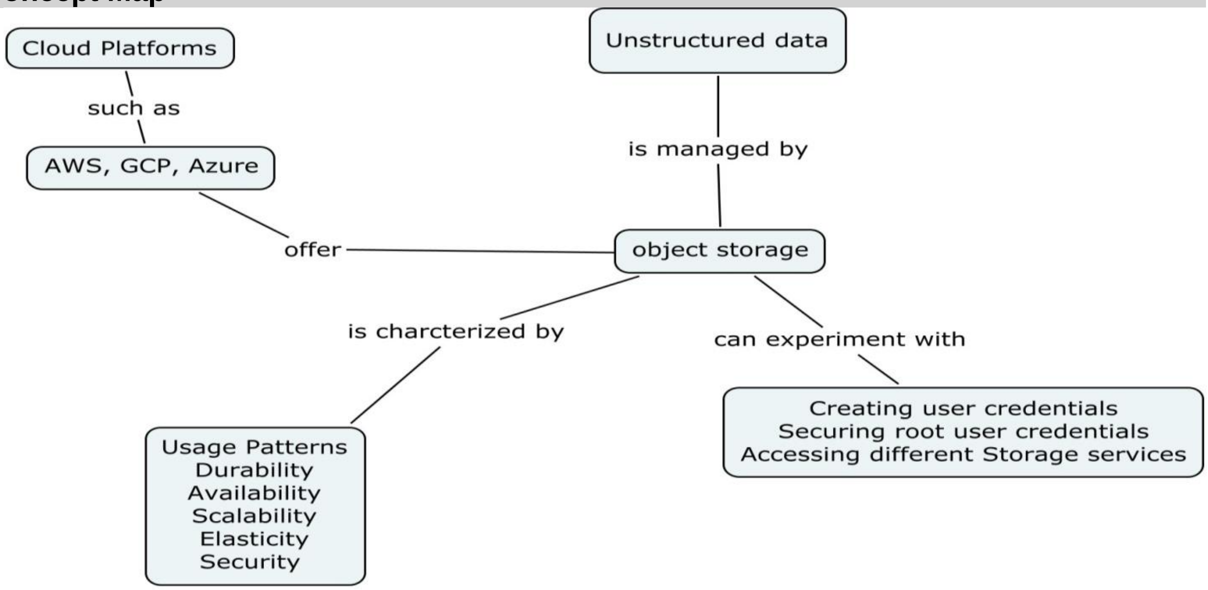
Course Outcome 3 (CO3)

1. Define Durability vs Availability in Cloud Storage. (Understand)
2. Illustrate the service in AWS that transports large amounts of data to and from the cloud. (Apply)
3. Illustrate the range of Storage classes offered in AWS S3. (Apply)

Course Outcome 4 (CO4)

1. Summarize AWS best practices to secure root user credentials. (Understand)
2. Create a new user with privileges to use Storage services. (Apply)
3. Create a bucket in S3 and copy any object into the created bucket. (Apply)

Concept Map



Syllabus

Basics of Cloud Object Storage - Introduction about Cloud Storage - Introduction about Cloud Object Storage - Cloud Platforms - AWS, GCP and Microsoft Azure - **Cloud Storage Services -** AWS Services on Cloud storage - AWS Services on Cloud object storage - Block and Object storage mechanism - **Features of Cloud Storage Services -** Usage Patterns and Performance - Durability and Availability - Scalability and Elasticity - Security and Interfaces - **Practical Component -** Creating AWS user credentials, Securing root user credentials - Overview of various services within AWS - Accessing different Storage services; A simple exercise using AWS S3

Learning Resources

1. Andrea Wittig, Michael Wittig, “Amazon Web Services in Action”, dreamtech Press, 2015.
2. Anil Patil, Simon Casey, Deepak Rangarao, Rob Markovic, Robert Rios, “Cloud Object Storage as a Service: IBM Cloud Object Storage from Theory to Practice – For Developers, IT Architects and IT Specialists”, Redbooks, 2017

Course Contents and Lecture Schedule

Module No.	Topic	No. of Lectures
1	**Basics of Cloud Object Storage (3)**	
1.1	Introduction about Cloud Storage	1
1.2	Introduction about Cloud Object Storage	1
1.3	Cloud Platforms - AWS, GCP and Microsoft Azure	1
2	**Cloud Storage Services(3)**	
2.1	AWS Services on Cloud storage	1
2.2	AWS Services on Cloud object storage	1

2.3	Block and Object storage mechanism	1
3	**Features of Cloud Storage Services(4)**	
3.1	Usage Patterns and Performance	1
3.2	Durability and Availability	1
3.3	Scalability and Elasticity	1
3.4	Security and Interfaces	1
4	**Practical Component(4)**	
4.1	Creating AWS user credentials, Securing root user credentials	1
4.2	Overview of various services within AWS	1
4.3	Accessing different Storage services; A simple exercise using AWS S3	2
	Total	14

Course Designers:

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18CS1E0	DATA ANALYTICS FOR INDUSTRIAL APPLICATION

Category	L	T	P	Credit
PE	1	0	0	1

Preamble

This course would give the students an overview of processes, technical know-hows and best practices involved in building data analytics solutions for industrial applications. Students would be introduced to few industrial datasets from open domain. Step-by-step process involved in building applications for solving industrial problems using the data would be demonstrated.

Prerequisite

Knowledge on databases

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Pre-process any industrial dataset and generate appropriate features for further analysis	30
CO2	Understand business requirement documentation and come up with technical design for common industrial data analytics problem	35
CO3	Build deployable data analytics solution and deploy it for wider usage	35

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value	Mechanism	1.3, 2.2.1,2.2.4
CO2	TPS3	Apply	Value	Mechanism	1.3,2.1.1,2.1.2,2.1.5,4.3.1,4.3.3
CO3	TPS3	Apply	Value	Mechanism	1.3,2.1.2,2.1.5,2.4.3,4.3.1,4.3.3

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L	L	M	M		M	L	L		L	M	L	L
CO2	S	M	L	L	M	M		M	L	M		L	M	L	L
CO3	S	M	L	L	M	M		M	L	M		L	M	L	L

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Terminal Examination
Remember	10
Understand	30

Apply	60
Analyse	0
Evaluate	0
Create	0

Assessment Pattern: Psychomotor

Psychomotor Skill	Miniproject /~~Assignment/Practical Component~~
Perception	--
Set	--
Guided Response	--
Mechanism	100
Complex Overt Responses	--
Adaptation	--
Origination	--

Sample Questions for Course Outcome Assessment**

Course Outcome 1(CO1):

1. How is missing data handled in pre-processing?
2. What are the steps involved in exploratory analysis?
3. How are data outliers detected and addressed during pre-processing?

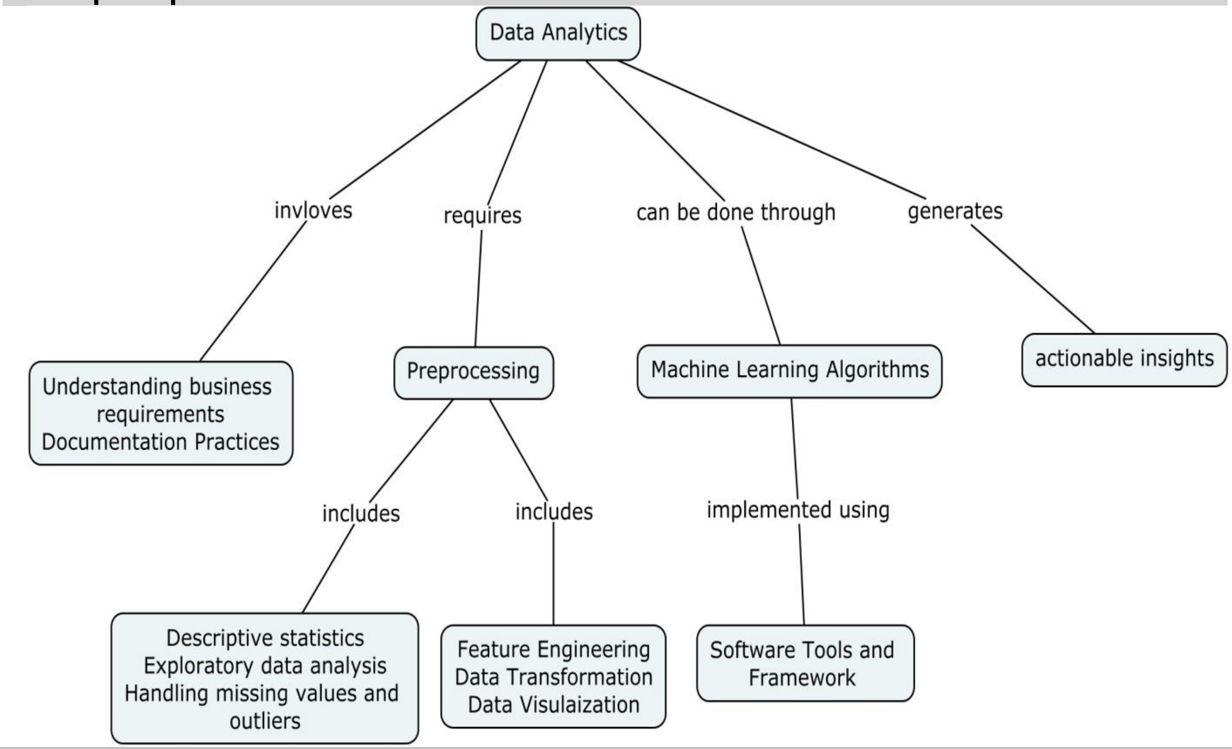
Course Outcome 2(CO2):

1. What are the key sections of a business requirement specification?
2. What are the important ingredients of a good technical design document?
3. What is the significance of reproducibility in data analytics?

Course Outcome 3(CO3):

1. What are the key considerations in data engineering?
2. What are popular deployment platforms for ML models?
3. What are all the approaches in model tuning?

Concept Map



Syllabus

Dataset introduction - Domain/engineering aspects of the data, Role of descriptive statistics and exploratory analysis. Preprocessing – Need and techniques, Handling missing values, Handling outliers, Data Transformation, Data enrichment, Visualization - Good and bad visualization practices, Telling story through visualization

Data Engineering - Data Engineering tools and practices, Introduction to Apache Nifi, Datalake basics

Problem introduction - Understanding business requirements, Documentation practices – Wiki/JIRA, Introduction to Jupyter/Zeppelin notebooks

Feature Engineering - Feature engineering basics, Automated feature engineering

Application of ML - Selection of algorithm – guidelines and best practices (explicability, deployment etc), Connecting business metrics and algorithm metrics, Selection of tools and frameworks (like R/Python/Spark/Tableau/Excel/SQL), Building business case - Converting model results to actionable insights, Business presentation

Learning Resources

1. https://www.kaggle.com/datasets
2. www.rbloggers.com
3. https://nifi.apache.org/docs.html
4. https://github.com
5. http://rstudio.github.io/shiny/tutorial/
6. https://docs.cloudera.com/

Course Contents and Lecture Schedule

S.No	Topic	No. of Hours	Course Outcome
1	**Dataset introduction**		
1.1	Domain/engineering aspects of the data, Role of descriptive statistics and exploratory analysis	1	CO1
1.2	Preprocessing – Need and techniques, Handling missing values, Handling outliers,	1	CO1
1.3	Data Transformation, Data enrichment	1	CO1
1.4	Visualization - Good and bad visualization practices, Telling story through visualization	1	CO1
2	**Data Engineering**		
2.1	Data Engineering tools and practices	1	CO1
2.2	Introduction to Apache Nifi	1	CO2
2.3	Datalake basics	1	CO2
3	**Problem introduction**		
3.1	Understanding business requirements	1	CO2
3.2	Documentation practices – Wiki/JIRA	1	CO2
3.3	Introduction to Jupyter/Zeppelin notebooks	1	CO2
4	**Feature Engineering**		
4.1	Feature engineering basics	1	CO3
4.2	Automated feature engineering	1	CO3
5	**Application of ML**		
5.1	Selection of algorithm – guidelines and best practices	1	CO3
5.2	Connecting business metrics and algorithm metrics		CO3
5.3	Selection of tools and frameworks (like R/Python/Spark/Tableau/Excel/SQL)	1	CO3
5.4	Building business case - Converting model results to actionable insights, Business presentation		CO3
	Total No. of. hours	**14**	

Course Designers:

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3. Dr.B.Subbulakshmi,TCE bscse@tce.edu

18CS1F0	PRACTICAL APPROACH TO DATA WAREHOUSING USING INFORMATICA	Category	L	T	P	Credit
		PE	1	0	0	1

Preamble

Informatica plays a major role in Data warehouse by extracting data from multiple sources, transforming data and loading into Data warehouse. Extract, Transform and Load (ETL) process requires active inputs from various stakeholders including developers, analysts, testers, top executives and is technically challenging with business changes. ETL is a recurring activity (daily, weekly, monthly) of a Data warehouse system and needs to be agile, automated.

Prerequisite

Basic knowledge on SQL and data base concepts.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	Course Outcomes	Weightage*** in %
CO1	Gain knowledge of the of Extract, Transform and Load (ETL) process.	15
CO2	Configure Clients and Repositories, Source and Target mappings and workflows in Informatica.	25
CO3	Use Informatica Power Center advanced Transformation techniques to load Dimension Tables.	30
CO4	Perform Data integration and management for many real-life Business Intelligence Projects.	30

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)[Refer CDIO report]
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	Guided Response	1.3,2.4.6,3.2.3,4.3.2

CO2	TPS3	Apply	Value	Mechanism	1.3 ,2.4.6,3.1.5,3.2.4,4.4.3
CO3	TPS3	Apply	Value	Mechanism	1.3, 2.4.6,3.1.5,3.2.4,4.5.1
CO4	TPS3	Apply	Value	Mechanism	1.3,2.2.3, 3.1.5, 2.4.6,3.2.4,4.5.1

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L										L	L		L
CO2	S	M	L		M			L	L	M		L	M	L	L
CO3	S	M	L		M			L	L	M		L	M	L	L
CO4	S	M	L		M			L	L	S		L	M	L	M

S- Strong; M-Medium; L-Low

Assessment Pattern

Bloom's Category	Terminal Examination
Remember	20
Understand	30
Apply	50
Analyse	0
Evaluate	0
Create	0

Assessment Pattern: Psychomotor

Psychomotor Skill	Mini-project /Assignment

Perception	-
Set	-
Guided Response	50
Mechanism	50
Complex Overt Responses	-
Adaptation	-
Origination	-

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Discuss about ETL/data warehouse process.
2. Explain the data integration solution.
3. Differentiate Data base and Data warehouse.

Course Outcome 2 (CO2):

1. Explain the features of Informatica Power center Informatica and its services & components.
2. Demonstrate the Typical use cases for Informatica and How to Configure Client and Repository in Informatica.
3. Implement the following : open Source Analyser, import Source table in Source Analyser Open Target Designer & import target in target designer and create folder in Informatica.

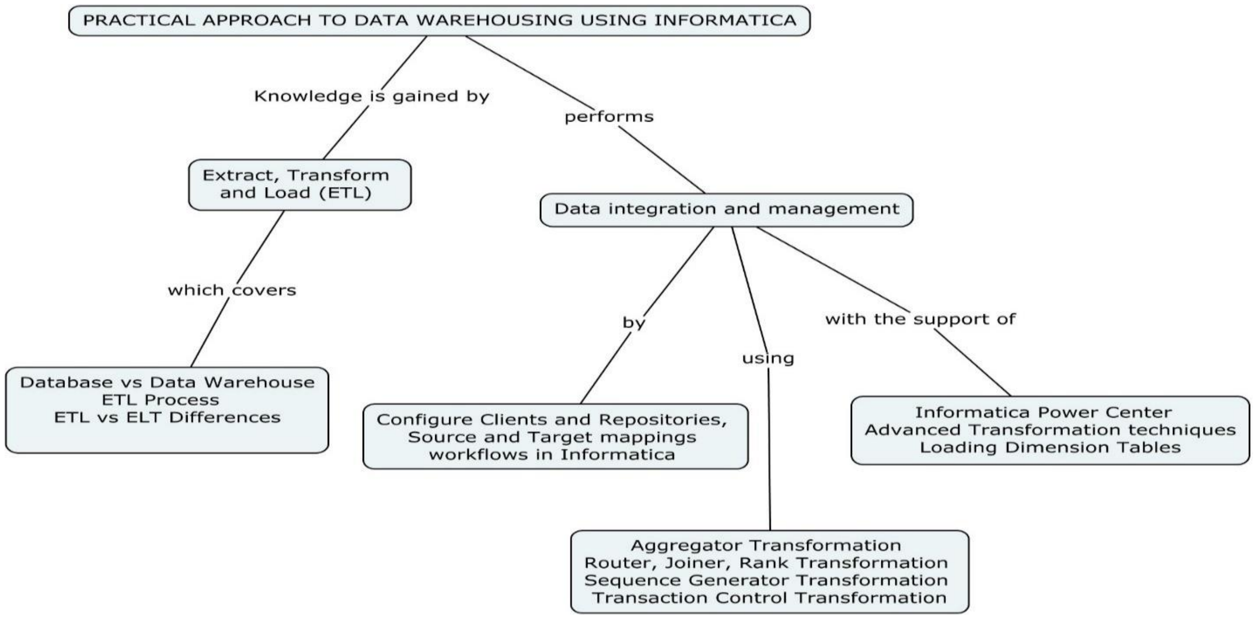
Course Outcome 3 (CO3):

1. Demonstrate the following in Workflow Monitor: Navigator window, Output window, Properties window – and Time window and also Task view and Gantt chart view.
2. Validate all mappings in the repository simultaneously and show different tools in workflow manager.
3. Differentiate connected look up and unconnected look up.

Course Outcome 4 (CO4):

1. Create source table "sales_source" and target table "sales_target" using the script and import them in Informatica, create a mapping having source "sales_source" and target table "sales_target" and from the transformation menu create a new transformation.
2. Use joiner transformation to join "emp" and "dept" table to bring department names.
3. When processing a high volume of data, there can be a situation when to commit the data to the target. If a commit is performed too frequently, then it will be an overhead to the system. If a commit is performed too late then in the case of failure, there are chances of data loss. Build a Solution for the above scenario.

Concept Map



Syllabus

Basics of ETL: Database vs Data Warehouse: Key Differences - ETL (Extract, Transform, and Load) Process - ETL vs ELT Differences

Data integration and management using Informatica - How to Configure Clients and Repositories in Informatica - Source Analyzer and Target Designer in Informatica - Mappings in Informatica - Workflows in Informatica - Workflow Monitor in Informatica - Session Objects in Informatica - Transformations in Informatica and Filter Transformation - Source Qualifier Transformation in Informatica - Aggregator Transformation in Informatica - Router Transformation in Informatica - Joiner transformation in Informatica - Rank Transformation in Informatica - Sequence Generator Transformation in Informatica - Transaction Control Transformation in Informatica

Learning Resources

1. Ralph Kimball , Margy Ross , “The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling”, John Wiley & Sons; 3rd edition, 2013.
2. Rahul Malewar’ “Learning Informatica PowerCenter 10.x - Second Edition: Enterprise data warehousing and intelligent data centers for efficient data management solutions” Packt Publishing, 2nd Edition, 2017.
3. Rudrani Josh, “Informatica Powercenter 9.x ETL Developer” (Including 20+ Hours of Online Video Tutorial), Kindle Edition, 2017.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures	Course Outcome
1	**Basics of ETL**		

1.1	Database vs Data Warehouse: Key Differences	1	CO1
O1	ETL (Extract, Transform, and Load) Process and ETL vs ELT Differences	1	CO1
2	**Data integration and management using Informatica**		
2.1	How to Configure Clients and Repositories in Informatica - Source Analyser and Target Designer in Informatica	1	CO2
2.2	Mappings in Informatica	1	CO2
2.3	Workflows in Informatica - Workflow Monitor in Informatica	1	CO2
2.4	Session Objects in Informatica	1	CO3
2.5	Transformations in Informatica and Filter Transformation	1	CO3
2.6	Source Qualifier Transformation in Informatica	1	CO3
2.7	Aggregator Transformation in Informatica	1	CO3
2.8	Router, Joiner, Rank Transformation in Informatica	2	CO4
2.9	Sequence Generator Transformation in Informatica	2	CO4
2.10	Transaction Control Transformation in Informatica	1	CO4
	Mini Project		
	Total	**14**	

Course Designers:

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18CS1G0	BASICS OF WEB APPLICATION SECURITY

Category	L	T	P	Credit
PE	1	0	0	1

Preamble

The main intention of web application security is to enforce an application with sound/effective security routines that minimize the probability of an attacker from being able to manipulate applications and access, steal, modify or delete sensitive data by unauthorised means.

Prerequisite

Basics of Computer Networks

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Explain the basic concepts of information security & application security (Understand)	20
CO2	Comprehend the secure coding principles while developing real time applications. (Understand)	20
CO3	Identify the different types of web application vulnerabilities (Understand)	20
CO4	Review on the strengths and vulnerabilities of a web application.(Apply)	40

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	Guided Response	1.3,2.1.1
CO2	TPS2	Understand	Respond	Guided Response	1.3,2.1.1
CO3	TPS2	Understand	Respond	Guided Response	1.3,2.1.1
CO4	TPS3	Apply	Value	Mechanism	1.3,2.1.4

Mapping with Programme Outcomes and Programme Specific Outcome

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L											L		
CO2	M	L										L	L		

CO3	M	L										L	L		
CO4	S	M	L		M	L						L	M	L	

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Test	Terminal Examination
Remember	10	10
Understand	50	50
Apply	40	40
Analyse		-
Evaluate		-
Create		-

Assessment Pattern: Psychomotor

Psychomotor Skill	Miniproject**/Assignment/**Practical Component
Perception	-
Set	-
Guided Response	80
Mechanism	20
Complex Overt Responses	-
Adaptation	-
Origination	-

Sample Questions for Course Outcome Assessment

Course Outcome 1 (CO1):

1. List the common web application protocols.
2. Recall the vulnerabilities in a web application.
3. Which attack can execute scripts in the user’s browser and is capable of hijacking user sessions, defacing websites or redirecting the user to malicious sites?
4. What threat arises from not flagging HTTP cookies with tokens as secure?
5. What is address spoofing?

Course Outcome 2 (CO2):

1. Understand the basics of Networking and about the commonly used protocols.
2. Describe different classes of application security and their real world implications.
3. Mention the common attacks on web applications and their countermeasures.
4. Explain the basic concepts of Secure Coding principles.
5. How to secure a database?

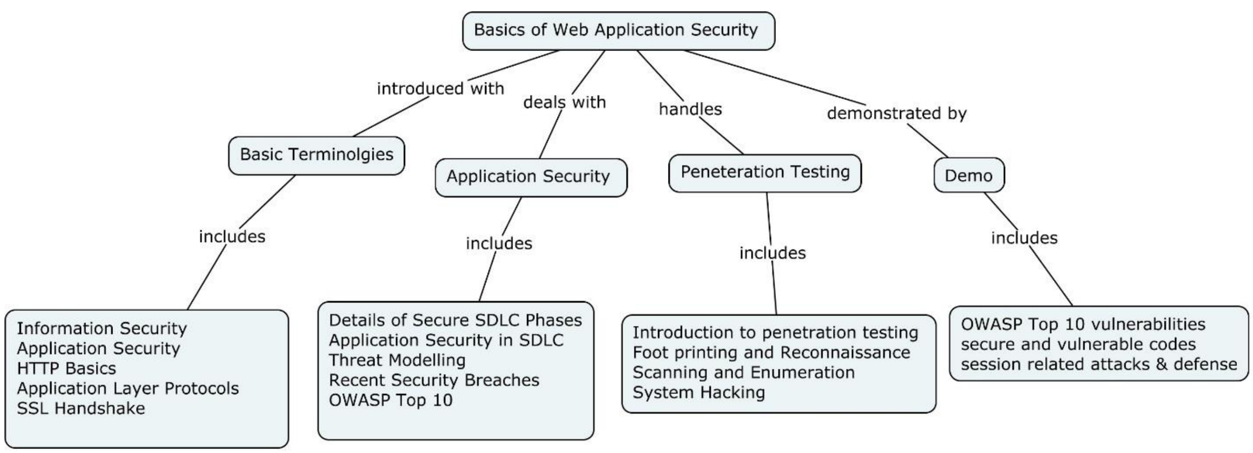
Course Outcome 3 (CO3):

1. Compare and understand the secure coding guidelines via a vulnerable code base.
2. Download and explore a vulnerable demo application.
3. Understand and analyze the implications of Secure SDLC process and try to incorporate the same in real time development projects
4. Appraise different infrastructure level configurations and prescribe countermeasures for the security loopholes identified (if any).
5. How different attacks occur and about how to bypass the currently implemented filters/countermeasures.

Course Outcome 4 (CO4):

1. Critique the web application security in YAHOO MAIL.
2. Identify and assess potential threats and vulnerabilities of GMAIL.
3. Rate the techniques that are best from a security standpoint in handling “Forgot Password”?
4. Estimate the vulnerabilities in the given code.
5. Critique the effect of SQL injection in the following code.
   SELECT booktitle **FROM** booklist **WHERE** bookId = ‘ook14cd’ **AND** ‘1’=’1’

Concept Map



Syllabus

Introduction: Introduction to Information Security, Common Terminologies in Application Security, HTTP Basics, Application Layer Protocols, SSL Handshake, **Application Security:** Details of Secure SDLC Phases, Application Security in SDLC, Introduction to Threat Modelling, Recent Security Breaches, OWASP Top 10, **Penetration Testing:** Introduction to penetration testing, Foot printing and Reconnaissance, Scanning and Enumeration, System Hacking, **Demo:** OWASP Top 10 vulnerabilities, secure and vulnerable codes, session related attacks & defense

Learning Resources

1. Dafydd Stuttard, Marcus Pinto, “The Web Application Hacker’s Handbook: Discovering and Exploiting Security Flaws,” 2nd Edition, Wiley, 2011, ISBN:1118026470/978-1118026472.
2. Stuart McClure, Joel Scambray, Kurtz, “Hacking Exposed 7:Network Security Secrets Solutions”, 7th Edition, McGraw-Hill Prof Med/Tech, 2012, ISBN13:9780071780285

3. Andrew S. Tanenbaum and David J. Wetherall,"Computer Networks",5th Edition,Prentice Hall,2011,IB-13:9780132126953
4. OWASP Security Testing Guide (https://www.owasp.org/index.php/File:OWASP_Testing_Guide_v2_pdf.zip)

Course Contents and Lecture Schedule

Module No.	Topic	No. of Lectures
1.	**Introduction**	
1.1	Introduction to Information Security	1
1.2	Common Terminologies in Application Security	1
1.3	HTTP Basics, Application Layer Protocols, SSL Handshake	1
2.	**Application Security**	
2.1	Details of Secure SDLC Phases	1
2.2	Application Security in SDLC	1
2.3	Introduction to Threat Modelling.	1
2.4	Recent Security Breaches	1
2.5	OWASP Top 10	1
3	**Penetration Testing**	
3.1	Introduction to penetration testing	1
3.2	Foot printing and Reconnaissance	1
3.3	Scanning and Enumeration, System Hacking	1
4	**Demo**	
4.1	OWASP Top 10 vulnerabilities	1
4.2	secure and vulnerable codes	1
4.3	session related attacks & defense	1
	Total	14

Course Designers:

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18CS1H0	HEALTHCARE AUTOMATION USING MACHINE LEARNING

Category	L	T	P	Credit
PE	1	0	0	1

Preamble:

Health care automation helps to give patients transparent, single-point access to their information. Patients could access their medical histories, billing information, and appointment scheduling and reminders from a unified online platform—which not only improve patient satisfaction, but also improve appointment turnout and timeliness of payments. Applying Machine Learning to Health care systems can strip costs from its supply chain through real-time reporting and better analytics that let it set optimal inventory levels based on previous needs and patterns in the demand.

Prerequisite:

Understanding of different concepts and various types in machine learning

Course Outcomes:

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Review the exploration of Health Care Systems	20
CO2	Elaborate the Role of Machine Learning in Healthcare System	20
CO3	Provide Machine learning Solutions to Healthcare Problems	30
CO4	Use the Strategies for solving various challenges in using Machine Learning to Healthcare	30

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	Guided Response	1.3,2.4.6,3.2.3,4.3.2
CO2	TPS2	Understand	Respond	Guided Response	1.3,2.4.6,3.2.3,4.3.2
CO3	TPS3	Apply	Value	Mechanism	1.3, 2.4.6,3.1.5,3.2.4,4.5.1
CO4	TPS3	Apply	Value	Mechanism	1.3, 2.4.6,3.1.5,3.2.4,4.5.1

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L											L		
CO2	M	L											L		

CO 3	S	M	L		M					M			M	L	
CO 4	S	M	L		M					M		L	M	L	L

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Terminal Examination
Remember	20
Understand	40
Apply	40
Analyse	0
Evaluate	0
Create	0

Assessment Pattern: Psychomotor

Psychomotor Skill	Miniproject /Assignment/~~Practical Component~~
Perception	
Set	
Guided Response	50
Mechanism	50
Complex Overt Responses	
Adaptation	
Origination	

Sample Questions for Course Outcome Assessment**

** (2 to 3 at the cognitive level of course outcome)

Course Outcome 1 (CO1):

1. Explain the flow of RCM and list down the three Ps' of RCM - services
2. Explain the phases in RCM
3. Explain any one of the advanced Healthcare technologies
4. Demonstrate the overview of US Healthcare system

Course Outcome 2 (CO2):

1. Explain the key benefits of applying Machine learning in EMR processing
2. Illustrate the insights that can be derived from the EMR datasets
3. Summarize the few methodologies that can be used to convert unstructured data into meaningful insights
4. Explain the Significant role of Information Extraction in machine learning.

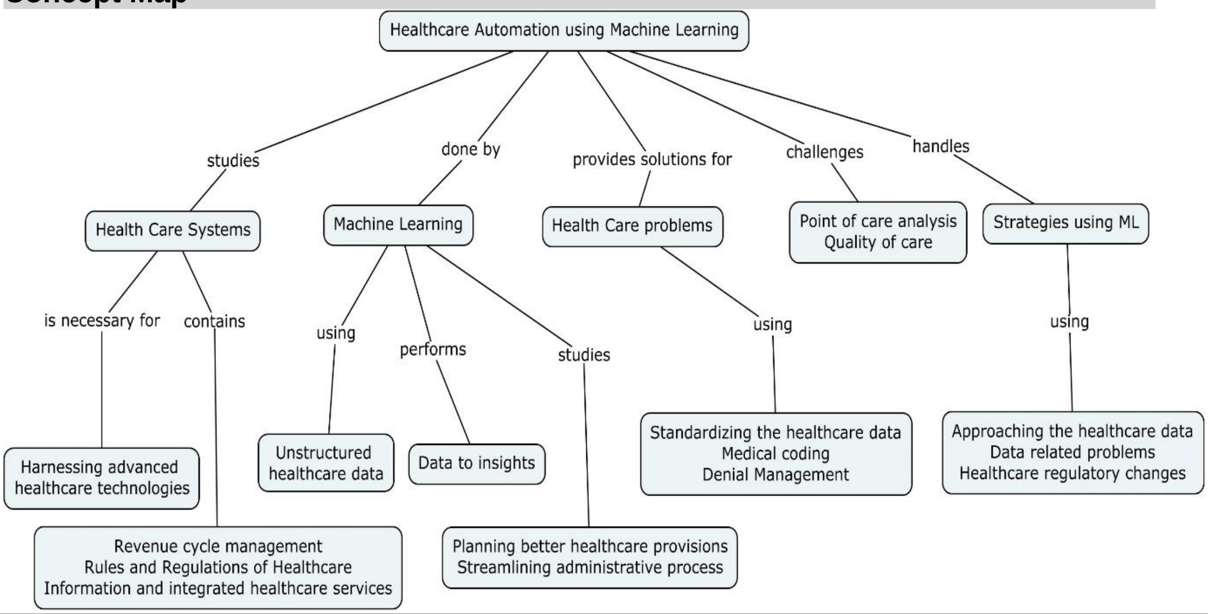
Course Outcome 3 (CO3):

1. Define CPT and ICD codes and explain it's usage
2. Explain the Factors involved in preparing a billable EMR

3. Explain the steps involved in processing a EMR
4. Select an algorithm that supports Information Extraction in ML
5. Demonstrate the steps involved in standardizing the EMRs

Course Outcome 4 (CO4):
1. Explain the risks involved in handling the EMRs
2. State the Importance of securing the Medical Data
3. Summarise the necessity of updating the health care systems to the changing rules and regulations
4. Apply an algorithm that supports data classification in health care dataset.

Concept Map



Syllabus

Fundamentals of Healthcare - Healthcare -Revenue cycle management -Rules and Regulations of Healthcare-Harnessing advanced healthcare technologies-Information and integrated healthcare services. Electronic Maintenance of Records -**Why machine learning in Healthcare -** Unstructured healthcare data - Data to insights- Planning better healthcare provisions-Streamlining administrative process - **Healthcare problems and ML solutions -**Healthcare -documentation and Improvement -Standardizing the healthcare data -Medical coding -Denial Management - Point of care analysis -Quality of care- Other problems overview- **Strategies and Challenges in Machine learning in Healthcare -**Approaching the healthcare data –Data related problems -Healthcare regulatory changes –Privacy, Security related challenges -Rising healthcare cost- case study (Early- warning algorithm targeting sepsis)

Learning Resources

1. A Complete Walkthrough of the Healthcare Revenue Cycle Management Steps - Web Link : https://www.adsc.com/blog/a-complete-walkthrough-of-the-healthcare-revenue-cycle-management-steps
2. Benefits of Automation in Healthcare – Web Link : https://tigerconnect.com/blog/17-benefits-of-automation-in-healthcare/.
3. How automation can help Healthcare – Web Link : https://info.nintex.com/rs/272-JVS-996/images/White_Paper_The_healing_process_whitepaper%20%282%29.pdf

4. HIPAA – Web Link : https://www.hhs.gov/hipaa/index.html
5. Study of Machine Learning in Healthcare - Web Link: https://ieeexplore.ieee.org/abstract/document/8029924

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1	Fundamentals of Healthcare **(3)**		
1.1	Healthcare Basics- Revenue cycle management	1	CO1
1.2	Rules and Regulations of Healthcare- Harnessing advanced healthcare technologies	1	CO1
1.3	Information and integrated healthcare services	1	CO1
2	**Why machine learning in Healthcare (3)**		
2.1	Unstructured healthcare data - Data to insights	1	CO2
2.2	Planning better healthcare provisions	1	CO2
2.3	Streamlining administrative process	1	CO2
3	**Healthcare problems and ML solutions - (4)**		
3.1	Healthcare documentation and Improvement	1	CO3
3.2	Standardizing the healthcare data- Medical coding	1	CO3
3.3	Denial Management - Point of care analysis	1	CO3
3.5	Quality of care- Other problems overview	1	CO3
4	**Healthcare problems and ML solutions - (4)**		
4.1	Approaching the healthcare data	2	CO4
4.2	Data related problems- Healthcare regulatory changes	1	CO4
4.3	Security related challenges- Rising healthcare cost	1	CO4
	TOTAL	14	

Course Designers:

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18CS1J0	**EDGE ANALYTICS**

Category	L	T	P	Credit
PEES	1	-	-	1

Preamble

This course is intended for the Computer science students and enables them to learn about Cloud Object Storage and management of unstructured data. The syllabus emphasizes on object storage, service offerings of cloud platforms and features of cloud object storage. The course also provides sufficient depth in object storage provided by different cloud providers.

Prerequisite

Knowledge on Networking and Data Science

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Summarize the fundamentals of IoT, IIoT and evolution of Analytics and AI	20
CO2	Explain the Edge Data Management Analytics Architecture	20
CO3	Make use of Time Series Database for Data pipelining and build models in Edge Devices	30
CO4	Experiment Analytics in AI Accelerated Edge Device	30

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond		1.2, 2.4.6, 2.5.4, 3.2.2, 3.2.6
CO2	TPS2	Understand	Respond		1.2, 2.4.6, 2.5.4, 3.2.2, 3.2.6
CO3	TPS3	Apply	Value		1.2, 2.1.2, 2.1.5, 4.4.3, 4.5.3
CO4	TPS3	Apply	Value		1.2, 2.1.2, 2.1.5, 4.4.3, 4.5.3

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L								M			L		
CO2	M	L								M			L		
CO3	S	M	L		S	L	L		M	M		M	M	L	L
CO4	S	M	L	L	S	M	L	L	M	M	L	M	M	M	M

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Terminal Examination

Remember	20
Understand	20
Apply	60
Analyse	
Evaluate	
Create	

Assessment Pattern: Psychomotor

Psychomotor Skill	~~Miniproject /~~Assignment/~~Practical Component~~
Perception	-
Set	-
Guided Response	40
Mechanism	60
Complex Overt Responses	-
Adaptation	-
Origination	-

Sample Questions for Course Outcome Assessment**
** (2 to 3 at the cognitive level of course outcome)

Course Outcome 1 (CO1)

1. What is IoT and IIoT? (Remember)
2. Explain in detail about the characteristics of Edge Computing. (Understand)
3. Explain the key benefits of Edge Computing over IIOT (Understand)

Course Outcome 2 (CO2)

1. Describe Edge Analytics Architecture (Remember)
2. What are the fundamental requirements of Edge Analytics? (Remember)
3. Illustrate the various ways in which Data stored in Edge. (Understand)

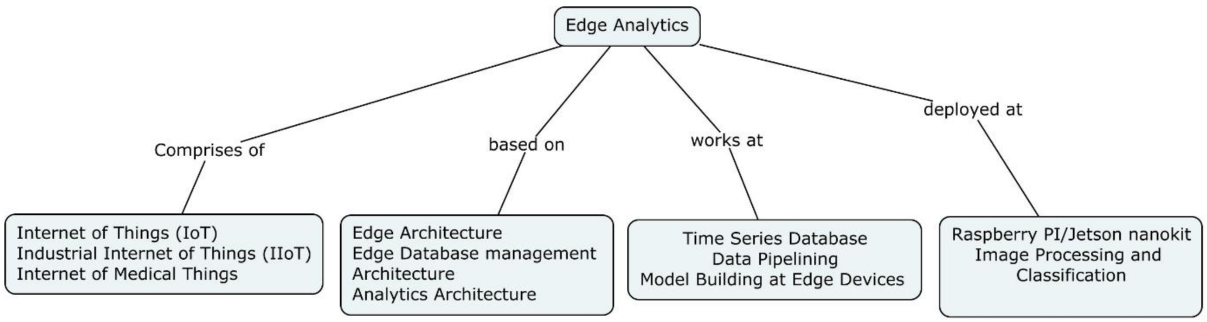
Course Outcome 3 (CO3)

1. Design a methodology for creating clusters of lightweight Edge clouds (Apply)
2. Identify the stages of data analysis techniques used in video surveillance camera generated data set for object identification (Apply)
3. Illustrate the range of Storage classes offered in AWS S3. (Apply)

Course Outcome 4 (CO4)

1. Design Edge-Fog-Cloud architecture for Smart Home Automation. (Apply)
2. Design and Develop logical workspace for automated car parking (Apply)
3. Create Physical workspace for in-house energy management (Apply)

Concept Map



Syllabus

Basics of Edge Computing - Introduction to IoT, IIoT, IoMT – Introduction to Edge Computing – Evolution of Analytics and AI

Edge Analytics Architecture – Edge Architecture –Hardware and Software at Edge –Edge Data Management and Analytics Architecture

Analytics at Edge – Time Series Databases - Edge Data Characteristics-Data Pipelining-Enabling ML/DL in low power/Embedded system devices- Model building and model optimization

Case Study - Setting up Jetson Nano kit and installing Keras, OpenCV, Numpy, Sci-Py, TensorFlow-Exercises of image processing and classification- Exercises on Numpy and Scikit-learn

Learning Resources

1. Perry lea, IoT and Edge Computing for Architects: Implementing Edge and IoT Systems from Sensors to Clouds with Communication Systems, Analytics, and Security, Packet Publishing, 2020, 2nd Edition
2. Edge Computing Consortium : https://ecconsortium.eu/
3. AWS IoT: Developing and Deploying an Internet of Things: https://courses.edx.org/courses/course-v1:AWS+OTP AWSD5+1T2019/course/

Course Contents and Lecture Schedule

Module No.	Topic	No. of Lectures
1	**Basics of Edge Anaytics (3)**	
1.1	Introduction to IoT, IIoT, IoMT	1
1.2	Introduction to Edge Computing	1
1.3	Evolution of Analytics and AI	1
2	**Edge Analytics Architecture (3)**	
2.1	Edge Architecture	1
2.2	Hardware and Software at Edge	1

2.3	Edge Data Management and Analytics Architecture	1
3	**Analytics at Edge (4)**	
3.1	Time Series Databases	1
3.2	Edge Data Characteristics- Data Pipelining	1
3.3	Enabling ML/DL in low power/Embedded system devices	1
3.4	Model building and model optimization	1
4	**Practical Component(4)**	
4.1	Setting up Raspberry PI/Jetson Nanokit and installing Keras, OpenCV, Numpy, Sci-Py, TensorFlow	1
4.2	Exercises of image processing and classification	1
4.3	Exercises on Numpy and Scikit-learn	2
	Total	14

Course Designers:

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18CS1K0	AGILE PRODUCT DEVELOPMENT FOR ENTERPRISES

Category	L	T	P	Credit
PEES	1	0	0	1

Preamble

The course is designed to provide a solid foundation of Agile Scrum based software development. It highlights the key roles and ceremonies involved in Agile Scrum. Commercially successful large software projects involve a precise coordination of distributed Agile teams, hence the course throws light on advanced concepts in SAFe (Scaled Agile Framework) as well.

Prerequisite

Basic knowledge in Software Engineering Practice

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcomes	Weightage in %
CO1	Explain how Agile Scrum development helps organizations build high quality products in rapidly changing business environment.	20
CO2	Build the project requirements for an Agile scrum project via User Stories and monitor their development status through burn down charts.	20
CO3	Plan Agile development with standard scrum rituals and identify the roles and responsibilities of key scrum roles.	30
CO4	Make use of SAFe principles to enable Agile Release Trains to create complex products.	30

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	Guided Response	1.3,2.4.6,3.2.3,4.3.2
CO2	TPS3	Apply	Value	Mechanism	1.3 ,2.4.6,3.1.5,3.2.4,4.4.3
CO3	TPS3	Apply	Value	Mechanism	1.3, 2.4.6,3.1.5,3.2.4,4.5.1
CO4	TPS3	Apply	Value	Mechanism	1.3 ,2.4.6,3.1.5,3.2.4,4.4.3

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L			L			L		L		L	L		L
CO2	S	M	L		M			L	L	M	L	L	M	L	M
CO3	S	M	L		M			L	L	M	L	L	M	L	M
CO4	S	M	L		M			L	L	M	L	L	M	L	M

S- Strong; M-Medium; L-Low

Assessment Pattern:

Cognitive Levels	Terminal Examination
Remember	20
Understand	40

Apply	40
Analyse	0
Evaluate	0
Create	0

Course Level Assessment Questions

Course Outcome1(CO1):

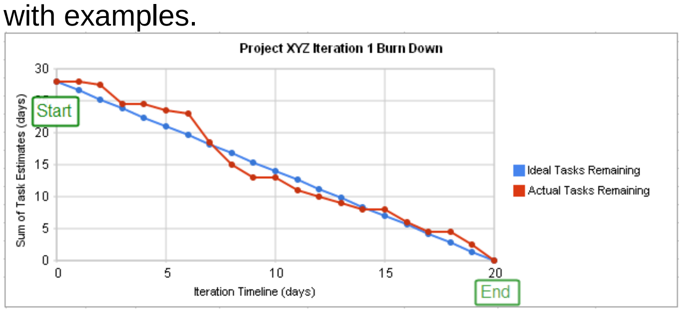
1. Explain rapidly changing business environmentand the other main drivers for the evolution of Scrum based Software development and the principles behindScrum
2. Highlight how Agile Scrumis beneficial than traditional models to help Organizations deliver products in a short cycle time.
3. Explain why Waterfall model doesn't suit current business environment.
4. A start-up is involved in the building of gaming apps. The competitors are rapidly gaining market in this space and the preferences of the players (kids to aged people) using the games is changing very fast. Justify why Agile Scrum will suit this scenario.

Course Outcome2(CO2):

1. Describe the various roles in Agile Scrum process and explain why scrum master's role is more than that of a traditional manager's role
2. Highlight Differences between release backlog, sprint backlog and product backlog
3. Explain the elements in "Definition of Done" and "Acceptance Criteria"
4. During the 3rd Sprint of a software development, the customer has changed a major requirement. Explain the process involved in handing the change.
5. How does SAFe differ from Agile Scrum?

Course Outcome3(CO3):

1. Highlight the importance of having Daily Scrum Meetings and explain the purpose it solves.
2. Explain the differences in the role of a scrum master / product owner.
3. Explain the need for refactoring the code.
4. In the PDCA cycle, where does Sprint Retrospective meeting fits.
5. What do you mean by Scrum of Scrums
6. Is it right to measure the velocity of a team at the end of the first sprint? Justify your answer with examples.

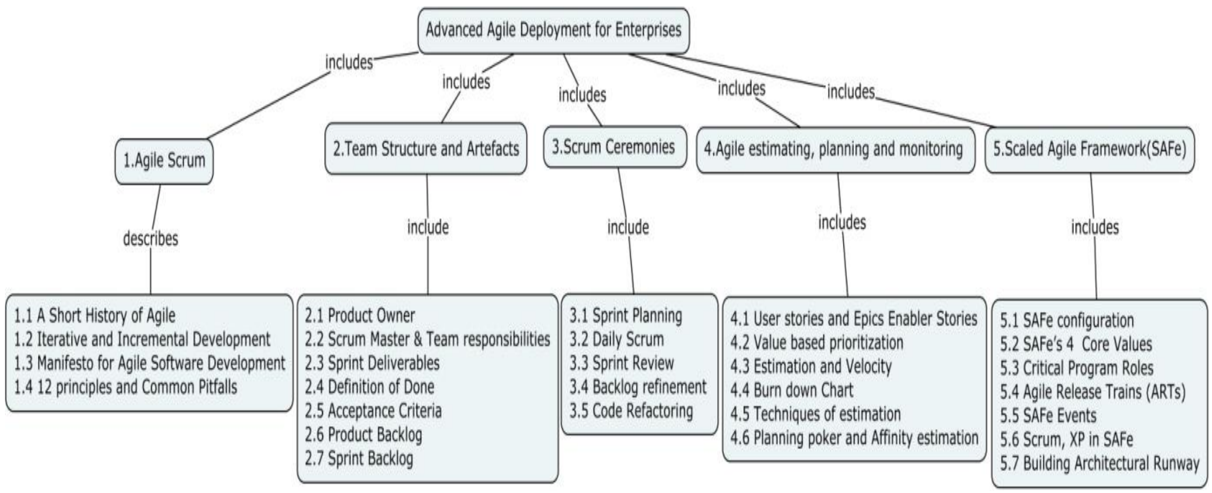


Course Outcome 4 (CO4):

1. Your organization develops Hospital management software for small clinics. Create the Epics and Use cases.
2. Explain how Lean , XP and Scrum fit into the SAFe framework
3. Explain the layered approach in SAFe
4. What is an architectural runway?

5. How is Program Increment (PI) related to ART?
6. Take a look at the below burn down chart and comment at the project progress at various time periods.

Concept Map



Syllabus

Agile Scrum-Dynamic Business Environment (M&As / Spin Off) -A Short History of Agile - Iterative and Incremental Development -Manifesto for Agile Software Development- 12 principles - Common Pitfalls

Team Structure and Artefacts -Product Owner - Scrum Master & Team responsibilities - Sprint Deliverables - Definition of Done –Acceptance Criteria - Product Backlog - Sprint Backlog

Scrum Ceremonies -Sprint Planning - Daily Scrum - Sprint Review & Sprint Retrospective - Backlog refinement - Code Refactoring

Agile estimating, planning and monitoring -User stories and Epics; Enabler Stories - Value based prioritization -Estimation and Velocity-Burn down Chart- Techniques of estimation - Planning poker and Affinity estimation

Scaled Agile Framework (SAFe)-Introduction- SAFe configuration -SAFe's 4 Core Values-Critical Program Roles -Agile Release Trains (ARTs) -SAFe Events : Live Program Increment Planning with real-life examples, System Demo;Advanced concepts : Scrum, XP in SAFe - Building Architectural Runway

References

1. Mary and Tom Poppendieck, *Implementing Lean Software Development: From Concept to Cash,* Addison-Wesley Signature Series, 1st Edition, 2006.
2. Mike Cohn, *Succeeding with Agile : Software Development using Scrum*, Pearson, 1st Edition,2015.
3. https://scaledagile.com

Course Contents and Lecture Schedule

Advanced Agile Deployment for Enterprises		
Module Number	**Topic**	**No. of Lectures**
1	**Agile Scrum**	
1.1	A Short History of Agile - Iterative and Incremental Development	1
1.2	Manifesto for Agile Software Development	1
1.3	12 principles - Common Pitfalls	1
2	**Team Structure & Scrum Artefacts**	
2.1	Product Owner - Scrum Master & Team responsibilities	1
2.2	Sprint Deliverables - Definition of Done	1
2.3	Product Backlog - Sprint Backlog	1
3	**Scrum Ceremonies**	
3.1	Sprint Planning - Daily Scrum - Sprint Review & Sprint Retrospective.	1
3.2	Backlog refinement - Code Refactoring	1
4	**Agile estimating, planning and monitoring**	
4.1	User stories and Epics - Value based prioritization - User stories and Enabler stories	1
4.2	Estimation and Velocity - Burn down Chart	1
4.3	Techniques of estimation: Planning poker and Affinity estimation	1
5	**Scaled Agile Framework (SAFe)**	
5.1	Introducing the Scaled Agile Framework (SAFe) - SAFe's four Core Values - SAFe configurations	1
5.2	Critical Roles in SAFe - Lean, XP - Scrum in SAFe; Architectural Runway	1
5.3	Agile Release Trains (ARTs) - common principles; Program Increment Planning ; System Demo	1
	Total Lectures	**14**

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18CS1L0	**DATA VISUALIZATION USING TABLEAU**	Category	L	T	P	Credit
		PEES	1	0	0	1

Preamble

Data visualization is the graphical representation of information and data. Tableau plays a major role in Data Visualisation with simple drag and drop. The main objective of this course is to create interactive graphs and charts in the form of dashboards and worksheets to gain business insights. Data visualization with Tableau will provide extremely fast data analysis.

Prerequisite

Basic knowledge on Database concepts.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	Course Outcomes	Weightage in %
CO1	Gain knowledge of Business Intelligence(BI) reporting tools and components of Tableau	20
CO2	Configure the connection using Tableau's native connectors to all the popular data sources	20
CO3	Use Worksheets, appropriate Charts, Maps, Graphs, Calculations and Filters for Data Analysis and Visualization	40
CO4	Examine the real-life Business Intelligence Projects using Tableau Dashboards	20

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)[Refer CDIO report]
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	Guided Response	1.3,2.4.6,3.2.3,4.3.2
CO2	TPS3	Apply	Value	Mechanism	1.3 ,2.4.6,3.1.5,3.2.4,4.4.3
CO3	TPS3	Apply	Value	Mechanism	1.3, 2.4.6,3.1.5,3.2.4,4.5.1
CO4	TPS4	Analyse	Organise	Complex Overt Responses	1.3,2.2.3, 3.1.5, 2.4.6,3.2.4,4.4.3,4.5.1

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L			L			L		L		L	L		L
CO2	S	M	L		M			L	L	M	L	L	M	L	M
CO3	S	M	L		M			L	L	M	L	L	M	L	M
CO4	S	S	M	L	M			L	S	M	L	L	S	L	M

S- Strong; M-Medium; L-Low

Assessment Pattern

Bloom's Category	CAT/Terminal Examination
Remember	20
Understand	30
Apply	50
Analyse	0
Evaluate	0
Create	0

Assessment Pattern: Psychomotor

Psychomotor Skill	Mini-project /Assignment
Perception	-
Set	-
Guided Response	30
Mechanism	50
Complex Overt Responses	20
Adaptation	-
Origination	-

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Discuss about BI Reporting tools.
2. Explain the File Types and supporting Data types.

Course Outcome 2 (CO2):

1. Explain the Tableau Architecture.
2. Demonstrate the connections to various Data Sources in Tableau.

Course Outcome 3 (CO3):

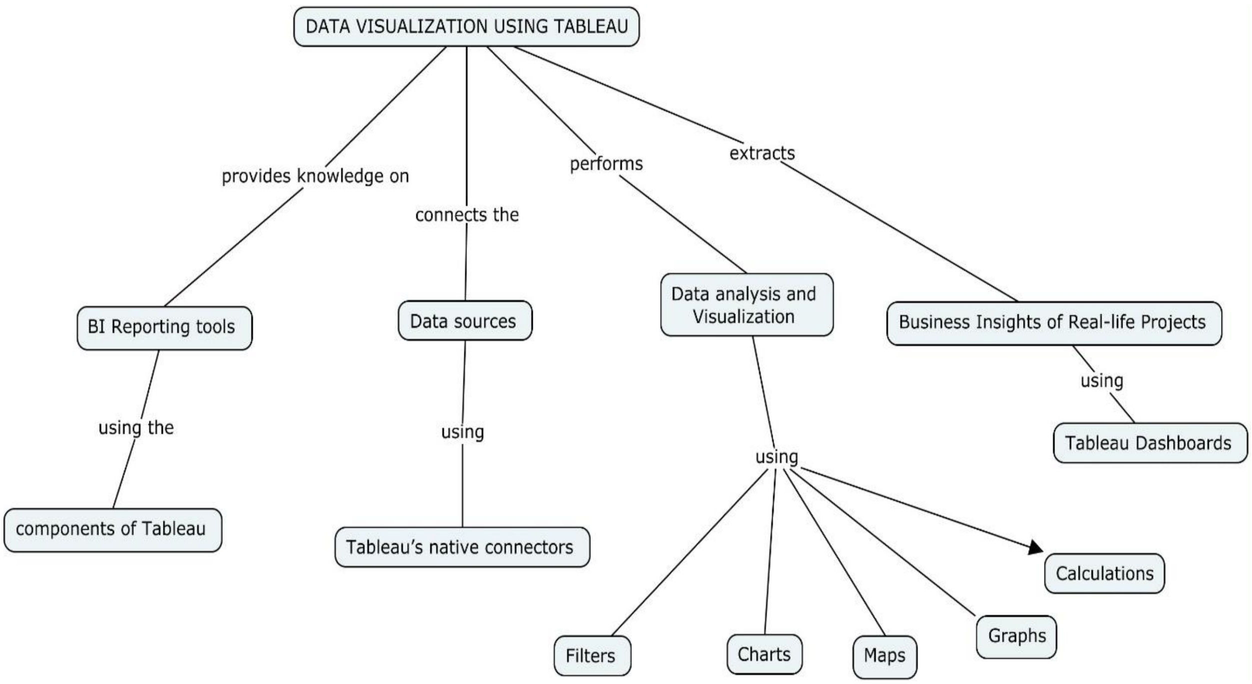
1. Give an expression to add 4 months to the date 2021-03-12.
2. Differentiate Joins and Blending in Tableau.

Course Outcome 4 (CO4):

1. Which is used to analyse two different measures at two different scales in the same graph
2. How can you display the Top Five and Bottom Five Sales in the Same View?

   CO4 will be evaluated using Mini Project

Concept Map



Syllabus

Overview of BI Reporting tools/Tableau -Components of Tableau -Tableau Architecture-Tableau File Types and Data types
Tableau Data Sources - Custom Data View-Extracting Data -Fields Operations- Editing Metadata - Data Joining - Data Blending
Data Analysis Tools: Creating and updating Tableau Worksheets-**Tableau Charts**- Bar Chart , Line Chart, Pie Chart , Crosstab , Scatter Plot , Bubble Chart, Bullet Graph, Box Plot, Tree Map, Bump Chart, Gantt Chart, Histogram, Motion Charts, Waterfall Charts-**Calculations** - Operators and Functions - Numeric, String , Date , Table calculations and LOD Expressions- Sorting and Various types of filters
Tableau Dashboard- Formatting, Forecasting, Trend Lines

Learning Resources

1. Alexander Loth, Nate Vogel, Sophie Sparkes, "Visual Analytics with Tableau", Wiley Publishers, 1st edition, 2019
2. Ryan Sleeper ,"Practical Tableau: 100 Tips, Tutorials, and Strategies from a Tableau Zen Master" O'Reilly Publishers, 1st edition, 2018
3. Ben Jones , "Communicating Data with Tableau: Designing, Developing, and Delivering Data", O'Reilly Media; 1st edition, 2014

Course Contents and Lecture Schedule

No	Topic	No. of Lectures	Course Outcome
1	**Overview of BI Reporting tools/Tableau**		
1.1	Components of Tableau -Tableau Architecture	1	CO1
1.2	Tableau File Types and Data types	2	CO1
2	**Tableau Data Sources**		
2.1	Custom Data View-Extracting Data	1	CO2
2.2	Fields Operations- Editing Metadata	1	CO2

2.3	Data Joining - Data Blending	1	CO2
3	**Data Analysis Tools**		
3.1	Creating and updating Tableau Worksheets	1	CO3
3.2	**Tableau Charts**- Bar Chart , Line Chart, Pie Chart , Crosstab , Scatter Plot , Bubble Chart, Bullet Graph, Box Plot, Tree Map, Bump Chart, Gantt Chart, Histogram, Motion Charts, Waterfall Charts	2	CO3
3.3	**Calculations** - Operators and Functions - Numeric, String , Date , Table calculations and LOD Expressions	1	CO3
3.4	Sorting and Various types of filters	1	CO3
4	**Tableau Dashboard**		
4.1	Formatting, Forecasting, Trend Lines	3	CO4
	Mini Project		
	Total	**14**	

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