B.E. COMPUTER SCIENCE AND ENGINEERING DEGREE PROGRAMME

SCHEDULING OF COURSES
&

CURRICULUM AND DETAILED SYLLABI

FOR

FIFTH SEMESTER TO EIGHTH SEMESTER

FOR THE STUDENTS ADMITTED IN THE

ACADEMIC YEAR 2022-23 ONWARDS

THIAGARAJAR COLLEGE OF ENGINEERING
(A Government Aided Autonomous Institution affiliated to Anna University)
MADURAI – 625 015, TAMILNADU

Phone: 0452 – 2482240, 41
Fax: 0452 2483427
Web: www.tce.edu

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.

Thiagarajar College of Engineering, Madurai - 625015
Credit Distribution for B.E (CSE) Programme – 2022 – 2023 Batch

S.No	Category of Courses	Credits	
		Regular Admission	**Lateral Entry Admission**
A	**Foundation Courses(FC)**	**54 - 66**	**22 - 35**
	Humanities and Social Sciences including Management Courses (HSMC)	09 - 12	08 – 11
	Basic Science Courses (BSC)	24 - 27	06 – 09
	Engineering Science Courses (ESC)	21 - 27	08 – 15
B	**Professional Core Courses (PCC)**	**55**	**45**
C	**Professional Elective Courses (PEC)**	**24 - 39**	**24 - 39**
	Programme Specific Electives (PSE)	15 – 24	15 – 24
	ProgrammeElectives for Expanded Scope (PEES)	9 - 15	9 - 15
D	**Open Elective Courses (OEC)**	**6 - 12**	**6 - 12**
	Interdisciplinary Elective (IE)	3 - 6	3 - 6
	Basic Science Elective (BSE)	3 - 6	3 - 6
E	**Project work**	**12**	**12**
E	Internship and Mandatory Audit as per the Regulatory Authorities	Non Credit (Not included for CGPA)	
	Minimum credits to be earned for the award of the Degree	**160 (from A to E) and the successful completion of Mandatory Courses**	**120 (from A to E) and the successful completion of Mandatory Courses**

Thiagarajar College of Engineering, Madurai-625015
Department of Computer science and Engineering
Scheduling of Courses – for those join in the year 2022 – 2023

Sem	Theory / Theory cum Practical / Practical									Audit Courses (Mandatory Non- credit}	Credit
	1	2	3	4	5	6	7	8	9		
I	22MA110 Calculus for Engineers (BS-4)	22PH120 Physics (BS-3)	22CH130 Chemistry (BS-3)	22EG140 Technical English (HSS-2)	22CS150 Engineering Exploration (ES-2)	22CS160 Foundations of Computer Programming (PC -3)	22EG170 English Laboratory (HSS-1)	22PH180 Physics Laboratory (BS-1)	22CH190 Chemistry Laboratory (BS-1)		20
II	22CS210 Matrices and Linear Algebra (BS-4)	22CS220 Electronics and Digital Systems (PC -3)	22CS230 Computer Organization and Architecture (PC-3)	22CS240 Problem Solving and Programming (ES-3)	22CS250 System Programming (ES- 2)	22CS260 Engineering Graphics and Extended Reality (ES-3)	22CS270 Computer Systems Lab (ES-1)	22CS280 Programming Lab (PC-1)		22CHAA0 Environmental Science	20
III	22CS310 Probability and Statistics (BS-4)	22CS320 Theory and Design of Programming Languages (ES-3)	22CS330 Object Oriented Programming (PC-3)	22CS340 Data Structures and Algorithms (PC-3)		22CS360 Operating Systems (PC-4)	22CS370 Data Structures Lab (PC-1)	22CS380 Object Oriented Programming Lab (PC-1)	22ES390 Design Thinking (ES-3)		22
IV	22CS410 Discrete Mathematics (BS-4)	22CS420 Design and Analysis of Algorithms (PC-3)	22CS430 Data Communication and Networks (PC-3)	22CS440 Database Management Systems (PC-3)	22CS450 Web Programming (PC-3)	22EG660 Professional Communication (HSS-2)	22CS470 Databases Lab (PC-1)	22CS480 Algorithms Lab (PC-1)	22CS490 Project Management (HSS-3)		23
V	22CS510 Modelling and Optimization (ES-3)	22CS520 Theory of Computation (ES-3)	22CS530 Artificial Intelligence (PC-3)	22CSPX0 Programme Elective (PE - 3)	22XXGX0 Interdisciplinary Elective (OE-3)	22CS560 Software Engineering (PC-4)	22CS570 Network Programming Lab (PC-1)	22CS580 Artificial Intelligence Lab (PC-1)	22CS590 Project – I (P-3)	Audit Course 2	24
VI	22CS610 Cryptography and Network Security (PC-3)	22CS620 Distributed Computing (PC-3)	22CS630 Compiler Design (PC-3)	22CSPX0 Programme Elective (PE - 3)	22XXFX0 Basic Science Elective (OE-3)	22CSPX0 Programme Elective (PE - 3)	22CS670 Distributed Computing Lab (PC-1)		22CS690 Project - II (P-3)		22
VII	22CS710 Engineering Economics (HSS-3)	22CS720 Human Computer Interaction (ES-2)	22CSPX0 Programme Elective (PE - 3)	22CSPX0 Programme Elective (PE - 3)	22CSPX0 Programme Elective (PE - 3)	22CSPX0 Programme Elective (PE - 3)			22CS790 Project - III (P-3)		20
VIII	22CSPX0 Programme Elective (PE - 3)	22CSPX0 Programme Elective (PE - 3)							22CS890 Project - IV (P-3)		9

Passed in Board of Studies meeting on 29.04.2023

Approved in 65th Academic Council meeting on 27.05.2023

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

List of Humanities and Social Sciences including Management Courses (9-12)

- Technical English (2)
- English Laboratory (1)
- Professional Communication (2)
- Project Management (3)
- Engineering Economics (3)

List of Basic Science Courses (24-27)

- Calculus for Engineers (4)
- Matrices and Linear Algebra (4)
- Probability and Statistics (4)
- Discrete Mathematics and Transformations (4)
- Physics (3)
- Chemistry (3)
- Physics Laboratory (1)
- Chemistry Laboratory (1)

List of Engineering Science Courses (21-27)

- Engineering Exploration (2)
- Problem Solving and Programming (3)
- System Programming (2)
- Engineering Graphics using CAD (3)
- Computer Systems Lab (1)
- Theory and Design of Programming Languages (3)
- Design Thinking (3)
- Modeling and Optimization (3)
- Theory of Computation (3)
- Human Computer Interaction (2)

List of Core Courses (55)

- Foundations of Computer Programming (3)
- Electronics and Digital Systems (3)
- Computer Organization and Architecture (3)
- Programming Lab (1)
- Object Oriented Programming (3)
- Object Oriented Programming Lab (1)
- Data Structures and Algorithms (3)
- Data Structures Lab (1)
- Operating Systems (4)
- Design and Analysis of Algorithms (3)
- Algorithms Lab (1)
- Database Management Systems (3)
- Databases Lab (1)
- Data Communication and Networks (3)

- Web Programming (3)
- Network Programming Lab (1)
- Artificial Intelligence (3)
- Artificial Intelligence Lab (1)
- Software Engineering (4)
- Cryptography and Network Security (3)
- Distributed Computing (3)
- Compiler Design (3)
- Distributed Computing Lab (1)

Programme Elective Courses (24 – 39)

- Programme Electives (27)

Open Elective Courses (OEC): (6 – 12)

- Interdisciplinary Elective (3)
- Basic Science Elective (3)

Project (12)

- Project – I (3)
- Project - II (3)
- Project – III (3)
- Project – IV (3)

B.E. COMPUTER SCIENCE AND ENGINEERING DEGREE PROGRAMME

CURRICULUM AND DETAILED SYLLABI

FOR

FIRST SEMESTER

FOR THE STUDENTS ADMITTED IN THE

ACADEMIC YEAR 2022-23 ONWARDS

THIAGARAJAR COLLEGE OF ENGINEERING
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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 2022-23 onwards)

FIRST SEMESTER

Course Code	Name of the Course	Category	No. of Hours / Week			credits
			L	T	P	
THEORY						
22MA110	Calculus for Engineers	BSC	3	1	-	4
22PH120	Physics	BSC	3	-	-	3
22CH130	Chemistry	BSC	3	-	-	3
22EG140	Technical English	HSMC	2	-	-	2
22CS150	Engineering Exploration	ESC	1	1	-	2
THEORY CUM PRACTICAL						
22CS160	Foundations of Computer Programming	PC	2	-	2	3
PRACTICAL						
22EG170	English Laboratory	HSMC	-	-	2	1
22PH180	Physics Laboratory	BSC	-	-	2	1
22CH190	Chemistry Laboratory	BSC	-	-	2	1
Total			**14**	**2**	**8**	**20**

BSC : Basic Science Courses
HSMC : Humanities and Social Sciences including Management Courses
ESC : Engineering Science Courses

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 2022-23 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	22MA110	Calculus for Engineers	3	40	60	100	27	50
2	22PH120	Physics	3	40	60	100	27	50
3	22CH130	Chemistry	3	40	60	100	27	50
4	22EG140	Technical English	3	40	60	100	27	50
5	22CS150	Engineering Exploration	3	40	60	100	27	50
THEORY CUM PRACTICAL								
6	22CS160	Foundations of Computer Programming	3 (Terminal Exam Type : Practical)	50	50	100	25	50
PRACTICAL								
7	22EG170	English Laboratory	3	60	40	100	18	50
8	22PH180	Physics Laboratory	3	60	40	100	18	50
9	22CH190	Chemistry Laboratory	3	60	40	100	18	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

22MA110	CALCULUS FOR ENGINEERS

Category	L	T	P	Credit
BSC	3	1	0	4

Preamble

This course aims to provide technical competence of modeling engineering problems using calculus. This course is implements the calculus concepts 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 model and 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

CO's	Course Outcomes	TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Cognize the concept of functions, limits and continuity	TPS2	75	70
CO2	Compute derivatives and apply them in solving engineering problems	TPS3	70	65
CO3	Employ partial derivatives to find maxima minima of functions of multi variables	TPS3	70	65
CO4	Demonstrate the techniques of integration to find the surface area of revolution of a curve.	TPS3	70	65
CO5	Utilize double integrals to evaluate area enclosed between two curves.	TPS3	70	65
CO6	Apply triple integrals to find volume enclosed between surfaces	TPS3	70	65

Mapping with Programme Outcomes

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

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

S- Strong; M-Medium; L-Low

Assessment Pattern

CO	Assessment 1						Assessment 2						Terminal (%)			
	Written Test 1 (%)			Assignment 1 (%)			Written Test 2 (%)			Assignment 2 (%)						
TPS	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**TOTAL (%)**
CO1	20%			50%			-			-			-	10%	-	10%
CO2	32%						-			-			-	-	16%	16%
CO3	36%						-			-			-	-	18%	18%
CO4	12%			-			39%			50%			-	-	25%	25%
CO5	-			-			35%						-	-	17%	17%
CO6	-			-			26%						-	-	14%	14%
MATLAB	-			50%			-			50%						
TOTAL	**100%**			**100%**			**100%**			**100%**			**-**	**10%**	**90%**	**100 %**

* Assignment 1: (i)Application Problems in CO1, CO2 and CO3 (50%).
(ii) MATLAB Onramp & Introduction to symbolic Math with MATLAB (50%).
**Assignment 2: (i) Application Problems in CO4, CO5 and CO6 (50%).
(ii) Application problems using MATLAB. (50%).
*******Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

Syllabus

DIFFERENTIAL CALCULUS

Functions - New functions from old functions - Limit of a function - Continuity - Limits at infinity - Derivative as a function - Maxima and Minima of functions of one variable – Mean value theorem - Effect of derivatives on the shape of a graph- Application problems in engineering using MATLAB.

FUNCTIONS OF SEVERAL VARIABLES

Function of several variables- Level curves and level surfaces - Partial derivatives – Chain rule - Maxima and minima of functions of two variables –Method of Lagrange's Multipliers - Application problems in engineering using MATLAB.[9 hours]

INTEGRAL CALCULUS:

The definite integral – Fundamental theorem of Calculus – Indefinite integrals and the Net Change Theorem – Improper integrals – Area of surface of revolution - Volume of solid of revolution -Application problems in engineering using MATLAB.

MULTIPLE INTEGRALS:

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 using MATLAB.

Text Books

1) James Stewart, "Calculus Early Transcendentals", 9e, Cengage Learning, New Delhi, 2019.

DIFFERENTIAL CALCULUS: [Sections: 1.3, 2.2, 2.5, 2,6,2.8, 4.1, 4.2 and 4.3.]

FUNCTIONS OF SEVERAL VARIABLES: [Sections: 14.1,14.3,14.5,14.7 and 14.8.]

INTEGRAL CALCULUS: [Sections: 5.2, 5.3, 5.4, 7.8, 8.2 and 6.2.]

MULTIPLE INTEGRAL: [Sections: 15.1-15.4, 15.6-15.9]

2) Lecture Notes on Calculus Through Engineering Application Problems and Solutions, Department of Mathematics, Thiagarajar College of Engineering, Madurai.

Reference Books and web resources

1. George B. Thomas, "Thomas Calculus: early Transcendentals", 14the ,Pearson, New Delhi, 2018.
2. Howard Anton, Irl Bivens and Stephen Davis, "Calculus: Early Transcendentals", 12the, John Wiley & Sons, 2021.
3. Kuldeep Singh, "Engineering Mathematics Through Appplications",2nde, Blooms berry publishing, 2019,
4. Kuldip S. Rattan, Nathan W. Klingbeil, Introductory Mathematics for Engineering Applications, 2nd e John Wiley&Sons , 2021.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Periods
1	**DIFFERENTIAL CALCULUS**	
1.1	Functions and New functions from old functions	2
1.2	Limit of a function &Continuity of a function	1

Module No.	Topic	No. of Periods
	Tutorial	1
1.3	Limits at infinity	1
1.4	Derivative as a function	2
	Tutorial	1
1.5	Maxima and Minima of functions of single variable	2
1.6	The Mean value theorem and effect of derivatives on the shape of a graph of a function	1
	Tutorial	1
1.7	Application problems in engineering using MATLAB	1
2	**FUNCTIONS OF SEVERAL VARIABLES**	
2.1	Level curves and level surfaces	2
2.2	Partial derivatives – Chain rule	1
	Tutorial	1
2.3	Maxima and minima of functions of two variables	2
2.4	Method of Lagrange's Multipliers	1
	Tutorial	1
2.5	Application problems in engineering using MATLAB	1
3	**INTEGRAL CALCULUS**	
3.1	The definite integral	1
3.2	Fundamental theorem of Calculus	2
	Tutorial	1
3.3	Indefinite integrals and the Net Change Theorem	1
3.4	Improper integrals	2
	Tutorial	1
3.5	Area of surface of revolution	1
3.6	Volume of solid of revolution.	2
3.7	Application problems in engineering using MATLAB	1
4	**MULTIPLE INTEGRALS**	
4.1	Iterated integrals	1
4.2	Double integrals over general regions	2
	Tutorial	1
4.3	Double integrals in polar coordinates	1
4.4	Applications of double integrals (density, mass, moments & moments of inertia problems only)	2
	Tutorial	1
4.5	Triple integrals	1
4.6	Triple integrals in cylindrical coordinates	1
4.7	Triple integrals in spherical coordinates	1
	Tutorial	1

Module No.	Topic	No. of Periods
4.8	Change of variables in multiple integrals	1
4.9	Application problems in engineering using MATLAB	1
	Total	**48**

Course Designer(s):

1. Dr.B.Vellaikannan bvkmat@tce.edu
2. Dr.C.S.Senthilkumarkumarstays@tce.edu
3. Dr.S.P.SuriyaPrabha suriyaprabha@tce.edu
4. Dr.S.Saravanakumar sskmat@tce.edu
5. Dr.M.Sundar msrmat@tce.edu

22PH120	**PHYSICS** **(Common to all branches)**	Category	L	T	P	Credit
		BSC	3	0	0	3

Preamble

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

Prerequisite

None

Course Outcomes

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

	Course Outcome	TCE Proficiency Scale	Expected Proficiency (%)	Expected Attainment Level (%)
CO1	Apply the vector calculus approach and Newton's law in polar coordinates to solve problems in mechanics	TPS3	85	80
CO2	Solve for the solutions and describe the behaviour of a damped harmonic oscillator and waves.	TPS3	85	80
CO3	Introduce Schrodinger equation to arrive at the energy values of particle in a box and linear harmonic oscillator	TPS3	85	80
CO4	Use the principle of quantum mechanics for quantum mechanical tunnelling, quantum confinement and quantum computation	TPS2	85	80
CO5	Use the laws of electrostatics and magnetostatics to explain electromagnetic wave propagation	TPS3	85	80
CO6	Explain the fundamentals of optical phenomena and its applications	TPS2	85	80

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

CO1	S	M	L	-	-	-	-	-	L	L	-	-
CO2	S	M	L	-	-	-	-	-	L	L	-	-
CO3	S	M	L	-	-	-	-	-	L	L	-	-
CO4	M	L		-	-	-	-	-	L	L	-	-
CO5	S	M	L	-	-	-	-	-	L	L	-	-
CO6	M	L										

S- Strong; M-Medium; L-Low

Assessment Pattern

	Assessment - I						Assessment - II						Terminal Exam (%)		
	CAT – I (%)			Assg. I * (%)			CAT – II (%)			Assg. II * (%)					
TPS Scale / CO	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**
CO1	8	15	22	100									6	6	10
CO2	8	10	15										4	3	10
CO3	4	5	13				-	-	15	100			-	2	15
CO4							4	15	-				4	6	-
CO5							-	-	35				-	3	15
CO6							16	15	-				6	10	-
Total	**20**	**30**	**50**	**100**			**20**	**30**	**50**	**100**			**20**	**30**	**50**

*Assignment I, II –Quiz/ Puzzle/ Case analysis/ Problem-solving/ Presentation/ Writing tasks

Syllabus

Mechanics of Particles:

Scalars and vectors under rotation transformation - Coordinate system - Cartesian, Polar, Spherical, Cylindrical - Newton's second law of motion - Forces in nature - Central forces - Conservative and non-conservative forces - Work - Energy theorem - Conservation of angular momentum - Satellite manoeuvres

Oscillations and Waves:

Simple harmonic oscillators - Energy decay in a Damped harmonic oscillator - Q factor- Impedance matching- Wave groups and group velocity - Non dispersive Transverse and Longitudinal waves - Waves with dispersion - Water waves - Acoustic waves - Earthquake and Tsunami waves

Quantum Mechanics:

Wave nature of particles - wave function - probability current density and expectation values - Schrodinger wave equation - Uncertainty principle - Particle in a box in 1D - Linear harmonic oscillator - Quantum tunnelling – Quantum confinement in 0D, 1D, 2D systems - Scanning tunnelling microscope - Quantum Cascade lasers - Quantum computation (qubit) - Entanglement - Teleportation

Electromagnetic Fields and Waves:

Electric potential and Electric field of a charged disc - Magnetic Vector potential - Maxwell's equation - Equation of continuity – Poynting Vector - Energy and momentum of EM waves - CT/MRI scan

Optics:

Ray paths in inhomogeneous medium and its solutions – Applications - Fibre optics - Numerical Aperture& Acceptance angle - Fibre optic sensors - Liquid Level & Medical Applications - Interference in non-reflecting films - Fabry-Perot interferometer - Diffraction - Fraunhofer diffraction due to double slit

Text Books

1. Principles of Physics, Halliday, Resnick and Jearl Walker, 9thEdition, Wiley, 2011.

2. PaulA.TiplerandG.Mosca,PhysicsforScientistsandEngineers,6thEdition,Freeman,2008.

Reference Books

MECHANICS OF PARTICLES

1. Paul A.Tipler and GeneMosca, Physics for Scientists and Engineers, 6thEdition, Freeman, 2008 (Chapters– 4, 9 & 10).
2. Manoj K. Harbola, Engineering Mechanics, 2ndEdition, Cengage, 2018.

OSCILLATIONS AND WAVES

1. Paul ATipler, Gene Mosca, Physics for Scientists and Engineers, 6thEdition, Freeman, 2008 (Chapters– 14 & 15).
2. HJ Pain, The Physics of Vibrations&Waves,6thEd., John Wiley 2005 (Ch. 2, 5, 6).

ELECTROMAGNETIC FIELDS AND WAVES

1. Principles of Physics, Halliday, Resnick and Jearl Walker, 9thEdition, Wiley, 2011 (Chapters - 23, 24, 32 & 33)
2. PMFishbane,Stephen G.Gasiorowicz, Stephen T Thornton, Physics for Scientists & Engineers with Modern Physics,3rdEdition,Pearson,2005(Chapters-26, 28, 31, 34).

OPTICS

1. Paul A.Tipler and Gene Mosca, Physics for Scientists and Engineers, 6thEdition, Freeman, 2008 (Chapters– 31 & 33).
2. Ajoy Ghatak, Optics, 5thEdition, Tata McGraw Hill, 2012 (Chapters – 3, 18, 20)

QUANTUM MECHANICS

1. Paul A.Tipler and GeneMosca, Physics for Scientists and Engineers, 6thEdition, Freeman, 2008 (Chapters– 34 & 35).
2. 2.StephenT.Thorntonand Andrew Rex, Modern Physics for Scientists and Engineers, 4th Edition, Cengage, 2013. (Chapters- 5 & 6).
3. R. Shankar, Fundamentals of Physics– I, II, Yale University Press, 2014, 2016.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Periods
1	**Mechanics of Particles**	**8**
1.1	Scalars and vectors under rotation transformation	2
1.2	Coordinate system - Cartesian, Polar, Spherical, Cylindrical	2
1.3	Newton's second law of motion - Forces in nature - Central forces	2
1.4	Conservative and non-conservative forces - Work - Energy theorem - Conservation of angular momentum - Satellite manoeuvres	2
2	**Oscillations and Waves**	**6**
2.1	Simple harmonic oscillators - Energy decay in a Damped harmonic oscillator	2
2.2	Q factor- Impedance matching – Wave groups and group velocity	2
2.3	Non-dispersive transverse and Longitudinal waves	1
2.4	Waves with dispersion- Water waves -Acoustic waves – Earthquake and Tsunami waves	1
3	**Quantum Mechanics**	**10**
3.1	Wave nature of particles - wave function -probability current density and expectation values -Uncertainty principle - Schrodinger wave equation	4
	CAT-I after 18 contact hours	
3.2	Applications - Particle in a box in 1D – Linear harmonic oscillator	2
3.3	Quantum tunnelling – Quantum confinement in 0D, 1D, 2D systems - Scanning tunnelling microscope – Quantum Cascade lasers – Quantum computation (qubit) – Entanglement - Teleportation	4

4	**Electromagnetic Fields and Waves**	**6**
4.1	Electric potential and Electric field of a charged disc	1
4.2	Magnetic Vector potential – Maxwell's Equations	2
4.3	Equation of continuity- Poynting vector - Energy and momentum of EM waves	2
4.4	CT/MRI scan	1
5	**Optics**	**6**
5.1	Ray paths in inhomogeneous medium & its solutions –Applications – Fiber optics	2
5.2	Numerical Aperture& Acceptance angle - Fiber optic sensors - Liquid Level & Medical Applications	2
5.3	Interference in non-reflecting films - Fabry- Perot interferometer - Diffraction - Two slit Fraunhoffer diffraction	2
	CAT-II after 18 contact hours	
	Total	**36**

Course Designers:

1. Dr. M Mahendran, Professor, mahendran@tce.edu
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3. Dr. A LSubramaniyan, Assistant Professor, alsphy@tce.edu
4. Dr. A Karuppasamy, Assistant Professor, akphy@tce.edu

22CH130	CHEMISTRY

Category	L	T	P	Credit
BSC	3	0	0	3

Preamble

The objective of this course is to bestow basic concepts of chemistry and its applications in engineering domain. It imparts knowledge on properties and treatment methods of water, spectroscopic techniques and their applications. This course provides exposure on electrochemical techniques for corrosion control, surface coatings and energy storage devices and also emphasis the properties and applications of engineering materials.

Prerequisite

Nil

Course Outcomes

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

CO	Course Outcome	TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Explain the essential water quality parameters of water	TPS2	70	70
CO2	Determine hardness of water and identify suitable water treatment method	TPS3	70	70
CO3	Explain the electrochemical process involved in energy storage devices and corrosion of metals	TPS2	70	70
CO4	Interpret the electrochemical principles in modern energy storage devices and corrosion control methods	TPS3	70	70
CO5	Identify the appropriate spectroscopic technique for various applications	TPS3	70	70
CO6	Select the materials based on the properties for Engineering applications	TPS3	70	70

Mapping with Programme Outcomes

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

S- Strong; M-Medium; L-Low

Assessment Pattern

CO	CAT1						CAT2						Terminal					
TPS Scale	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
CO1	4	20	0										2	8				
CO2	4	0	20										2	4	10			
CO3	4	20	0										2	8				
CO4	8	0	20										2	4	10			
CO5							12	20	20				6	8	10			
CO6							8	20	20				6	8	10			

*****Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

CO	Assignment 1*						Assignment 2*					
TPS Scale	1	2	3	4	5	6	1	2	3	4	5	6
CO1												
CO2			20									
CO3												
CO4			20									
CO5									20			
CO6									20			

*Assessment type: Quiz / Test /Presentation

Syllabus

Water: Water-sources- physical - characteristics - alkalinity - hardness of water – types - determination of hardness by EDTA method. Boiler trouble-Softening of water: Internal and External treatment methods. Waste water treatment process. **Electrochemical technologies for energy storage and surface engineering:** Electrochemistry and Energy storage: Basics of electrochemistry. Batteries **-** Primary and Secondary batteries. Fuel cells.Hydrogen generation and storage. Corrosion and Surface Engineering–Basics –Corrosion - causes-factors- types - corrosion of metal and computer components- Corrosion control. Electroplating - Electroless process. **Spectroscopic technique and applications:** Principle, instrumentation, and applications: X-ray-diffraction - UV–Visible spectroscopy- Atomic Absorption Spectroscopy - Fluorescence spectroscopy - Inductively Coupled Plasma - Optical Emission Spectroscopy- Infra-red spectroscopy - Nuclear magnetic resonance spectroscopy**. Engineering materials:** Bonding and their influences on the property of materials - melting point - brittleness, ductility – thermal, electrical, and ionic conductivity - optical – magnetic properties, hydrophobic, hydrophilic. **Polymer composites** - structure and properties-applications.**Ceramics and advanced ceramics** - types-properties-applications-**Nano-materials** – Synthesis, structure, and properties –applications.

Text Book

1. P.C. Jain and Monica Jain, A Textbook of Engineering Chemistry, DhanpatRai publications, New Delhi, 16thedition, 2015.

Reference Books & web resources

1. S.S. Dara and S.S. Umare, "A Textbook of Engineering Chemistry", S.Chand& Company, 12thEdition, Reprint, 2013.
2. ShashiChawla, " A text book of Engineering Chemistry", DhanpatRai& Co.(pvt) ltd, 3rd edition, reprint 2011.
3. C. N. Banwell and E.M. McCash, "Fundamentals of Molecular Spectroscopy", Tata McGraw-Hill (India), 5thEdition, 2013.
4. W.F. Smith, Principles of Materials Science and Engineering: An Introduction; Tata Mc-Graw Hill, 2008.
5. V. Raghavan, Introduction to Materials Science and Engineering; PHI, Delhi, 2005.
6. M. Akay, 2015, An introduction to polymer matrix composites," from: https://www.academia.edu/37778336/An_introduction_to_polymer_matrix_composites

Course Contents and Lecture Schedule

Module No.	Topic	No. of Periods
1	**Water**	
1.1	Importance of water, sources, standards for drinking water, (WHO, BIS & ICMR standards) physical, chemical & biological characteristics, Alkalinity (principle only)	1
1.2	Hardness of water - types, units. Determination of hardness by EDTA method and numerical problems	2
1.3	**boiler trouble:** Scale and sludge formation, boiler corrosion, priming and foaming, caustic embrittlement	1
1.4	**Internal treatment methods:** Carbonate, Phosphate, Colloidal, Calgon conditioning	1
1.5	**softening of water:** External treatment methods:Lime-soda process (concept only), zeolite process,ion exchange process	2
1.6	Desalination- reverse osmosis, electro dialysis, solar and multistage flash distillation, nano-filtration	1
1.7	Waste water treatment – primary, secondary, and tertiary treatment	1
2	**Electrochemical technologies for energy storage and surface engineering**	
2.1	**Electrochemistry and Energy storage**: Introduction**–** Basics of electrochemistry – Redox process, EMF	1
2.2	**Energy storage** – Batteries, Battery quality parameters	1
2.3	Primary battery – Dry cell and Alkaline cell	1
2.4	Secondary battery – Lead-acid battery, Lithium-ion battery	1

Module No.	Topic	No. of Periods
2.5	Fuel cells – Fundamentals, types and applications. Hydrogen generation and storage	1
2.6	**Corrosion and Surface Engineering**- Basics – Corrosion - causes- factors- types	1
2.7	chemical, electrochemical corrosion (galvanic, differential aeration), corrosion of metal and computer components-	1
2.8	Corrosion control - material selection and design aspects - electrochemical protection – sacrificial anode method and impressed current cathodic method	1
2.9	Electroplating –Introduction, Process, Applications (Gold and nickel plating). Electroless plating – Principle, process, Applications (PCB manufacturing)	1
3	**Spectroscopic technique and applications**	
3.1	Introduction to Electromagnetic Radiation, Types of atomic and molecular spectra	1
3.2	***Principle, Instrumentation and Applications:*** X-ray-diffraction	1
3.3	UV–Visible spectroscopy,Atomic Absorption Spectroscopy	2
3.4	Fluorescence spectroscopy, Inductively Coupled Plasma - Optical Emission Spectroscopy	2
3.5	Infra-red spectroscopy	2
3.6	Nuclear magnetic resonance spectroscopy – Magnetic resonance imaging	1
4	**Engineering materials**	
4.1	Bonding and its influence on the property of materials	1
4.2	Properties of materials- melting point - brittleness, ductility - thermal, electrical and ionicconductivity	1
4.3	optical – magnetic properties, hydrophobic, hydrophilic	1
4.4	**Polymer composites** - structure and properties	1
4.5	applications -automotive, aerospace, marine, biomedical, and defense	1
4.6	**Ceramics and advanced ceramics** - types- properties	1
4.7	applications- medicine, electrical, electronics, space	1

Module No.	Topic	No. of Periods
4.8	**Nano-materials** – Synthesis, structure and properties	1
4.9	applications - sensors, drug delivery, photo and electro-catalysis, and pollution control	1
	Total	36

Course Designer(s):

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22EG140	TECHNICAL ENGLISH

Category	L	T	P	Credit
HSMC	2	0	0	2

Preamble

The course aims at fostering the students' ability to communicate effectively in various academic, professional, and social settings through oral and written forms. Besides imparting the basic skills such as Listening, Speaking, Reading and Writing (LSRW), significant emphasis is placed on enriching their analytical, descriptive, and creative skills, enabling them to develop and demonstrate a holistic English language proficiency.

Prerequisite

- NIL

Course Outcomes

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

COs	Course Outcomes	TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Relate the fundamentals of language in terms of vocabulary, grammar and pronunciation in technical communication.	Understand	60%	70%
CO2	Infer ideas from technical and general contexts by identifying main ideas, specific details, predicting and note-making.	Understand	60%	70%
CO3	Make use of language in professional and social contexts with clarity and conciseness.	Apply	60%	70%
CO4	Identify specific contexts in technical writing, where appropriate lexical and grammatical functions are applied	Apply	60%	70%
CO5	Develop the skills such as understanding, evaluating, analysing and summarising the text and graphical representations.	Apply	60%	70%
CO6	Organise ideas with coherence, cohesion and precision in formal written	Apply	70%	80%

Mapping with Programme Outcomes

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

CO5									M	S		S
CO6								L	M	S		S
S- Strong; M-Medium; L-Low												

Assessment Pattern

CO	Assessment 1						Assessment 2						Terminal (%)		
	Written Test 1 (%)			Assignment 1 (%)			Written Test 2 (%)			Assignment 2 (%)					
TPS	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**
CO1		24%		100%						-			-	10%	-
CO2		34%								-			-	20%	
CO3			14%						24%	-			-	-	20%
CO4			14%	-					34%	100%			-	-	10%
CO5			14%	-									-	-	20%
CO6				-					42%				-	-	20%
TOTAL	**100%**			**100%**			**100%**			**100%**			**100%**		

* Assignment 1:Speaking activities in CO1, CO2, and CO3 (100%).
**Assignment 2: Writing activities in CO4, CO5, and CO6 (100%).
***Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

Syllabus:

MODULE- I - Basics of Language (CO1)

Vocabulary - Word Building, Prefix, Suffix and Root Words, Basics of Grammar – Parts of Speech, Tenses, Phonetics - Phonemes, Syllables and Stress.

MODULE- II – Reading (CO2)

Reading - Skimming and Scanning of Short Comprehension Passages and Answering Questions or Cloze exercises based on the text prescribed for extensive reading, Note-Making.

MODULE- III – Functional English (CO3)

Framing Questions (WH and Yes/No), Modals, Manual Writing, Recommendations Writing, Agenda and Minutes of Meeting.

MODULE-IV – Technical Notions (CO4)

Technical Notions - Subject-Verb Agreement, Relative Clause, Phrasal Verbs, Impersonal Passive Voice, Noun Compounds, Classifications and Definitions, Cause and Effect, Purpose and Function, Numerical Adjectives.

MODULE-V – Analytical Writing and Business Correspondence (CO5 & CO6)

Summary Writing, Interpretation of Graphics, Jumbled Sentences, Paragraph Writing, Formal Letters (Seeking Permission for Industrial Visit/internship/Bonafide), E-mail Writing (BEC Vantage Writing Task I)

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,2013.
4. Dhanavel, S.P. English and Communication Skills for Students of Science & Engineering, Orient BlackSwan, Chennai: 2016.
5. Swan, Michael.Practical English Usage.4thEdn. OUP. 2017.
6. Elbow, Peter. Writing with Power: Techniques for Mastering the Writing Process. New York, Oxford University Press, 1998.

Extensive Reading:

1. Anthology of Select Five Short Stories
2. Tagore, Rabindranath. *Chitra, a Play in One Act.* London, Macmillan and Co., 1914

Websites:

1. www.englishclub.com
2. owl.english.purdue.edu
3. www.oxfordonlineenglish.com
4. www.bbclearningenglish.com
5. tcesrenglish.blogspot.com

Course Contents and Lecture Schedule

S.No	Topic	No. of Hours
1.	Word Building, Prefix, Suffix and Root Words	1
2.	Parts of Speech	1
3.	Tenses	1
4.	Skimming and Scanning of Short Comprehension Passages	1
5.	Manual Writing	1
6.	Recommendations	1
7.	Note-Making	1
8.	Subject-Verb Agreement	1
9.	Phonemes	1
10.	Syllables and Stress	1
11.	Answering Questions or Cloze exercises based on the text prescribed for extensive reading	1

12.	Noun Compounds, Classifications and Definitions	1
13.	Summary Writing	1
14.	Interpretation of Graphics	1
15.	Cause and Effect, Purpose and Function	1
16.	Jumbled Sentences	1
17.	Formal Letters (Seeking Permission for Industrial Visit/internship/ Bonafide)	1
18.	Phrasal Verbs and Impersonal Passive Voice	1
19.	Numerical Adjectives	1
20.	Framing Questions (WH and Yes/No) and Modals	1
21.	Agenda and Minutes of Meeting	1
22.	Relative Clause	1
23.	E-mail Writing (BEC Vantage Writing Task I)	1
24.	Paragraph Writing	1
Total		**24**

Course Designers:

1. Dr.A.Tamilselvi tamilselvi@tce.edu
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3. Dr. G. JeyaJeevakani gjjeng@tce.edu
4. Dr. R. Tamil Selvi rtseng@tce.edu
5. Mrs. M. Sarpparaje mseeng@tce.edu

22CS150	ENGINEERING EXPLORATION

Category	L	T	P	Credit
ESC	1	1	-	2

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

CO	Course Outcome	TCE Proficiency Scale	Expected Proficiency	Expected Attainment
CO1	Explain technological & engineering development, change and impacts of engineering	TPS2	70	70
CO2	Draw a product in enough detail that others can accurately build it and write specification sheet for a given product	TPS3	70	70
CO3	Complete initial steps (Define a problem, list criteria and constraints, brainstorm potential solutions and document the ideas) in engineering design process	TPS3	70	70
CO4	Draw sketches to a design problem and provide a trade-off matrix	TPS3	70	70
CO5	Communicate possible solutions through drawings, modelling and Testing Final output	TPS3	70	70
CO6	Apply the concept of engineering fundamentals in Electrical and Computer Engineering	TPS3	70	70

Mapping with Programme Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C01	M	L	-	-	-	-	-	-	-	-	-	-	L	-	-
C02	S	M	L	-	-	-	-	-	-	-	-	-	M	-	-
C03	S	M	L	-	-	-	-	-	-	-	-	-	M	-	-
C04	S	M	L	-	-	-	-	-	-	-	-	-	M	-	-
C05	S	M	L	-	-	-	-	-	-	-	-	-	M	-	-

C06	S	M	L	-	-	-	-	-	-	-	-	-	M	-	-

S- Strong; M-Medium; L-Low

Assessment Pattern

CO	Worksheet-1			Worksheet-2			CAT			Terminal (Theory)
TPS Scale	1	2	3	1	2	3	1	2	3	
CO1	5	20							5	10
CO2		5	20						5	10
CO3				5	20				10	20
CO4					5	20			10	20
CO5									10	20
CO6									10	20

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. **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

No.	Topic	No. of Lectures
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.	**Electrical Engineering:**	
6.1	Reading analog multimeter, measuring current, voltage and resistance	1
6.2	electricity from chemicals, solar cells, magnets	1
6.3	Ohms law and watts law, circuit identification and circuit calculation	2
6.4	resistor color code, continuity	1
7	**Computer Engineering**	
7.1	Logic gates, algorithms,	1
7.2	computer architecture,	1
7.3	binary code	1
	Total	24

Course Designers:

1. Mr. M.Sivakumar mskcse@tce.edu

22CS160	FOUNDATIONS OF COMPUTER PROGRAMMING	Category	L	T	P	Credit
		PC	2	-	2	3

Terminal Exam: Practical

Preamble

The course on computer programming is intended to introduce the students to computational thinking, Python programming and constructs of programming. The course aims to provide exposure to solve the problems through Python programming. It aims to train the student to the fundamental concepts of the Python programming language. This course has a lab component which is designed to give the student hands-on experience with the concepts.

Prerequisite

NIL

Course Outcomes

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

CO. No	Course Outcomes (COs)	TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Practice the basics of Procedural programming using Python	TPS3	70	85
CO2	Solve the problems using basic data types, operators and expressions.	TPS3	70	85
CO3	Appreciate the usage of collections, Array techniques in Python to solve problems.	TPS3	70	85
CO4	Make use of appropriate control structure to solve engineering problems.	TPS3	70	85
CO5	Demonstrate the Python functions, scoping, recursion and functions as modules to develop simple applications	TPS3	70	85
CO6	Take part in real life problem solving using Python programming.	TPS4	70	80

Mapping with Programme 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	L	M	L	L
CO2.	S	M	L	L	L			L	L	L	L	L	M	L	L
CO3	S	M	L	L	L			L	L	L	L	L	M	L	L
CO4	S	M	L	L	L			L	L	L	L	L	M	L	L
CO5.	S	M	L	L	L			L	L	L	L	L	M	L	L
CO6	S	M	L	L	L			L	L	L	L	L	M	L	L

S- Strong; M-Medium; L-Low

Assessment Pattern

CO	CAT 1(Theory Component)						CAT 2 (Practical Component)						Terminal (Practical Component)					
	100						100						100					
TPS Scale	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
CO1	5	10	15											5	10			
CO2	5	10	20											5	10			
CO3	5	10	20											10	10			
CO4								10	20					5	10			
CO5								10	20					5	10			
CO6								10	20	10					10	10		

CO	Assignment 1*					
TPS Scale	1	2	3	4	5	6
CO1			30			
CO2			30			
CO3			40			
CO4						
CO5						
CO6						

Syllabus

Procedural Programming and Python Programming - Fundamentals of Computing- Problems-Pseudo-code and flowcharts- Memory and Programs-Python Programming Language –Alternate Implementations-Highlights- Setting Up Python Programming Environment- Python on Different Operating Systems -Creating and Running Python Program

Variables and simple Data Types- Identifiers and Keywords – Strings- Numbers-Comments-User Input-Operators and expressions- operator precedence – Boolean expression – expression evaluation

Collection Data Types and Array Techniques – Lists- Numerical List-Tuples - Sets and Frozen Sets -Mapping Types - Dictionaries - Changing, Adding, Removing, Slicing Elements-Avoiding Errors in collections- **Array Techniques -**Counting, reversal, partitioning and removal of duplicates in an array

Control Structures - Conditional Tests- if Statements Looping- for and while -Nesting-Control Statements – break, continue and pass- Iterating and Copying Collections

Functions and Modules -Defining a Function- Function Arguments-Return Values- Passing an Arbitrary Number of Arguments- scoping – specifications – recursion – Fibonacci numbers

– palindromes – global Variables- Modules and Packages- Overview of Python's Standard Library

File Handling -Classes and objects -Projects - Writing and Reading Binary Data - Writing and Parsing Text Files- Writing and Parsing XML Files- Random Access Binary Files-**Classes and objects -Projects**

Text Books

1. Eric Matthes , "Python Crash Course A Hands-On , Project - Based Introduction to Programming", No Starch Press, Inc. 2nd Edition,2019
2. Mark Summerfield, "Programming in Python 3: A Complete Introduction to the Python Language", Pearson Education, 2nd Edition, 2018

Reference Books& web resources

1. Mark Lutz, "Python Pocket Reference", O Reilly, Fifth Edition, 2014
2. Zed Shaw, "Learn Python the Hard Way" Addison-Wesley, 2013.
3. Martin C. Brown, "Python: The Complete Reference ",McGraw Hill,2018.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Lectures	Course Outcome
1	**Procedural Programming and Python Programming**		
1.1	Fundamentals of Computing- Problems-Pseudo-code and flowcharts- Memory and Programs-	1	CO1
1.2	Python Programming Language –Alternate Implementations-Highlights	1	CO1
1.3	Setting Up Python Programming Environment-Python on Different Operating Systems -Creating and Running Python Program	1	CO1
2	**Variables and simple Data Types**		
2.1	Identifiers and Keywords – Strings- Numbers-Comments	1	CO2
2.2	User Input-Operators and expressions- operator precedence	1	CO2
2.3	Boolean expression – expression evaluation	1	CO2
3	**Collection Data Types and Array Techniques**		
3.1	Lists- Numerical List-Tuples - Sets and Frozen Sets	2	CO3
3.2	Mapping Types - Dictionaries - Changing, Adding, Removing, Slicing Elements-Avoiding Errors in collections	1	CO3
3.3	**Array Techniques -**Counting, reversal, partitioning and removal of duplicates in an array	1	CO3
4	**Control Structures**		
4.1	Conditional Tests- if Statements Looping- for and while -Nesting-	1	CO4
4.2	Control Statements – break, continue and pass-	1	CO4
4.3	Iterating and Copying Collections		
5	**Functions and Modules**		
5.1	Defining a Function- Function Arguments-Return Values- Passing an Arbitrary Number of Arguments	1	CO5

Module No.	Topic	No. of Lectures	Course Outcome
5.2	Scoping – abstractions – Recursion – Fibonacci numbers – palindromes	1	CO5
5.3	Modules and Packages- Overview of Python's Standard Library- global Variables	1	CO5
6	**File Handling -Classes and objects -Projects**		
6.1	Writing and Reading Binary Data - Writing and Parsing Text Files- Writing and Parsing XML Files- Random Access Binary Files-	2	CO6
6.2	**Classes and objects -Projects**	1	CO6
	Total Hours	**24**	

Course Contents and Lecture Schedule for Laboratory

Module No.	Topic	No. of Lectures	Course Outcome
1.	Write a Python program using basic datatypes	2	CO1
2.	Write a Python program to display multiple variables using operators and expressions	2	CO1
3.	Develop a Python Program for number conversions	2	CO2
4.	Demonstrate a Python Program for String manipulations	2	CO2
5.	Implement all the collections in Python	2	CO3
6.	Write a Python program to perform Array Techniques	2	CO3
7.	Write a Python Program using different types of function call to find Prime number, generate Fibonacci series, sorting and searching etc.	2	CO4
8.	Create a Python module for recursive functions.	2	CO4
9.	Write a program in Python for various file handling	2	CO5
10.	Write a Python Program for implementing classes and objects	2	CO5
11.	Mini project	4	CO1, CO2, CO3, CO4, CO5, CO6
	Total Hours	**24**	

Course Designers:

1. Dr.S.Prasanna sprcse@tce.edu
2. Dr.M.P.Ramkumar ramkumar@tce.edu
3. Dr.M.Nirmala Devi mnit@tce.edu

22EG170	ENGLISH LABORATORY	Category	L	T	P	Credit
		HSMC	0	0	2	1

Preamble

This practical course enables the students to develop and evaluate their basic English language skills through individualized learning process at the Language Lab, using English Software and online resources. In addition, it 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

COs	Course Outcomes	TCE Proficiency Scale
CO1	Interpret words correctly through listening and watching general and technical online contents	Understand
CO2	Develop appropriate pronunciation skills through listening and speaking practices	Apply
CO3	Build and apply a wide range of lexicons in general and technical presentations	Apply
CO4	Identify and apply the key ideas and spoken English features learnt through auditory and visual listening tools	Apply
CO5	Experiment with inventiveness by creating a blog, vlog, or YouTube channel.	Apply
CO6	Prepare and deliver oral and written presentations using digital tools.	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

Students' performance will be assessed in the language lab/ classroom as given below:

- Spoken Task - General / Technical Presentation / Picture Description: 20 Marks
- Listening Task –(MCQs, Gap Filling Exercises) : 10 Marks
- Written Test - Phonetics, Grammar, Vocabulary, Reading : 20 Marks

External: Online Exam- Phonetics, Grammar, Vocabulary, Reading (45 Minutes): 50 Marks

Listening Test : 20 Marks

Submission of Students' Record on Practical Tasks in the Class and Lab :10 Marks

BEC Vantage Speaking Tasks I and II : 20 Marks

List of Experiments

S.No	Topic	Hours
	LAB ACTIVITIES (12 Hours)	
1	Listening to TED Talks/ Podcasts/ Product Advertisements/ NewsBulletins.	2
2	Phonetics – Tutorials through Online Repositories, English Movie Clips and Software in the Lab(S-net)	2
3	Vocabulary Development through Movies / Short Films/ Documentaries	2
4	Language Development through English softwareS-net and Online Content (Te Voices, SV Agreement, Prepositions, Coherence Markers, Relative Clauses, M Punctuation)	2
5	Reading Comprehension – I (General / Technical, BEC Vantage Reading Task	2
6	Creating a Blog/Vlog/YouTube Channel –Uploading MP3/MP4 – Practice (Movie/Book/ Gadget Review, General/Tech Talks, Interview with Celebrities)	1
7	Revision – Model Online Aptitude Test	1
	CLASSROOM ACTIVITIES (12 Hours)	
8	Introduction of Spoken English Features	1
9	Self-introduction and Introducing others	1
10	Video Comprehension – Brainstorming and Note-Taking	2
11	Role-Play, Picture/Movie Description	1
12	Reporting the events from Media / Newspapers – Discussion	1
13	Interactive Games for Language Development	1
14	Reading / Note Making (Extensive Reading – News Paper Reports)	1
15	Presentation – I (Book /Movie Review, Story Telling, General Presentations)	2
16	Presentation – II (Technical Presentations)	2
	Total	24

Software Used:

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

Teaching Resources and Websites:

1. Open Online Repositories from Oxford / Cambridge / British Council/ Voice of America
2. Free Video Downloads from YouTube
3. www.ted.com
4. tcesrenglish.blogspot.com

Course Designers:

1	Dr.A.Tamilselvi	tamilselvi@tce.edu
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4	Mrs. M. Sarpparaje	mseeng@tce.edu

22PH180	PHYSICS LABORATORY

Category	L	T	P	Credit
BSC	0	0	2	1

Preamble

This course ensures that students are able 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.

Prerequisite

- None

Course Outcomes

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

	Course Outcome	TCE Proficiency Scale	Expected Proficiency (%)	Expected Attainment Level (%)
CO1	Analyze the mechanical & electrical oscillations and determine their resonance frequency	TPS3	85	90
CO2	Analyse the interference and diffraction patterns for micron sized objects	TPS3	85	90
CO3	Investigate the V-I characteristics of photodiode, phototransistor under dark and bright illumination conditions	TPS3	85	90
CO4	Determine the Planck's constant using LEDs	TPS3	85	90
CO5	Plot the VI characteristics of solar cell and find the fill factor	TPS3	85	90
CO6	Determine the reversibility of classical and quantum logic gates	TPS3	85	90
CO7	Identify the variation of magnetic field with distance for circular coils	TPS3	85	90

Mapping with Programme Outcomes

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

CO7	S	M	L	-	M	-	-	-	S	-	-	L

S- Strong; M-Medium; L-Low

LIST OF EXPERIMENTS

1. Quantum Logic Gate-Toffoli gate
2. Study of Optoelectronic Devices- Photodiode, Phototransistor.
3. Solar cell VI characteristics,fill factor & Optical fibre-Determination of numerical aperture.
4. Torsional pendulum – Determination of rigidity modulus of wire and moment of inertia of regular objects.
5. Laser Diffraction - Determination of wave length of the laser using grating and determination of micro particle size.(Observing diffraction pattern due to single and double slit)
6. Air wedge – Determination of thickness of a thin sheet/wire.
7. Determination of Planck's constant through V-I characteristics of LED.
8. Determination of magnetic field-Stewart and Gees.
9. LCR Circuit – Determination of resonant frequency

Course Designer(s):

1. Dr. N. Sankarasubramanian nssphy@tce.edu
2. Dr. A.L .Subramaniyanalsphy@tce.edu
3. Dr.P.K.Kannan akphy@ce.edu

22CH190	CHEMISTRY LABORATORY (Common to all branches)

Category	L	T	P	Credit
BSC	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.

Prerequisite

Nil

Course Outcomes

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

CO	Course Outcome	TCE Proficiency Scale
CO1	Estimate the chemical water quality parameters of sample water / effluent	Apply
CO2	Demonstrate presence of calcium ions in milk sample	Apply
CO3	Determine the surface tension of solvent mixtures	Apply
CO4	Estimate pH and acid content of samples using pH metric and conduct metric titrations	Apply
CO5	Illustrate the strength of oxidisable materials present in given sample by potentiometric method	Apply
CO6	Determine Fe^{2+} ion in effluent using colorimetric method	Apply
CO7	Calculate the efficiency of electroplating	Apply
CO8	Determine the rate of corrosion of metal & alloy using potentio-dynamic polarisation method	Apply

Mapping with Programme Outcomes

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

S- Strong; M-Medium; L-Low

List of Experiments/Activities with CO Mapping

Experimental List	CO
Quantitative Analysis	
Estimation of total hardness of water sample	CO1
Estimation of COD of industrial effluent	CO1
Determination of calciumion inmilk sample	CO2
Determination of surface tension of solvent mixture	CO3
Electrochemical and Photochemical Analysis	
Determination of the Phosphoric acid content in soft drinks using conductometric titration	CO4
Determination of pH of soil by pH metric titration	CO4
Potentiometric redox titration ($K_2Cr_2O_7$vs FAS, $KMnO_4$vs FAS)	CO5
Estimation of iron content in water sample using colorimeter	CO6
Estimation of current density of electroplating process using Hull cell	CO7
Determination of rate of corrosion of metal and alloy using potentiodynamic polarisation technique (TAFEL)	CO8

Learning Resources

1. Vogel's Textbook of Quantitative Chemical Analysis (8^{TH}edition, 2014)
2. LaboratoryManual – Department of Chemistry, Thiagarajar College of Engineering (2022)

Course Designers:

1. Dr.M.Kottaisamy hodchem@tce.edu
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CURRICULUM AND DETAILED SYLLABI

FOR

B.E DEGREE (Computer Science and Engineering) PROGRAMME

SECOND SEMESTER

FOR THE STUDENTS ADMITTED FROM THE

ACADEMIC YEAR 2022 - 2023 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. / B.Tech. Degree Programmes

COURSES OF STUDY
(For the candidates admitted from 2022-23 onwards)

SECOND SEMESTER

Course Code	Name of the Course	Category	No. of Hours / Week			credits
			L	T	P	
THEORY						
22CS210	Matrices and Linear Algebra	BSC	3	1	-	4
22CS220	Electronics and Digital Systems	PC	2	1	-	3
22CS230	Computer Organization and Architecture	PC	3	-	-	3
22CS240	Problem Solving and Programming	ESC	3	-	-	3
22CS250	System Programming	ESC	2	-	-	2
THEORY CUM PRACTICAL						
22CS260	Engineering Graphics and Extended Reality	ESC	1	-	4	3
PRACTICAL						
22CS270	Computer Systems Lab	ESC	-	-	2	1
22CS280	Programming Lab	PC	-	-	2	1
AUDIT COURSE						
22CHAA0	Environmental Science	AC				-
Total			**14**	**2**	**8**	**20**

BSC : Basic Science Courses
PC : Professional Core Courses
ESC : Engineering Science Courses
AC : Audit Course

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 2022-23 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	22CS210	Matrices and Linear Algebra	3	40	60	100	27	50
2	22CS220	Electronics and Digital Systems	3	40	60	100	27	50
3	22CS230	Computer Organization and Architecture	3	40	60	100	27	50
4	22CS240	Problem Solving and Programming	3	40	60	100	27	50
5	22CS250	System Programming	3	40	60	100	27	50
THEORY CUM PRACTICAL								
6	22CS260	Engineering Graphics and Extended Reality (Terminal Exam: Practical)	3	50	50	100	22.5	50
PRACTICAL								
7	22CS270	Computer Systems Lab	3	60	40	100	18	50
8	22CS280	Programming Lab	3	60	40	100	18	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.

		Category	L	T	P	Credit
22CS210	**MATRICES AND LINEAR ALGEBRA**	BSC	3	1	0	4

Preamble

This course introduces the concept of vector space, which is a unifying abstract framework for studying linear operations involving a diverse set of mathematical objects such as vector space, matrices, and functions. Students learn to use the concepts of basis and linear transformations to operate within and between vector spaces. They can perform approximations and orthogonal projections and construct an orthonormal basis for vector spaces. Moreover, this course demonstrates procedure to solve linear and non-linear system of equations.

Prerequisite

- Nil

Course Outcomes

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

		TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Evaluate basis and dimension of a vector space	TPS3	B	60
CO2	Compute the orthonormal basis of an inner product space given a basis	TPS3	B	60
CO3	Represent linear transformations by a matrix and hence verify their similarity	TPS3	B	60
CO4	Compute the Eigen value of a matrix and hence its singular value decomposition and generalised inverse	TPS3	B	60
CO5	Solve linear system of equations using matrices.	TPS3	B	60
CO6	Compute the solution of non-linear systems.	TPS3	B	60

Mapping with Programme Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1.	S	M	L		M			L	M	L		M	M	L	L
CO2.	S	M	L		M			L	M	L		M	M	L	L
CO3.	S	M	L		M			L	M	L		M	M	L	L
CO4	S	M	L		M			L	M	L		M	M	L	L
CO5	S	M	L		M			L	M	L		M	M	L	L
CO6	S	M	L		M			L	M	L		M	M	L	L

S- Strong; M-Medium; L-Low

Assessment Pattern

CO	Assessment 1						Assessment 2						Terminal (%)		
	CAT 1 (%)			Assignment 1 (%)			CAT 2 (%)			Assignment 2 (%)					
TPS	1 10	2 30	3 60	1 -	2 -	3 100	1 10	2 30	3 60	1 -	2 -	3 100	1 -	2 30	3 70
CO1	5	15	30	-	-	50	-	-	-	-	-	-		12	14
CO2	5	15	30	-	-	50	-	-	-	-	-	-		9	14
CO3	-	-	-	-	-	-	3	10	14	-	-	26		-	14
CO4	-	-	-	-	-	-	7	10	22	-	-	42		9	14
CO5	-	-	-	-	-	-		5	12	-	-	16		-	7
CO6	-	-	-	-	-	-		5	12	-	-	16		-	7
TOTAL	10	30	60	-	-	100	10	30	60	-	-	100	-	30	70

*****Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

Syllabus

Vector Spaces: Vector space - Definition and Examples, Subspaces, Linearly Independence, Basis and Dimension, Row space and Column spaces.

Orthogonality: The scalar Product in $\mathbf{R^n}$ **-** Orthogonal Subspaces- Inner Product spaces, Orthonormal sets - Gram-Schmidt process.

Linear Transformations: Linear Transformations-Definitions and Examples - Matrix Representations of Linear Transformations -Similarity.

Eigen systems: Eigen values of Matrices and Eigen vectors of Matrices–Diagonalization of Matrices – The Singular Value Decomposition (SVD) of Matrices –The eigen value problem of Matrices – Generalized inverse of Matrices.

Linear Systems: System of linear Equations-Row Echelon forms - Gauss Elimination. **Nonlinear systems:** System of Non-Linear Equations - Fixed point iteration- Newton Raphson Method - Nonlinear system of Equations-Gauss Jordan method.

Text Books

1. Steven J. Leon., “Linear Algebra with Application” Ninth Edition, Pearson, 2015.

2. Steven C. Chapra& Raymond P. Canale., Numerical Methods for Engineers. 7th Edition, McGraw Hill Publications. 2015.

Reference Books& web resources

1. David C.Lay., "Linear Algebra And Its Applications" 5th Edition, 2015.
2. Gilbert Strang., "Introduction to Linear Algebra" 5th Edition, 2016.

Course Contents and Lecture Schedule

Module No.	Topic	No. of. Lectures
1	**VECTOR SPACES**	
1.1	Vector space-Definition and Examples	1
1.2	Subspaces	2
	Tutorial	1
1.3	Linearly Independence	2
1.4	Basis and Dimension	2
	Tutorial	1
1.5	Row space and Column space	2
	Tutorial	1
	Program Using Python / MATLAB	
2	**ORTHOGONALITY**	
2.1	The scalar Product in $\mathbf{R^n}$	1
2.2	Orthogonal Subspaces	2
	Tutorial	1
2.3	Inner Product spaces	2
2.4	Orthonormal sets	2
	Tutorial	1
2.5	Gram-Schmidt process	2
	Tutorial	1
	Program Using Python / MATLAB	
3	**LINEAR TRANSFORMATION**	
3.1	Linear Transformation- Definition and Examples	1
3.2	Matrix Representations of Linear Transformations	2
	Tutorial	1
3.3	Similarity	1
	Tutorial	1
	Program Using Python / MATLAB	
4	**EIGEN SYSTEMS**	
4.1	Eigenvalues of Matrices and Eigen vectors of Matrices	1
4.2	Diagonalization of Matrices	2
	Tutorial	1
4.3	The Single Value Decomposition (SVD) of Matrices	2
4.4	The eigen value problem of Matrices	2
4.5	Generalized Inverse of Matrices	1
	Tutorial	1
	Program Using Python / Matlab	

5	**LINEAR SYSTEMS**	
5.1	System of linear equations	1
5.2	Row Echelon forms	1
5.3	Gauss Elimination	1
	Tutorial	1
	NONLINEAR SYSTEMS	
5.4	System of Non-Linear Equations, Fixed point iteration, Newton Raphson Method	1
5.5	Nonlinear system of Equations	1
5.6	Gauss Jordan Method	1
	Tutorial	1
	Program Using Python / Matlab	
	Total	**48**

Course Designer(s):

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22CS220	ELECTRONICS AND DIGITAL SYSTEMS	Category	L	T	P	Credit
		PC	2	1	0	3

Preamble

This course is designed to enable the students to understand and apply the basic principles of analog operational amplifiers and digital circuits and systems. Operational amplifier principles and characteristics, their different configurations and applications are illustrated. Then introduction to number systems, binary arithmetic, Boolean algebra, digital logic gates, design and implementation of combinational logic circuits are discussed. HDL simulation of combinational logic is briefly introduced. The fundamental concepts of flip flops and their application in implementing sequential logic circuits are also illustrated. Principles of Mealy and Moore type of circuits and their design are briefly discussed.

Prerequisite

- 22CS150 - Engineering Exploration

Course Outcomes

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

CO		TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Explain the operation and characteristics of an operational amplifier (Understand)	TPS2	B	75
CO2	Design and implement linear and nonlinear circuits using operational amplifiers. (Apply)	TPS 3	B	70
CO3	Perform simplification of boolean logic functions by applying the theorems and postulates of Boolean algebra and Karnaugh map. (Apply)	TPS 3	B	70
CO4	Design combinational logic circuits for given specifications and implement them using logic gates, multiplexers and programmable logic devices. (Apply)	TPS 3	B	70
CO5	Explain the HDL simulation of combinational logic circuits. (Understand)	TPS 2	B	75
CO6	Design sequential logic circuits like counters and sequence detectors and implement them using given flip flops. (Apply	TPS 3	B	70

Mapping with Programme 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	M		L	M		L

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

S- Strong; M-Medium; L-Low

Assessment Pattern

CO	CAT1						CAT2						Assignment 1/2						Terminal		
TPS Scale	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3
CO1	6	10																	3	5	
CO2		6	24												34					3	12
CO3	4	4	46												66				2	2	22
CO4							2	4	28						40				1	2	14
CO5							6	10											3	5	
CO6							2	6	42						60				1	3	22

*****Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.
Assignment 1 covers CO2 and CO3 only.
Assignment 2 covers CO4 and CO6 only.

Syllabus

Operational Amplifier (Op-Amp) Principles: Internal structure of an op-amp- Ideal op-amp characteristics and non-idealities in a practical op-amp- Idealized analysis of op-amp circuits.

Applications of Op-Amp: Inverting, non-inverting and differential amplifiers -Integrator, differentiator and comparator - Waveform generator -Zero crossing detector, peak detector and precision rectifier

Binary Number System and Boolean Algebra: Binary Number system and its conversion to hexadecimal number System-Complements, Signed Binary Numbers and Arithmetic-Binary Coded Decimal (BCD) and decimal Addition using BCD-Theorems and Properties of Boolean Algebra-Digital Logic Gates and Logic Operations-Simplification of logic functions using Karnaugh Map Method.

Combinational Logic Circuits: Design and Implementation

Binary Adder, Subtractor and Multiplier - Magnitude comparator, decoder and encoder-Multiplexers and their applications in implementing combinational logic functions -Organization of ROM, PLA and PAL and their application in implementing combinational logic circuits.

Simulation of Combinational Logic Circuits using HDL: Introduction to Hardware Description Language - Verilog model of simple combinational Circuits-Test benches, Boolean expressions and user defined primitives.

Sequential Logic Circuits: Introduction- Types of flip flops, their truth diagrams and conversions between them-Operation of shift Registers-Design of synchronous and ripple counters-. Principles and operation of Mealy and Moore type Circuits-Design of Mealy and Moore type simple sequence detectors.

Text Books

1. Ramakant A. Gayakwad,Op-Amps and Linear Integrated Circuits, Pearson Education; Fourth Edition, 2015.
2. M. Morris Mano, Micheal D. Ciletti, Digital Design: With an Introduction to the Verilog HDL, VHDL, and System Verilog, Pearson Education; Sixth edition,2018.

Reference Books & web resources

1. R. P. Jain, Kishor Sarawadekar, Modern Digital Electronics, McGraw Hill; Standard Edition,2022.
2. Leach, Malvino, Saha, Digital Principles and Applications, McGraw Hill Education; Eighth edition, 2014.
3. Jacob Millman,Christos Halkias, Chetan D. Parikh, Millman's Integrated Electronics- Analog and Digital Circuit and Systems, McGraw Hill Education, 2nd edition, 2017.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Periods
1	**Operational Amplifier (Op-Amp) Principles:**	
1.1	Internal structure of an op-amp.	1
1.2	Ideal op-amp characteristics and non-idealities in a practical op-amp.	1
1.3	Idealized analysis of op-amp circuits	1
2	**Applications of Op-Amp**	
2.1	Inverting, non-inverting and differential amplifier	1
2.2	Integrator, differentiator and comparator	1
2.3	Waveform generator	2
2.4	Zero crossing detector, peak detector and precision rectifier	1
3	**Binary Number System and Boolean Algebra**	
3.1	Binary Number system and its conversion to hexadecimal number system.	1
3.2	Complements, Signed Binary Numbers and arithmetic	2
3.3	Binary Coded Decimal (BCD) and decimal addition using BCD.	1
3.4	Theorems and Properties of Boolean Algebra	1
3.5	Digital Logic Gates and Logic Operations	1
3.6	Simplification of logic functions using Karnaugh Map Method	3

Module No.	Topic	No. of Periods
4	**Combinational Logic Circuits: Design and Implementation**	
4.1	Binary Adder, Subtractor and multiplier	1
4.2	Magnitude comparator, decoder and encoder	1
4.3	Multiplexers and their applications in implementing logic functions.	2
4.4	Organization of ROM, PLA and PAL and their application in implementing combinational logic circuits.	2
5	**Simulation of Combinational Logic Circuits using HDL**	
5.1	Introduction to Hardware Description Language	1
5.2	Verilog model of a simple combinational circuits	2
5.3	Test benches, Boolean expressions and user defined primitives	1
6	**Sequential Logic Circuits**	
6.1	Introduction- Types of flip flops, their truth diagrams and conversions between them.	2
6.2	Operation of shift registers	1
6.3	Design of synchronous and ripple counters	2
6.4	.Principles and operation of Mealy and Moore type circuits	1
6.5	Design of Mealy and Moore type simple sequence detectors	3
	Total	**36**

Course Designer(s):

1. C.Sridharan, Associate Professor of Computer Science and Engineering, cscse@tce.edu
2. Dr.C.Senthil Kumar, Associate Professor of Computer Science and Engineering, **cskcse@tce.edu**

22CS230	COMPUTER ORGANIZATION AND ARCHITECTURE

Category	L	T	P	Credit
PC	3	0	0	3

Preamble

The purpose of the course is to introduce principles of computer organization and the basic architectural concepts. It gives a brief overview of the memory format and instruction execution. It explains the function of each element of memory hierarchy and different ways of communication with I/O devices. It helps to estimate the performance and trade-offs involved in designing.

Prerequisite

NIL

Course Outcomes

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

CO	Course Outcome	TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Estimate the data transfer rate and length of the instruction cycle with bus interconnection and timing diagrams.	TPS3	70	70
CO2	Identify the impacts on cost/performance by making use of memory hierarchy	TPS3	70	70
CO3	Design the cache memory organization and replacement algorithms and evaluate the design trade-offs	TPS3	70	70
CO4	Explain the features of I/O and DMA transfer	TPS2	70	75
CO5	Perform ALU operations on binary numbers	TPS3	70	70
CO6	Identify the methods to deal with hazards in pipelining	TPS3	70	70

Mapping with Programme Outcomes

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

S- Strong; M-Medium; L-Low

Assessment Pattern

CO	CAT1						CAT2						Assignment		Terminal					
													1	2						
TPS Scale	1	2	3	4	5	6	1	2	3	4	5	6	3	3	1	2	3	4	5	6
CO1	10	10											20		10					
CO2	10	10	20										40			10				
CO3	10		30										40			10	20			
CO4							20	10						30	10	10				
CO5							10	10	15					30			20			
CO6							10	10	15					40			10			

*****Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

Syllabus

Introduction: 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, GPU Architecture - Overview.

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, Performance estimation and trade-offs in design.

Computer Arithmetic: Arithmetic and Logic Unit, Integer multiplication of unsigned and signed numbers, Booth's algorithm, Division of unsigned binary, Floating point arithmetic. **Pipelining**: Basic Concepts, Data Hazards, Instruction hazards, Influence on Instruction Sets, Data path and Control Considerations, Superscalar Operation, Performance Considerations.

Learning Resources

1. William Stallings, Computer Organization and Architecture Designing for Performance, Eleventh 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 (2)**		
1.1	Introduction to IAS Computer Structure and Operation	2	CO1

Module No.	Topic	No. of Lectures	Course Outcome
2	**Computer Function and Interconnection (9)**		
2.1	Top level view of components and functions	1	CO1
2.2	Instruction cycle and program execution	1	
2.3	Interrupts and instruction cycles	1	
2.4	Multiple interrupts	1	
2.5	Interconnection structures	1	
2.6	Bus interconnection	1	
2.7	Multiple buses	1	
2.8	Synchronous and asynchronous bus timings	1	
2.9	GPU Architecture - Overview	1	
3	**Memory and I/O (11)**		
3.1	Characteristics and hierarchy of memory	2	CO2
3.2	Cache memory principles and operation		
3.3	Cache design and mapping functions		
3.4	Replacement algorithms	1	CO3
3.5	Main memory	1	
3.6	DRAM and SRAM	1	
3.7	Types of ROMs,	1	
3.8	Module organization	1	CO4
3.9	Introduction to magnetic disks	1	
3.10	I/O transfer and disk performance	1	
3.11	Interrupt driven and DMA transfers	1	
3.12	Performance estimation and trade-offs in design	1	CO4
4	**Computer Arithmetic (7)**		
4.1	Arithmetic and Logic Unit	1	CO5
4.2	Integer multiplication of unsigned and signed numbers	1	
4.3	Booth's algorithm	2	
4.4	Division of unsigned binary	2	
4.5	Floating point arithmetic	1	
5	**Pipelining (7)**		
5.1	Basic Concepts	1	CO6
5.2	Data Hazards	1	
5.3	Instruction hazards	1	
5.4	Influence on Instruction Sets	1	
5.5	Data path and Control Considerations	1	
5.6	Superscalar Operation	1	
5.7	Performance Considerations	1	
	Total Hours	**36**	

Course Designer(s):

1. Dr. K. NarasimhaMallikarjunan, Associate Professor, CSE — arjunkambaraj@tce.edu
2. Ms. C.Santhiya ,Assistant Professor, CSE — csit@tce.edu

22CS240	PROBLEM SOLVING AND PROGRAMMING	Category	L	T	P	Credits
		ESC	3	0	0	3

Preamble

The main objective of this course is to learn problem solving methodologies and aspects of C programming. Programming is a fundamental task in finding solutions to real life problems. Aim of this course is to train the students to solve problems using the fundamentals of C programming.

Prerequisite

- NIL

Course Outcomes

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

COs	Course Outcome 1 (CO1)	TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Interpret Mathematical problems using algorithms, flowchart and pseudocode.	TPS 2	B	85
CO2	Develop algorithms for solving engineering problems using appropriate conditional and control structure	TPS 3	B	80
CO3	Decompose a problem into functions for recursive solutions	TPS 3	B	80
CO4	Use arrays, pointers and structures to formulate algorithms and programs	TPS 3	B	80
CO5	Solve matrix addition, matrix multiplication, searching and sorting problems using C Programming	TPS 3	B	80
CO6	Implement file operations and pre-processor directives for a given application	TPS 3	B	80

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	L	-	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	M	L	L	M	L	L

S- Strong; M-Medium; L-Low

Assessment Pattern

CO	CAT 1						CAT 2						Terminal					
TPS Scale	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	**6**
CO1	10	10	20	-	-	-	-	-	-	-	-	-	5	5	10	-	-	-
CO2	-	10	20	-	-	-	-	-	-	-	-	-	-	5	10	-	-	-
CO3	-	10	20	-	-	-	-	-	-	-	-	-	-	5	10	-	-	-
CO4	-	-	-	-	-	-	10	10	20	-	-	-	5	5	10	-	-	-
CO5	-	-	-	-	-	-		10	20	-	-	-	-	5	10	-	-	-
CO6	-	-	-	-	-	-		10	20	-	-	-	-	5	10	-	-	-

CO	Assignment 1						Assignment 2					
TPS Scale	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	**6**
CO1	-	-	30	-	-	-	-	-	-	-	-	-
CO2	-	-	30	-	-	-	-	-	-	-	-	-
CO3	-	-	40	-	-	-	-	-	-	-	-	-
CO4	–	-	-	-	-	-	-	-	30	-	–	-
CO5	-	-	-	-	-	-	-	-	30	-	-	-
CO6	-	-	-	-	-	-	-	-	40	-	-	-

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

Syllabus

Introduction to Problem Solving through programs, Algorithm, and Flowchart for problem solving with Sequential Logic Structure, Decisions and Loops, compilation process, Syntax and Semantic Errors-Character set – Constants – Keywords – Primitive data types – Declaration, Type Conversion

Conditional Branching and Iterative Loops-Sequential- Arithmetic Operators, Relational Operators, Logical Operators, Increment Decrement Operators, Bitwise Operators, Assignment Operators and Expressions, Precedence and Order of Evaluation, selective - If-Else-If, Switch- repetitive structures-for, while, do while, Nested loops, go to, break, continue –Finding maximum of 3 numbers, Unit converters, Interest calculators, multiplication tables, GCD and LCM, Prime number generation.
Arrays – Declaration, initialization and accessing array elements - 2-D arrays, Character Arrays and String operations -Matrix Operations-Searching- Linear search, Binary Search and Sorting-Bubble sort and Selection Sort - Minimum, Maximum and average of n numbers

Functions: Definition – call – prototypes - block structure -Storage Classes- call by Value-Variable Length Arguments-Call by Reference-Passing Arrays to Functions –recursion-iteration vs recursion- types of recursion- Simple recursive and non-recursive programs, Factorial and Fibonacci Generation-Towers of Hanoi problem

Pointers – Address and indirection operators, Pointer type declaration – Pointer arithmetic-Functions and pointers – Arrays and pointers -Strings and Pointers – Pointer to Pointers-Dynamic memory management

Structures – Variables, Accessing members, Assignment and nesting – Pointers to Structures -Structures and functions – Array of Structures – Unions- Pre-processor Directives-Command line arguments

Files: -Input and Output: Standard I/O, Formatted Output – printf, Formatted Input – scanf- file access including FILE structure, fopen, stdin, stdout and stderr, Error Handling including exit, perror and error.h, Line I/O, related miscellaneous functions.

Text Books

1. R.G.Dromey, "How to solve it by Computers", Reprint, PHI Publishers, 2011.
2. Kernighan, B.W and Ritchie,D.M, “The C Programming language”, Second Edition, Pearson Publisher, 2015.
3. J.R.Hanly and E.B. Koffmann, "Problem Solving and Program design in C", Fifth Edition, Pearson Publisher, 2012

Reference Books & web resources

1. YashwantKanetkar, "Let us C", 18th Edition, BPB Publications, 2021.
2. ReemaThareja, “Programming in C”, Second Edition,Oxford University Press,2016.
3. Byron Gottfried, "Programming with C", Fourth Edition, Tata McGraw Hill Education, 2018
4. Paul Deital and Harvey Deital, "C How to Program", Seventh Edition, Prentice Hall, 2012.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Periods
1	**Introduction to Problem Solving through programs**	
1.1	Algorithm, and Flowchart for problem solving with Sequential Logic Structure, Decisions and Loops	1
1.2	compilation process, Syntax and Semantic Errors-Character set – Constants – Keywords	1
1.3	Primitive data types – Declaration, Type Conversion	1
2	**Conditional Branching and Iterative Loops**	
2.1	Sequential- Arithmetic Operators, Relational Operators, Logical Operators, Increment Decrement Operators, Bitwise Operators, Assignment Operators and Expressions, Precedence and Order of Evaluation	2
2.2	Selective - If-Else-If, Switch	1
2.3	Repetitive structures-for, while, do while, Nested loops, go to, break, continue	1
2.4	Finding maximum of 3 numbers, Unit converters, Interest calculators, multiplication tables, GCD and LCM, Prime number generation.	1
3	**Arrays**	
3.1	Declaration, initialization and accessing array elements - 2-D arrays	1
3.2	Character Arrays and String operations	1
3.3	Matrix operations	1
3.4	Searching- Linear search, Binary Search	1
3.5	Sorting-Bubble sort and Selection Sort	1
3.6	Minimum, Maximum and average of n numbers	1
4	**Functions**	
4.1	Definition – call – prototypes - block structure -Storage Classes	1
4.2	call by Value- Variable Length Arguments-Call by Reference	1
4.3	Passing Arrays to Functions	1
4.4	Recursion-iteration vs recursion- types of recursion	1
4.5	Simple recursive and non-recursive programs, Factorial and Fibonacci Generation	1
4.6	Towers of Hanoi problem	1

5	**Pointers**	
5.1	Address and indirection operators, Pointer type declaration – Pointer arithmetic	1
5.2	Functions and pointers	1
5.3	Arrays and pointers	1
5.4	Strings and pointers	1
5.5	Pointer to pointers	1
5.6	Dynamic memory management	1
6	**Structures**	
6.1	Variables, Accessing members, Assignment and nesting	1
6.2	Pointers to Structures	1
6.3	Structures and functions	1
6.4	Array of Structures,Unions	1
6.5	Pre-Processor Directives-Command line arguments	1
7	**Files**	
7.1	Input and Output: Standard I/O, Formatted Output – printf, Formatted Input – scanf	2
7.2	Variable length argument list	1
7.3	File access including FILE structure, fopen, stdin, stdout and stderr	1
7.4	Error Handling including exit, perror and error.h, Line I/O, related miscellaneous functions	1
	Total	**36**

Course Designer(s):

1. Dr.M.Nirmala Devi, AP,CSE,TCE mnit@tce.edu
2. Ms.G.Bhavani, AP,CSE,TCE gbicse@tce.edu

		Category	L	T	P	Credit
22CS250	**SYSTEM PROGRAMMING**	ESC	2	0	0	2

Preamble

This course teaches students how to think about, build, debug, and test computer programs. The course also emphasizes the understanding of how programs execute on today's computers and their interaction with hardware and software. The practical programming is in C on Unix/Linux systems to introduce students to the mapping of high-level language constructs to the system software components and the underlying machine.

Prerequisite

Nil

Course Outcomes

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

COs	Course Outcomes	TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Illustrate the role and types of components significant in computing systems. (CO1)	TPS2	B	85
CO2	Identify and utilize the proper system software component for computer program execution.(CO2)	TPS3	B	80
CO3	Perform Unix/Linux basic commands to facilitate user interaction with the Operating System.(CO3)	TPS3	B	80
CO4	Illustrate the system programming tools and resources that assists in program development.(CO4)	TPS2	B	85
CO5	Develop C programs using Process Management and File Management System calls.(CO5)	TPS3	B	80
CO6	Construct bash scripts to solve problems using control statements and functions.(CO6)	TPS3	B	80

Mapping with Programme 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							L	L		
CO3	M	L			M					L		L	L	L	

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

S- Strong; M-Medium; L-Low

Assessment Pattern

CO	CAT1						Assignment 1	CAT2						Assignment2	Terminal					
TPS Scale	1	2	3	4	5	6		1	2	3	4	5	6		1	2	3	4	5	6
CO1	10	10	-	-	-	-	20	-	-	-	-	-	-	-	3	10	-	-	-	-
CO2	10	10	20	-	-	-	30	-	-	-	-	-	-	-	3	5	6	-	-	-
CO3	10	10	20	-	-	-	50	-	-	-	-	-	-	-	3	5	12	-	-	-
CO4	-	-	-	-	-	-	-	5	15	-	-	-	-	20	3	10	-	-	-	-
CO5	-	-	-	-	-	-	-	5	10	25	-	-	-	40	3	5	12	-	-	-
CO6	-	-	-	-	-	-	-	5	10	25	-	-	-	40	3	5	12	-	-	-

*****Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

Syllabus

Fundamentals of Computer System: Functional components of a programming system: Machine Structure, Hardware and Software, Software: Application Software and System Software.

System Software: Operating System, Text Editor, Debugger, Language Translator, Linker and Loader, Programming Languages: Machine Language, Assembly Language and High level language, Programming language processing activities.

System Programming: Basics of Systems Programming, Tools of system programming: Shell, Editor, Debugger, IDE, Program Development and Management: Case Study "C" programming, Basics of C programming and C program execution model.

System Programming on UNIX/Linux Systems: Unix/Linux Operating System structure, Basic Unix/Linux commands, Input / Output – Streams, Buffers, Pipes, Files and Devices, Processes, Privileged instructions and Non-privileged instructions, Environments, Shells, Kernel System Resources, System Calls and System Libraries.

System Calls & Libraries: Basics of System Call and Operation of system calls, Process management system calls - fork(), exec(), wait() & exit(), File management system calls - fopen(), fclose(), fread(), fwrite() and fseek(), Libraries: purpose of libraries and example of C standard libraries.

Scripting Language: Basics of scripting languages, Shell scripting: Basic Shell commands, Variables, Conditionals, Loops and Functions.

Text Books

1. System programming with C and Unix, Adam Hoover, Addison-Wesley, 2010 Pearson Education.
2. Practical System Programming with C: Pragmatic Example Applications in Linux and Unix-Based Operating Systems, Sri Manikanta Palakollu, Apress Media.
3. Systems Programming, John. J.Donovan, Tata McGraw Hill Edition.

4. System Software – An Introduction to Systems Programming, Leland L. Beck, Third Edition, Addison-Wesley.
5. Systems Programming, DM Dhamdhere, McGraw-Hill Education (India) Pvt Limited, 2011.

Reference Books & web resources

1. System Software, Santanu Chattopadhyay, 2007, PHI Learning.
2. The Linux Programming Interface - A Linux and UNIX System Programming Handbook, Michael Kerrisk, 2010, No Starch Press.
3. https://script.spoken-tutorial.org/index.php/BASH/C2/Introduction-to-BASH-Shell-Scripting/English-timed
4. https://onlinecourses.swayam2.ac.in/aic20_sp05/preview

Course Contents and Lecture Schedule

Module No.	Topic	No. of Periods
1	**Fundamentals of Computer System**	
1.1	Functional components of a programming system: Machine Structure, Hardware and Software.	1
1.2	Software: Application Software and System Software.	1
2	**System Software**	
2.1	Operating System and Text Editor	1
2.2	Programming Languages: Machine Language, Assembly Language and High level language.	1
2.3	Debugger, Language Translator, Linker and Loader.	2
2.4	Programming language processing activities.	1
3	**System Programming**	
3.1	Basics of Systems Programming and Tools of system programming: Shell, Editor, Debugger, IDE.	1
3.2	Program Development and Management: Case Study “C” programming and Basics of C programming, C program execution model	2
4	**System Programming on UNIX/Linux Systems**	
4.1	Unix/Linux Operating System structure and Basic Unix/Linux commands.	1
4.2	Input / Output – Streams, Buffers, Pipes, Files and Devices.	1
4.3	Processes, Privileged instructions and Non-privileged instructions, Environments and Shells.	1
4.4	Kernel System Resources, System Calls and System Libraries.	1
5	**System Calls & Libraries**	

5.1	Basics of System Call and Operation of system calls.	1
5.2	Process management system calls - fork(), exec(), wait() and exit().	2
5.3	File management system calls - fopen(), fclose(), fread(), fwrite() and fseek().	2
5.4	Libraries: purpose of libraries and example of C standard libraries.	1
6	**Scripting Language**	
6.1	Basics of scripting languages and types of shells	2
6.2	Shell scripting: Basic Shell commands, Variables and Conditional control statements.	
6.3	Shell scripting using Loops and Functions.	2
	Total	24

Course Designer(s):

1. Dr.S.MercyShalinie, Professor,CSE shalinie@tce.edu
2. Dr.G.Madhupriya, Associate Professor,CSE gmadhupriya@tce.edu

22CS260 ENGINEERING GRAPHICS AND EXTENDED REALITY

Category	L	T	P	Credit
ESC	1	0	4	3

Terminal Exam: Practical

Preamble

Engineering Graphics and Extended Reality (XR) encapsulates various immersive technologies that can merge the physical and virtual worlds, including virtual reality (VR), and augmented reality (AR). This course is an introduction to engineering graphics, objects design and interactions to the virtual worlds with practical applications of Extended Reality concepts in human perception, immersion and presence, virtual world modelling and 3D user interaction.

Prerequisite

Nill

Course Outcomes

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

		TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Define and explain the fundamental concepts in 2D 3D graphics, transformations and views.	TPS2	70	85
CO2	Understand the fundamental hardware and software for VR experiences	TPS2	70	85
CO3	Apply VR experience design for user interaction and interface design.	TPS3	70	80
CO4	Model and create a scene for interaction in Virtual Reality	TPS3	70	80
CO5	Design user interface for interacting with the virtual worlds in Augmented Reality.	TPS3	70	80
CO6	Develop an AR prototype that addresses an interesting and/or important real problem	TPS4	70	80

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	L						S	S	S	S	S	M	M	S
CO2	M	L			S			S	S	S	S	S	M	M	S
CO3	S	M	L		S			S	S	S	S	S	M	M	S
CO4	S	M	L		S			S	S	S	S	S	M	M	S
CO5	S	M	L					S	S	S	S	S	M	M	S
CO6	S	S	M	L	S			S	S	S	S	S	S	M	S

S- Strong; M-Medium; L-Low

Assessment Pattern

CO	CAT 1						CAT 2						Model Test			OCR			Terminal (Practical Component)					
	100						100						100			100			100					
TPS Scale	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	1	2	3	1	2	3	4	5	6
CO1	7	20																						
CO2	7	20																						
CO3	6	10	30					10	20						20			20			20			
CO4								10	20						20			20			20			
CO5								10	20	10					40			40			40			
CO6															20			20			20			

Syllabus

Engineering Graphics Graphics Pipeline, 2D Linear Transformations, 3D Linear Transformations, Viewing and Projective Transformations, Perspective Projection and Perspective Transform.

Defining Virtual Reality Four Key Elements of Virtual Reality Experience, Interface to the Virtual World Input and Output, Position and Orientation tracking, Head-Mounted Displays, Augmenting Displays, Binocular Augmenting Displays, Fully Immersive Displays, Smartphone Based Displays, 2D Versus 3D Interaction and Navigation, Hand and Gesture Tracking, Whole Body Tracking, Gaming and Entertainment.

Development tools- Interacting with the Virtual World, Interactions: Manipulation, Navigation, and Communication, Scene Graphs, Creating Basic Shapes, Navigation in 3D environment, Grouping and Components, Development of 3d objects using SketchUp.

Building a sample scene in VR, Interaction and Virtual Walkthrough using Jump and walk

Defining Augmented Reality, Getting started with Unity, Installing Unity Hub and a Unity Editor, Introducing the Unity Editor interface, preparing a project for AR development, Installing XR plugins for AR devices, Installing the AR Foundation package, Choosing an input handler Setting up for mobile development, Setting up for Android/ARCore development

A sample scene in AR Building and running the Samples project using Unity - AR Session, AR Session Origin, and AR Camera, Tracking Images using mobile devices

Text Book

1. Steve Marschner Peter Shirley, “Funtamentals of Computer graphics”, Taylor & Francis, fourth edition, 2016
2. William R.Sherman, Alan B.Craig, "Understanding Virtual Reality – Interface, Application, Design”, The Morgan Kaufmann Series, second edition, 2018.
3. Jonathan Linowes, “Augmented Reality with Unity AR Foundation”, Packt Publishing, 2021

Reference Books & web 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. John Vince, "Introduction in Virtual Reality", Springer, 2004.
5. Steve Aukstakalnis, “Practical Augmented Reality”, Addision Wesley 2017.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Periods	CO
1	**Engineering Graphics**		
1.1	Graphics Pipeline, 2D Linear Transformations, 3D Linear Transformations,	1	CO1
1.2	Viewing and Projective Transformations		CO1
1.3	Perspective Projection and Perspective Transform.	1	CO1
2	**Defining Virtual Reality**		
2.1	Four Key Elements of Virtual Reality Experience, Interface to the Virtual World Input and Output, Position and Orientation tracking,	1	CO2
2.2	Head-Mounted Displays, Augmenting Displays, Binocular Augmenting Displays, Fully Immersive Displays, Smartphone Based Displays,		CO2,
2.3	2D Versus 3D Interaction and Navigation, Hand and Gesture Tracking,	1	CO2,
2.4	Whole Body Tracking, Gaming and Entertainment.		CO2,
3	**Development tools-**		
3.1	Interacting with the Virtual World, Interactions: Manipulation, Navigation, and Communication,	1	CO3
3.2	Scene Graphs, Creating Basic Shapes, Navigation in 3D environment, .		CO3, CO6
3.3	Grouping and Components, Development of 3d objects using SketchUp	1	CO3, C06
Continuous Assessment Test – I			
4	**Building a sample scene in VR**,		
4.1	Interaction to virtual scene using VR devices	1	CO4
4.2	Virtual Walkthrough using Jump and walk using VR devices		CO4, CO6
4.3	Creating a Walkthrough in a model on mobile devices	1	CO4, CO6
	Assignment 1		CO6
5	**Defining Augmented Reality**,		

5.1	Getting started with Unity, Installing Unity Hub and a Unity Editor,	1	CO5
5.2	Introducing the Unity Editor interface, preparing a project for AR development		CO5
5.3	Installing XR plugins for AR devices, Installing the AR Foundation package,	1	CO5, CO6
5.4	Choosing an input handler Setting up for mobile development, Setting up for Android/ARCore development	1	CO5, CO6
6	**A sample scene in AR**		CO5
6.1	Building and running the Samples project using Unity - AR Session, AR Session Origin, and AR Camera,	1	CO5, CO6
6.2	Tracking Images using mobile devices		CO5, CO6
	Total Hours	**12**	

Course Contents and Lecture Schedule for Laboratory

Module No.	Topic	No. of Lectures	Course Outcome
1.	Create a sample scene with 3d objects in SketchUp	4	CO3
2.	Integrating the model with VR devices	2	CO3
3.	Navigation in the 3d scene	4	CO3
4.	Virtual Walkthrough using Jump and walk using fully immersive kits	2	CO4
5.	Creating a walkthrough on mobile devices for a model	4	CO4
6.	Unity Interface design	2	CO4
7.	Creating an APK file to run on mobile devices	2	CO5
8.	Placing a 3d object on a plane on mobile AR using Unity	4	CO5
9.	Tracking of images using mobile camara in AR using Unity	4	CO5
10.	Mini project	8	CO3, CO4, CO5, CO6
	Total Hours	**36**	

Course Designer(s):

1. Dr. N. Shivakumar APCSE shiva@tce.edu

22CS270	COMPUTER SYSTEMS LAB

Category	L	T	P	Credit
ESC	0	0	2	1

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 and students will get a chance to reinforce concepts in the working of a "real" operating system like Operating system installation procedure, shell Commands, file system management and process management techniques

Prerequisite

NIL

Course Outcomes

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

CO	Course Outcome	TCE Proficiency Scale	Expected Proficiency (%)	Expected Attainment Level (%)
CO1	Design half adder, full adder and Verify the truth tables of Boolean logic gates and theorems of Boolean algebra (Apply)	TPS3	70	80
CO2	Design combinational logic circuits for given specifications and implement them using HDL, multiplexers and programmable logic devices. (Apply)	TPS3	70	80
CO3	Design sequential logic circuits like counters, Registers, flip-flops and sequence detectors using Logic gates. (Apply)	TPS3	70	80
CO4	Identify and utilize the proper system software component, for programming Systems. (Apply)	TPS3	70	80
CO5	Implement Process Management and File Management system calls in C program. (Apply)	TPS3	70	80
CO6	Create shell scripts to automate and capture common repetitive tasks using bash scripting. (Apply)	TPS3	70	80

Mapping with Programme 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		M	M	L	M

CO2	S	M	L		L	-	-	M	M	M		M	M	L	M
CO3	S	M	L		L	-	-	M	M	M		M	M	L	M
CO4	S	M	L		L	-	-	M	M	M		M	M	L	M
CO5	S	M	L		L	-	-	M	M	M		M	M	L	M
CO6	S	M	L		L	-	-	M	M	M		M	M	L	M

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

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

List of Experiments/Activities with CO Mapping

1. Verification and interpretation of truth table for AND, OR, NOT,NAND, NOR, Ex-OR, Ex-NOR gates
2. Construction of half / full adder using XOR and NAND gates andverification of its operation
3. Implementation of 4x1 multiplexer and 1x4 de-multiplexer using logic gates
4. Verification of Binary to Gray and Gray to Binary conversion usingNAND gates only
5. Verification of the truth table of RS, JK, T and D flip-flopsusing NAND & NOR gates
6. Design and Verification of the 4-Bit Serial In - Parallel OutShift Registers
7. Installation of Windows and Linux operating systems.
8. Perform operations using the text editors, Compilers and IDE in Windows and Linux OS.
9. Perform C programs using process management system calls.
10. Perform C programs using File system management system calls.
11. Perform shell scripts with the basic shell commands.
12. Perform shell scripts using conditional and looping constructs.

Learning Resources

1. Ramakant A. Gayakwad,Op-Amps and Linear Integrated Circuits, Pearson Education; Fourth Edition, 2015.
2. M. Morris Mano, Micheal D. Ciletti, Digital Design: With an Introduction to the Verilog HDL, VHDL, and SystemVerilog, Pearson Education; Sixth edition,2018.
3. System programming with C and Unix, Adam Hoover, Addison-Wesley, 2010 Pearson Education.

Course Designers:

1. Dr.R. Leena Sri (rlsit@tce.edu)
2. Mr.D.Nagendra Kumar (dnkcse@tce.edu)

22CS280	PROGRAMMING LAB	Category	L	T	P	Credits
		PC	0	0	2	1

Preamble

This course objective is to provide practical experience on fundamentals of C programming as well as the design of simplified computer solutions to real-world problems. Programming concepts, data types, conditional and control structures, functions, arrays, recursion, file handling, and preprocessor directives are all projected in solving the engineering and real life problems.

Prerequisite

- NIL

Course Outcomes

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

COs	Course Outcome 1 (CO1)	TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Develop Programs using various Data types and operators	TPS 3	B	80
CO2	Use appropriate conditional and control structure to solve Engineering problems	TPS 3	B	80
CO3	Implement modular programming using user defined and recursive functions	TPS 3	B	80
CO4	Perform sorting , searching and matrix operations using C Programming	TPS 3	B	80
CO5	Make use of pointers, structure and union to solve problems	TPS 3	B	80
CO6	Solve real life problems by file handling functions and preprocessor directives	TPS 3	B	80

Mapping with Programme 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	M	M	M	M	M	M	L	M
CO2.	S	M	L	L	L	L	L	M	M	M	M	M	M	L	M
CO3.	S	M	L	L	L	L	L	M	M	M	M	M	M	L	M
CO4.	S	M	L	L	L	L	L	M	M	M	M	M	M	L	M
CO5.	S	M	L	L	L	L	L	M	M	M	M	M	M	L	M
CO6.	S	M	L	L	L	L	L	M	M	M	M	M	M	L	M

Assessment Pattern: Cognitive Domain

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

List of Experiments/Activities with CO Mapping

Ex.NO	Experiment	CO
1	Develop C Programs with various data types	CO1
2	Develop C Programs to illustrate operators and sequence control structure	CO1
3	Write a C Program for decision making problems	CO2
4	Implement C program to solve iterative problems using loops	CO2
5	Implement bubble and selection sorting using modular programming	CO3
6	Write C Programs for linear and binary searching techniques.	CO3,CO4
7	Implement matrix operations and recursive fuctions using C programs	CO3,CO4
8	Implement pointers to array and function	CO5
9	Develop a C Program for user defined Data Types: Structure and Union	CO5
10	Demonstrate file Handling operations using C program	CO6
11	Illustrate C preprocessor directives through programming	CO6
12	Simple Application Development	CO1,CO2,CO3,CO4,CO5,CO6

Learning Resources

1.R.G.Dromey, "How to solve it by Computers", Reprint, PHI Publishers, 2011.
2. Kernighan, B.W and Ritchie,D.M, “The C Programming language”, Second Edition, Pearson Publisher, 2015.

3. J.R.Hanly and E.B. Koffmann, "Problem Solving and Program design in C", Fifth Edition, Pearson Publisher, 2012
4. YashwantKanetkar, "Let us C", 18th Edition, BPB Publications, 2021.
5. ReemaThareja, “Programming in C”, Second Edition,Oxford University Press,2016.
6. Byron Gottfried, "Programming with C", Fourth Edition, Tata McGraw Hill Education, 2018
7. Paul Deital and Harvey Deital, "C How to Program", Seventh Edition, Prentice Hall, 2012

Course Designer(s):

1. Dr.M.Nirmala Devi, AP,CSE,TCE mnit@tce.edu
2. Ms.G.Bhavani, AP,CSE,TCE gbicse@tce.edu

CURRICULUM AND DETAILED SYLLABI

FOR

B.E DEGREE (Computer Science and Engineering) PROGRAMME

THIRD SEMESTER

FOR THE STUDENTS ADMITTED FROM THE

ACADEMIC YEAR 2022 - 2023 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. / B.Tech. Degree Programmes

COURSES OF STUDY
(For the candidates admitted from 2022-23 onwards)

THIRD SEMESTER

Course Code	Name of the Course	Category	No. of Hours / Week			credits
			L	T	P	
THEORY						
22CS310	Probability and Statistics	BSC	3	1	-	4
22CS320	Theory and Design of Programming Languages	ESC	3	-	-	3
22CS330	Object Oriented Programming	PC	3	-	-	3
22CS340	Data Structures and Algorithms	PC	3	-	-	3
THEORY CUM PRACTICAL						
22CS360	Operating Systems	PC	3	-	2	4
PRACTICAL						
22CS370	Data Structures Lab	PC	-	-	2	1
22CS380	Object Oriented Programming Lab	PC	-	-	2	1
22ES390	Design Thinking	ESC				3
		Total	**15**	**1**	**6**	**22**

BSC : Basic Science Courses
PC : Professional Core Courses
ESC : Engineering Science Courses

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 2022-23 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	22CS310	Probability and Statistics	3	40	60	100	27	50
2	22CS320	Theory and Design of Programming Languages	3	40	60	100	27	50
3	22CS330	Object Oriented Programming	3	40	60	100	27	50
4	22CS340	Data Structures and Algorithms	3	40	60	100	27	50
THEORY CUM PRACTICAL								
5	22CS360	Operating Systems	3	50	50	100	22.5	50
PRACTICAL								
6	22CS370	Data Structures Lab	3	60	40	100	18	50
7	22CS380	Object Oriented Programming Lab	3	60	40	100	18	50
8	22ES390	Design Thinking						

* 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

22CS310 PROBABILITY AND STATISTICS

Category	L	T	P	Credit
BS	3	1	0	4

Preamble

A mathematical model of some phenomena is frequently impossible to construct due to inherent uncertainties. Many real-world problems, in fact, involve multiple variables (some of which may be unknown), making it difficult to define the problem and perform a precise mathematical analysis. Statistical inference can help in this situation by identifying and limiting the variability involved, as well as projecting outcomes with high probability. After constructing a probabilistic model, we can use correlation and regression to study the relationship between variables and solve the prediction problem. Furthermore, the significance of decisions based on experimental and observed data is validated using hypothesis testing. Discerete-transform concepts can also be used to solve difference equations, which can then be used to model discrete time systems.

Prerequisite

Nil

Course Outcomes

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

		TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Apply the concept of probability, conditional probability to solve problems in the field of science and technology.	TPS3	B	85
CO2	Computing expectation, variance, moments and moment generating functions of random variables.	TPS3	B	85
CO3	Modelling and solving science and engineering problems using discrete probability distributions.	TPS3	B	85
CO4	Modelling and solving science and engineering problems using continuous probability distributions.	TPS3	B	85
CO5	Apply the test of hypothesis and ANOVA for small and large samples to make decisions based on observed and experimental data.	TPS3	B	85
CO6	Model discrete time system using difference equation and solve it by applying Discrete transform techniques.	TPS3	B	85

Mapping with Programme 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	M	L	L
CO2.	S	M	L		M			L	M	L		M	M	L	L
CO3.	S	M	L		M	L		L	M	L		M	M	L	L

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

S- Strong; M-Medium; L-Low

Assessment Pattern

CO	Assessment 1						Assessment 2						Terminal (%)		
	CAT 1 (%)			Assignment 1 (%)			CAT 2 (%)			Assignment 2 (%)					
TPS	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
	10	30	60	-	-	100	10	30	60	-	-	100	-	30	70
CO1	-	5	20	-	-	28	-	-	-	-	-	-		6	10
CO2	7	10	20	-	-	44	-	-	-	-	-	-		6	12
CO3	3	5	20	-	-	28	-	-	-	-	-	-		3	10
CO4	-	10	-	-	-	-	-	10				20		3	10
CO5	-	-	-	-	-	-	7	10	30			40		6	14
CO6	-	-	-	-	-	-	3	10	30			40		6	14
TOTAL	10	30	60	-	-	100	10	30	60	-	-	100	-	30	70

*****Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

Syllabus

Introduction to Probability: Sample space - Events and their Probabilities-Rules of Probability-Combinatorics-Conditional probability and independence – Baye's theorem.

Random Variables and Their Distributions: Distribution of a random variable- Expectation- Expectation of a function-Variance and standard deviation – Probability density function- Expectation and variance-Moments-Moments generating functions.

Discrete Random Variables and Their Distributions: Bernoulli distribution -Binomial distribution -Negative Binomial distribution -Poisson distribution.

Continuous Random Variables and Their Distributions: Uniform distribution- Exponential distribution – Gamma distribution - Normal distribution.

Testing of Hypotheses: Hypotheses and test procedures – Z tests for Hypotheses about a population mean – The one sample t Test– Z tests for a difference between two population means – The twosample t Test – Analysis of paired data – inferences concerning two population variances- Single Factor ANOVA.

Discrete Transforms: The Z-transform – Properties of the Z-transform -The Inverse Z transform – Discrete Fourier transform - Discrete time systems and difference equations.

Text Book

1. Michael Baron., "Probability and Statistics for Computer Scientists" Second Edition, CRC Press, 2014.
2. Jay. L. Devore., "Probability and Statistics for Engineering and the Sciences", Ninth Edition, Cengage Learning, 2014.
3. Glyn James and Phil Dyke., "Advanced Modern Engineering Mathematics", Fifth Edition, Pearson Education Limited, 2018.

Reference Books

1. Douglas C. Montgomery., George C. Runger., "Applied Statistics and Probability for Engineers" Seventh Edition, 2018.
2. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers., "Probability & Statistics for Engineers & Scientists", Ninth Edition, 2012.
3. Mendenhall, William, Robert J. Beaver, Barbara M. Beaver., "Introduction to probability and Statistics" Fifteenth Edition, 2019.
4. Introduction to Probability and Statistics for Engineers and Scientists, Sheldon M. Ross., USA,Elsevier, Fifthedition,2014.

Course Contents and Lecture Schedule

Module No.	Topic	No. of. Lectures
1	**Introduction to Probability**	
1.1	Sample space, Events and their Probabilities	1
1.2	Rules of Probability	1
1.3	Combinatorics	1
	Tutorial	1
1.4	Conditional probability and independence	1
1.5	Baye's theorem	1
	Program Using Python / Matlab	
2	**Random Variables and Their Distributions**	
2.1	Distribution of a random variable	1
	Tutorial	1
2.2	Expectation, Expectation of a function	1
2.3	Variance and standard deviation	1
2.4	Probability density function, Expectation and variance	1
	Tutorial	1

2.5	Moments	1
2.6	Moments generating functions	2
	Program Using Python / Matlab	
3	**Discrete Random Variables and Their Distributions**	
3.1	Bernoulli Distribution	1
	Tutorial	1
3.2	Binomial distribution	1
3.3	Negative Binomial distribution	1
3.4	Poisson distribution	1
	Tutorial	1
	Program Using Python / Matlab	
4	**Continuous Random Variables and Their Distributions**	
4.1	Uniform distribution	1
4.2	Exponential distribution	1
4.3	Gamma distribution	1
	Tutorial	1
4.4	Normal distribution	2
	Program Using Python / Matlab	
5	**Testing of Hypotheses**	
5.1	Hypotheses and test procedures	1
	Tutorial	1
5.2	Z tests for Hypotheses about a population mean	1
5.3	The one sample t test	1
5.4	Z tests for a differencebetween two population means	1
	Tutorial	1
5.5	The two-Sample t Test	1
5.6	Analysis of paired data	1
5.7	Inferences concerning two population Variances	1
5.8	Single factor ANOVA	1
	Tutorial	1
	Program Using Python / Matlab	
6.	**Discrete Transforms**	
6.1	The Z-transform	1
6.2	Properties of Z-transform	2
	Tutorial	1
6.3	The Inverse Z-transform	2
6.4	Discrete Fourier transform	1
	Tutorial	1
6.5	Discrete time systems and difference equations	2
6.6	Tutorial	1
	Program Using Python / Matlab	

	Total	48

Course Designer(s):

1. Dr.C.S.Senthilkumarkumarstays@tce.edu
2. Dr.P.Krishnapriyapkamat@tce.edu
3. Dr.P.Victorpvmat@tce.edu

22CS320	THEORY AND DESIGN OF PROGRAMMING LANGUAGES	Category	L	T	P	Credit
		ESC	3	0	0	3

Preamble

This course is a fundamental course on programming principles. It gives an overview of different programming paradigms. It deals with the concepts common in various imperative programming languages and declarative programming languages. The course also covers the use of parallelism in programming. The principles of programming are dealt with the case study of programming languages C, Java, Ada, Haskell, Prolog and JavaScript.

Prerequisite

22CS240 – Problem Solving and Programming

22CS250 – System Programming

Course Outcomes

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

COs	Course Outcomes	TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Solve engineering problems using Sequential Procedural Programming Paradigm (CO1)	TPS3	B	80
CO2	Solve engineering problems using Sequential Object Programming Paradigm (CO2)	TPS3	B	80
CO3	Solve engineering problems using Concurrent Programming Paradigm (CO3)	TPS3	B	80
CO4	Solve engineering problems using Functional Programming Paradigm (CO4)	TPS3	B	80
CO5	Solve engineering problems using Logic Programming Paradigm (CO5)	TPS3	B	80
CO6	Develop scripts for given specification using web scripting paradigm (CO6)	TPS3	B	80

Mapping with Programme Outcomes

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

S- Strong; M-Medium; L-Low

Assessment Pattern

CO	CAT1						Assignment 1	CAT2						Assignment 2	Terminal					
TPS Scale	1	2	3	4	5	6	3	1	2	3	4	5	6	3	1	2	3	4	5	6
CO1	10	10	15	-	-	-	30	-	-	-	-	-	-	-	2	-	15	-	-	-
CO2	10	10	15	-	-	-	40	-	-	-	-	-	-	-	-	5	15	-	-	-
CO3	10	10	10	-	-	-	30	-	-	-	-	-	-	-	2	5	10	-	-	-
CO4	-	-	-	-	-	-	-	5	5	20	-	-	-	20	2	-	10	-	-	-
CO5	-	-	-	-	-	-	-	5	10	20	-	-	-	30	2	5	10	-	-	-
CO6	-	-	-	-	-	-	-	5	10	20	-	-	-	50	2	-	15	-	-	-

*****Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

Syllabus

The Imperative Programming Paradigm: Basics of Programming Paradigms, Expression Semantics, Data Semantics, Imperative Design principles – Structured, Turing Complete, Modularity, Procedural abstraction, Structured Theorem - Sequencing, Selection, Iteration and Recursion.

Sequential Programming - Procedural Programming Paradigm: Procedures, Parameter passing, Procedural abstraction, Case Study - C Programming.

Sequential Programming - Object Oriented Programming Paradigm: OOP design principles - Groupings of Data and Operations, Encapsulation, Data Abstraction, Inheritance and Polymorphism, Exceptions, Case Study - Java Programming.

Concurrent Programming Paradigm: Concurrency design with interleaving of process, Safe Access to Shared Data – Semaphore, Liveness property of concurrent programs - Case Study - Concurrency in ADA.

Functional Programming Paradigm: Declarative programming design – Functional and logic paradigm, Basics of Functional programming paradigm, Expressions – Syntax, Parsing, Types and Values, Assigning names to expressions, Lambda Calculus fundamentals, Function Abstraction and Recursive Functions - Case Study Haskell.

The Logic Programming Paradigm: Clauses and Predicates, Operations and Arithmetic, List and Operations, Unification and Backtracking, Case Study – Prolog.

Scripting Paradigm: – Basics of Web design language and Scripting Language, Case Study: JavaScript – Syntax of writing JavaScript, Variables and Functions.

Text Book

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. Programming Languages: Design and Implementation (4th Edition), by Terrence W. Pratt, Marvin V. Zelkowitz, Pearson, 2000.
5. David A.Watt, “Programming Language Concepts and Paradigms”, Prentice Hall, 1990.

6. Bruce J. Maclennan, “Principles of Programming Languages: Design, Evaluation and Implementation”, Second Edition.

Reference Books & web resources

1. Minh Quang Tran, “The Art of Functional Programming Paradigm”, 2022.
2. Alejandro Serrano Mena, “Practical Haskell: A Real-World Guide to Functional Programming”, Apress Media, 2019.
3. Axel Rauschmayer, “Speaking JavaScript”, O’Reilly Media, 2015.
4. Max Bramer, "Logic Programming with Prolog", Springer 2005.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Periods
1	**The Imperative Programming Paradigm**	
1.1	Basics of Programming Paradigms, Expression Semantics, Data Semantics, Imperative Design principles – Structured, Turing Complete, Modularity, Procedural abstraction	2
1.2	Structured Theorem - Sequencing, Selection, Iteration and Recursion.	1
2	**Sequential Programming - Procedural Programming Paradigm**	
2.1	Procedures, Parameter passing, Procedural abstraction	1
2.2	Case Study - C Programming.	2
3	**Sequential Programming - Object Oriented Programming Paradigm**	
3.1	OOP design principles - Groupings of Data and Operations, Encapsulation, Data Abstraction	1
3.2	OOP design principles - Inheritance and Polymorphism, Exceptions	2
3.3	Case Study - Java Programming	2
4	**Concurrent Programming Paradigm**	
4.1	Concurrency design with interleaving of process	1
4.2	Safe Access to Shared Data – Semaphore	2
4.3	Liveness property of concurrent programs	2
4.4	Case Study - Concurrency in ADA.	2
5	**Functional Programming Paradigm**	
5.1	Declarative programming design – Functional and logic paradigm, Basics of Functional programming paradigm, Expressions – Syntax, Parsing, Types and Values, Assigning names to expressions	2
5.2	Lambda Calculus fundamentals	2

Module No.	Topic	No. of Periods
5.3	Function Abstraction and Recursive Functions	1
5.4	Case Study Haskell.	2
6	**The Logic Programming Paradigm**	
6.1	Clauses and Predicates & Operations and Arithmetic	1
6.2	List and Operations, Unification and Backtracking,	2
6.3	Case Study – Prolog	2
7	**Scripting Paradigm**	
7.1	Basics of Web design language and Scripting Language	2
7.2	Case Study: JavaScript – Syntax of writing Java Script	2
7.3	Variables and Functions in JavaScript	2
	Total	36

Course Designer(s):

1. G.Madhupriya, Associate Professor,CSE gmadhupriya@tce.edu
2. M.Suguna, Assistant Professor, CSE mscse@tce.edu

22CS330 **OBJECT ORIENTED PROGRAMMING**

Category	L	T	P	Credit
PC	3	0	0	3

Preamble

This syllabus is intended for Computer Science Engineering students and enables them to learn Object Oriented Programming and the design of computer solutions in a precise manner. The syllabus emphasizes OOP concepts, Functions, Polymorphism, Inheritance and I/O. The intention is to provide sufficient depth in these topics to enable students to apply Object Oriented approach to programming. The modules in the syllabus reflect solving general problems via programming solutions. 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

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

CO	Course Outcome	TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Construct Object oriented programs using methods and passing arrays, objects, and array of objects to them.	TPS3	B	80
CO2	Demonstrate Compile-time and Run-time polymorphism using object oriented programs	TPS3	B	80
CO3	Illustrate the relationships between objects using inheritance hierarchies and aggregation	TPS3	B	80
CO4	Develop Object Oriented programs to handle data using Java collections, Files and Object Serialization	TPS3	B	80
CO5	Develop Object Oriented programs to handle exceptions	TPS3	B	80
CO6	Develop Object Oriented programs to demonstrate event driven programming, concurrent programming and network programming.	TPS3	B	80

Mapping with Programme 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	M		L	M	L	L
CO2	S	M	L		L	L		L	M	M		L	M	L	L

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

S- Strong; M-Medium; L-Low

Assessment Pattern

CO	CAT1						CAT2						Assignment		Terminal					
													1	2						
TPS Scale	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	**6**	**3**	**3**	**1**	**2**	**3**	**4**	**5**	**6**
CO1	10		10										20		2	4	10			
CO2	10	10	10										40		2	4	10			
CO3	10	20	20										40		4	4	10			
CO4							10		10					30	4	4	10			
CO5							10	10	10					30	4	4	10			
CO6							10	20	20					40	4		10			

*****Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

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

Collection Framework in Java – Introduction to java collections, Overview of java collection framework, commonly used collection classes- Array List, Vector, Hash table, Stack

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

Text Book

1. Herbert Schildt: “Java: The Complete Reference”, Twelfth Edition, McGraw-Hill, 2021.
2. Tony Gaddis, “Starting Out with Java: From Control Structures through Objects”, Sixth edition, Pearson Education Limited, 2016.
3. Bart Baesens, Aimee Backiel, SeppevandenBroucke, “Beginning Java Programming:The Object-Oriented Approach”, John Wiley & Sons, 2015.
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 Contents and Lecture Schedule

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

5.1	Introduction to java collections	1
5.2	Overview of java collection framework	1
5.3	Collection classes - Array List, Vector	2
5.4	Collection classes - Hash table, Stack	2
6	**Event-Driven Programming Concurrent Programming Network programming (7)**	
6.1	Frameworks	1
6.2	Text-related GUI components, other GUI components	1
6.3	Handling mouse events and button events	1
6.4	Thread life cycle and methods	1
6.5	Runnable interface	1
6.6	Thread Synchronization	1
6.7	Basics of network programming	1

Course Designer(s):

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2. Mr S.Santhana Hari, Assistant Professor, CSE – sshcse@tce.edu

22CS340	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

22CS240 : Problem Solving and Programming

Course Outcomes

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

CO	Course Outcome	TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Apply linked list including singly, double and circular list for solving problems	TPS3	B	70
CO2	Use linear data structure including stack, queue and deque operations to solve a given problem	TPS3	B	70
CO3	Choose appropriate binary non-linear data structure including binary search tree, AVL tree, splay tree for performing searching operations in trade-off with time complexity.	TPS4	B	70
CO4	Apply multiway non-linear data structure including B-tree and tries to solve problems	TPS3	B	70
CO5	Demonstrate the concepts of advanced data structures including heap in various applications	TPS3	B	70
CO6	Analyse linear, binary and hashing algorithms for searching including collision-resolving methods in hashing technique.	TPS4	B	70
CO7	Demonstrate the efficiency of sorting algorithms	TPS3	B	70
CO8	Explore methods for maintaining disjoint set data structure that supports union and find set operations	TPS3	B	70

Mapping with Programme 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		M	M		M
CO2	S	M	L		L			M	M	M		M	M		M

CO 3	S	S	M	L	L			M	M	M		M	M	L	M
CO 4	S	M	L		L			M	M	M		M	M		M
CO 5	S	M	L		L			M	M	M		M	M		M
CO 6	S	S	M	L	L			M	M	M		M	M	L	M
CO 7	S	M	L		L			M	M	M		M	M		M
CO 8	S	M	L		L			M	M	M		M	M		M

S- Strong; M-Medium; L-Low

Assessment Pattern

CO	CAT1						Assignment-1	CAT2						Assignment-2	Terminal					
TPS Scale	**1**	**2**	**3**	**4**	**5**	**6**		**1**	**2**	**3**	**4**	**5**	**6**		**1**	**2**	**3**	**4**	**5**	**6**
CO1	4		20				20								2		10			
CO2	2	5	20				30								2		10			
CO3	4			20			30								2			10		
CO4		5	20				20								2	2	10			
CO5								4		20				20	2	2	10			
CO6								4			20			30		2		10		
CO7									5	20				30		2	10			
CO8								2	5	20				20		2	10			

*****Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

Syllabus

INTRODUCTION TO ABSTRACT DATA TYPES AND ANALYSIS:

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:

Abstract Data Types (ADTs) – List ADT – Array-based implementation – Linked list implementation – Singly linked lists – Circularly linked lists – Doubly-linked lists – Applications of lists – Polynomial ADT – Radix Sort – Multilists – Josephus Problem – Palindrome Checking.

STACKS AND QUEUES:

Stack ADT – Operations – Applications – Balancing Symbols – Evaluating arithmetic expressions - Infix to Postfix conversion – Function Calls – Queue ADT – Operations – Circular Queue – DeQue – Applications of Queues – Scheduling

TREES:

Tree ADT – Tree Terminologies – Tree Traversals – Tree representation and properties - Binary Tree ADT – Types of Binary Tree - Applications of Binary Tree - Expression trees – Priority Queue

(Heaps) – Binary Heap – Leftist Heap – Binomial Queue – Applications of Heap – Huffman Coding, Heap Sort.
Binary Search Tree ADT – AVL Trees – Red Black Trees – Splay Trees

MULTIWAY SEARCH TREES:
Multiway Search Trees - B-Tree - Tries - Standard Tries - Compressed Tries - Suffix Trees – Linear Construction of Suffix Trees - Application on Tries - Longest Prefix – Binary Tries (PATRICIA Structure) - Pattern Searching
DISJOINT SETS:
Disjoint-set operations - Representation – Smart union algorithms – Path Compression
SEARCHING, SORTING AND HASHING TECHNIQUES
Sorting - Insertion sort – Shell sort –. Merge Sort – External Sorting - The Simple Algorithm - Multiway Merge – Polyphase Merge - Replacement Selection. Searching – Linear Search – Binary Search - Hashing - Hash functions – Division Method, Multiplication Method, Mid-Square Method, Folding Method - Collision resolution and overflow handling techniques - Open Hashing (Separate Chaining) - Open Addressing / Closed Hashing - Linear, Quadratic, Double, Rehashing - Extendible Hashing

Text Books

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2nd Edition, Pearson Education, 2005.
2. Kamthane, Introduction to Data Structures in C, 1st Edition, Pearson Education, 2007

Reference Books & web resources

1. Langsam, Augenstein and Tanenbaum, Data Structures Using C and C++, 2nd Edition, Pearson Education, 2015.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein, Introduction to Algorithms", Fourth Edition, Mcgraw Hill/ MIT Press, 2022.
3. Alfred V. Aho, Jeffrey D. Ullman,John E. Hopcroft ,Data Structures and Algorithms, 1st edition, Pearson, 2002.
4. Kruse, Data Structures and Program Design in C, 2nd Edition, Pearson Education, 2006.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Periods
1	**INTRODUCTION TO ABSTRACT DATA TYPES AND ANALYSIS**	
1.1	Review of elementary data types and structures in C	1
1.2	Abstract Data Types (ADT)-Basic concept of Data Structures-Performance measures for Data Structures	1
1.3	Time and Space Complexity Asymptotic Measures - Big-Oh, Omega, Theta.	1
2	**LINKED LISTS**	
2.1	Abstract Data Types (ADTs) – List ADT – Array-based implementation- Linked list implementation	1

Module No.	Topic	No. of Periods
2.2	Singly linked lists – Circularly linked lists	1
2.3	Doubly-linked lists	1
2.4	Applications of lists – Polynomial ADT – Radix Sort	1
2.5	Multilists – Josephus Problem – Palindrome Checking.	1
3	**STACKS AND QUEUES**	
3.1	Stack ADT – Operations	1
3.2	Applications – Balancing Symbols – Evaluating arithmetic expressions- Infix to Postfix conversion – Function Calls	1
3.3	Queue ADT – Operations – Circular Queue	1
3.4	DeQue – Applications of Queues – Scheduling	1
4	**TREES**	
4.1	Tree ADT – Tree Terminologies – Tree Traversals – Tree Representation	1
4.2	Binary Tree ADT – Types of Binary Tree	1
4.3	Applications of Binary Tree - Expression trees	1
4.4	Priority Queue (Heaps) – Binary Heap- Leftist Heap – Binomial Queue	1
4.5	Applications of Heap – Huffman Coding, Heap Sort.	1
4.6	Binary Search Tree ADT – AVL Trees	1
4.7	Red Black Trees – Splay Trees	1
5	**MULTIWAY SEARCH TREES**	
5.1	Multiway Search Trees - B-Tree	1
5.2	Tries - Standard Tries - Compressed Tries	1
5.3	Suffix Tries – Ukkonen's Algorithm- Application on Tries - Longest Prefix – Binary Tries (PATRICIA Structure) - Pattern Searching	2
6	**SEARCHING, SORTING AND HASHING TECHNIQUES**	
6.1	Searching – Linear Search – Binary Search	1
6.2	Sorting –Insertion sort- Shell sort –. Merge Sort	1

Module No.	Topic	No. of Periods
6.3	External Sorting - The Simple Algorithm - Multiway Merge - Replacement Selection	1
6.4	Hashing - Hash functions – Division Method, Multiplication Method	1
6.5	Mid-Square Method, Folding Method	1
6.6	Collision resolution and overflow handling techniques - Open Hashing (Separate Chaining)	1
6.7	Open Addressing / Closed Hashing - Linear, Quadratic, Double, Rehashing - Extendible Hashing	1
7	**GRAPHS**	
7.1	Graph algorithms: Representations of graphs - Graph traversal: DFS – BFS	2
7.2	Applications - Connectivity, strong connectivity, bi-connectivity	1
7.3	Topological sort, Euler circuits	1
7.4	Minimum spanning tree-Kruskal's and Prim's algorithm	1
	Total	**36**

Course Designer(s):

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2. Mrs.RajaLavanya, Assistant Professor,CSE rlit@tce.edu

22CS360	OPERATING SYSTEMS

Category	L	T	P	Credit
PC	3	0	2	4

Preamble

This course has two components: a theory component is to teach the concepts and principles that underlie modern operating systems. Students will learn about processes and processor management, concurrency and synchronization, memory management schemes, filesystem, secondary storage management and security measures. The practical component of this course will relate theoretical principles with operating system implementation.

Prerequisite

NIL

Course Outcomes

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

CO	Course Outcome	TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Practice the following terms in context of operating systems: Evolution, Types, Structure, Functions and components	TPS3	70	70
CO2	Choose the best design and evaluate the trade-offs of various modern operating systems	TPS3	70	70
CO3	Examine the given scenario to implement processor scheduling and synchronization algorithms	TPS4	70	70
CO4	Construct solutions for problems related to deadlocks in a multi-programmed operating system	TPS3	70	70
CO5	Develop appropriate solutions to solve problems related to primary and secondary memory management.	TPS3	70	70
CO6	Implement the disk allocation algorithms and identify the security measures for a given scenario	TPS3	70	70

Mapping with Programme Outcomes

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

S- Strong; M-Medium; L-Low

Assessment Pattern

CO	CAT 1(Theory Component)						CAT 2(Theory Component)						Model (Lab Component)				OCR				Terminal (Theory Component)					
	100						100						100				100				100					
TPS Scale	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**5**	**6**
CO1		10																			4	6				
CO2		20																			5	5				
CO3			40	30					20						20				20			5	10	5		
CO4									30						20	10			20	10		5	15			
CO5									30						30				30			5	15			
CO6									20						20				20			5	15			

*****Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

Syllabus

Introduction: Role of OS, Types of OS - Batch Systems, Multiprogramming, Time Sharing, Distributed & Real time OS, System Architecture, System components - OS Services, System Calls, System Programs, System Design, Design Trade-offs.

Process Management: Concepts - Process status, Process description, Process model, Process Scheduling - Scheduler organization, pre-emptive and non-pre-emptive scheduler strategies, Scheduling algorithms - FCFS, SJF, SRTF, Priority Scheduling, Round Robin Scheduling, Multiple Processor scheduling, Thread Concepts and Multiple threaded OS.

Process Synchronization and Deadlock: Process Co-operation, Inter-process communication, Process Synchronization, Synchronization Issues, Critical Section problem, Mutual exclusion, Process Synchronization with semaphores. Deadlock - Conditions, Prevention, Avoidance and Recovery.

Memory Management and File system: Paging, Segmentation and Contiguous memory allocation, Virtual Memory - Demand Paging, Page replacement and Frame Allocation policies, Thrashing, File System - Concepts, Access Method, Directory Structure and File System Management.

Disk management and Security: Disk management - Disk Structure and Scheduling, File systems and operating system support for distributed systems, Security- Protection Goals, Access Control, Program threats, System threats.

Advanced Operating Systems: Needs & Design Goals – Distributed OS, Multiprocessor OS, Mobile OS, MAC OS.

Learning Resources

1. AviSilberschatz, Peter Baer Galvin and Greg Gagne: Operating System Concepts, Ninth edition, John Wiley and Sons, 2012.

2. Advanced Concepts in Operating Systems, MukeshSinghal, Niranjan G. Shivaratri, Tata McGraw-Hill Edition 2001.

3. Andrew S. Tanenbaum, Albert S.WoodHull: Operating Systems, Design and Implementation, Fourth Edition, Prentice Hall, 2008.

4. Gary Nutt, “Operating Systems”, Third Edition, Addison Wesley, 2004

Course Contents and Lecture Schedule

Module No.	Topic	No. of Lectures	Course Outcome
1	**Introduction (7)**		
1.1	Role of OS	1	CO1
1.2	Types of OS	2	CO1
1.3	System Architecture	1	CO1
1.4	System components	1	CO1
1.5	System Design	1	CO2
1.6	Design Trade-offs	1	CO2
2	**Process Management (10)**		
2.1	Concepts - Process status, Process description, Process model	2	CO3
2.2	Process Scheduling - Scheduler organization, pre-emptive and non-pre-emptive scheduler strategies	2	CO3
2.3	Scheduling algorithms- FCFS, SJF, SRTF, Priority Scheduling, Round Robin Scheduling, Multiple Processor scheduling	4	CO3
2.4	Thread Concepts and Multiple threaded OS	2	CO3
3	**Process Synchronization and Deadlock (9)**		
3.1	Process Co-operation	1	CO3
3.2	Inter-process communication	1	CO3
3.3	Process Synchronization	1	CO3
3.4	Synchronization Issues	1	CO3
3.5	Critical Section problem	1	CO3
3.6	Mutual exclusion	1	CO3
3.7	Semaphores	1	CO3
3.8	Deadlock - Conditions, Prevention, Avoidance and Recovery.	2	CO4
4	**Memory Management and File system (4)**		
4.1	Paging	1	CO5
4.2	Segmentation and Contiguous memory allocation	1	CO5
4.3	Virtual Memory - Demand Paging, Page replacement and Frame Allocation policies, Thrashing	1	CO5
4.4	File System - Concepts, Access Method, Directory Structure and File System Management	1	CO5
5	**Disk management and Security (3)**		
5.1	Disk Structure and Scheduling	1	CO6
5.2	File systems and operating system support for distributed systems	1	CO6
5.3	Security measures	1	CO6
6	**Advanced Operating Systems (3)**		
6.1	Needs & Design Goals – Distributed OS, Multiprocessor OS, Mobile OS, MAC OS.	3	CO2
	Total Hours	**36**	

List of Experiments

Module No.	Topic	No. of Lectures	Course Outcome
1.	Experiment to implement the following CPU scheduling algorithms a) FCFS b) SJF c) Round Robin d) Priority	4	CO3
2.	Program to implement producer – consumer problem using semaphores	2	CO3
3.	Program to implement Dining-philosophers problem	2	CO3
4.	Program to implement InterProcess Communication Using Pipes	2	CO3
5.	Program to implement the following contiguous memory allocation Techniques a) Worst fit b) Best fit c) First fit.	2	CO4
6.	Program to implement Bankers Algorithm for Dead Lock Avoidance.	2	CO4
7.	Program to implement Bankers Algorithm for Dead Lock Prevention	2	CO4
8.	Simulate all page replacement algorithms a) FIFO b) LRU c) OPTIMAL	2	CO5
9.	Simulate all File Organization Techniques a) Single level directory b) Two level directory	2	CO5
10.	Simulate all file allocation strategies a) Sequential b) Indexed c) Linked.	2	CO5
11.	Program to simulate disk scheduling algorithms. a) FCFS b) SCAN c) C-SCAN	2	CO6
	Total Hours	**24**	

Course Designers:

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2. Ms. C.Santhiya ,Assistant Professor , CSE csit@tce.edu

		Category	L	T	P	Credit
22CS370	**DATA STRUCTURES LAB**	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

22CS240 : Problem Solving using Computers

Course Outcomes

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

CO	Course Outcome	TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Construct and Implement the stack and queue functionality for suitable applications.	TPS3	A	75
CO2	Implement the operations in linked list data structure for suitable applications	TPS3	A	75
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	TPS3	A	75
CO4	Implement heap tree for various applications	TPS3	A	75
CO5	Show the avoidance of collisions in the hash tables using collision resolution techniques including open and closed hashing techniques.	TPS3	A	75
CO6	Analyse various internal sorting techniques	TPS3	A	75
CO7	Implement of disjoint set and analyse their performance.	TPS3	A	75

Mapping with Programme Outcomes

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

CO 4	S	M	L		M	L	L	L	L	L	L	M	M	L	L
CO 5	S	M	L		M	L	L	L	L	L	L	M	M	L	L
CO 6	S	M	L		M	L	L	L	L	L	L	M	M	L	L
CO 7	S	M	L		M	L	L	L	L	L	L	M	M	L	L

S- Strong; M-Medium; L-Low

Assessment Pattern

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

List of Experiments/Activities with CO Mapping

Module No.	Topic	CO
1	Array and List implementation of Stack, Queue and Circular Queue ADTs	CO1
2	Implementation of Evaluating Postfix Expressions, Infix to Postfix conversion using stack	CO1
3	Implementation of Josephus Problem using DLL	CO1
4	Implementation of Palindrome Checking using Stack and DLL	CO1
5	Implementation of Singly Linked List	CO2
6	Implementation of Polynomial Manipulation using Linked list	CO2
7	Implementation of Binary Search Trees-operations and traversal.	CO3
8	Implementation of AVL Trees	CO3
9	Implementation of Heaps using Priority Queues	CO4
10	Implementation of Open and Closed Hashing	CO5
11	Implementation internal sorting algorithms	CO6
12	Implementation of disjoint sets with smart union and path compression methods	CO7

Learning Resources

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2nd Edition, Pearson Education, 2005.
2. Kamthane, Introduction to Data Structures in C, 1st Edition, Pearson Education, 2007
3. Y. Langsam, M. J. Augenstein and A. N. Tanenbaum, “Data Structure Using C and C++”, Pearson Education, 2nd Edition, 2015.
4. Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein, Introduction to Algorithms", Fourth Edition, Mcgraw Hill/ MIT Press, 2022.

Course Designer(s):

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2. Mrs.RajaLavanya, Assistant Professor,CSE rlit@tce.edu

22CS380	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

Programming Fundamentals

Course Outcomes

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

CO	Course Outcome	TCE Proficiency Scale	Expected Proficiency (%)	Expected Attainment Level (%)
CO1	Construct Object oriented programs using methods and passing arrays, objects, and array of objects to them	TPS3	B	80
CO2	Demonstrate Compile-time and Run-time polymorphism using object oriented programs	TPS3	B	80
CO3	Illustrate the relationships between objects using inheritance hierarchies and aggregation	TPS3	B	80
CO4	Develop Object Oriented programs to handle data using Java Collections, Files and Object Serialization	TPS3	B	80
CO5	Develop Object Oriented programs to handle exceptions	TPS3	B	80
CO6	Develop Object Oriented programs to demonstrate event driven programming, concurrent programming and network programming.	TPS3	B	80

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PS	PS	PS

	1	2	3	4	5	6	7	8	9	10	11	12	O1	O2	O3
CO1	S	M	L		L	L		L	M	M		L	M	L	L
CO2	S	M	L		L	L		L	M	M		L	M	L	L
CO3	S	M	L		L	L		L	M	M		L	M	L	L
CO4	S	M	L		L	L		L	M	M		L	M	L	L
CO5	S	M	L		L	L		L	M	M		L	M	L	L
CO6	S	M	L		L	L		L	M	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		

List of Experiments 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.	Develop Object Oriented Program for passing arrays and objects as arguments to method and returning objects from methods	CO1
3.	Construct Object Oriented Program for method overloading and constructor overloading	CO2
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.	Develop Object Oriented Program for manipulation of data using Collections in Java	CO4
9.	Construct Object Oriented Program to demonstrate exception	CO5

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

Learning Resources

1. Herbert Schildt: "Java: The Complete Reference", Twelfth Edition, McGraw-Hill, 2021.
2. Tony Gaddis, "Starting Out with Java: From Control Structures through Objects", Sixth edition, Pearson Education Limited, 2016.
3. Bart Baesens, Aimee Backiel, SeppevandenBroucke, "Beginning Java Programming:The Object-Oriented Approach", John Wiley & Sons, 2015.
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, KelliHouston"Object Oriented Analysis and Design with Applications", Third Edition, 2012

Course Designers:

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CURRICULUM AND DETAILED SYLLABI

FOR

B.E DEGREE (Computer Science and Engineering) PROGRAMME

FOURTH SEMESTER

FOR THE STUDENTS ADMITTED FROM THE

ACADEMIC YEAR 2022 - 2023 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 2022-23 onwards)

FOURTH SEMESTER

Course Code	Name of the Course	Category	No. of Hours / Week			credits
			L	T	P	
THEORY						
22CS410	Discrete Mathematics	BSC	3	1	-	4
22CS420	Design and Analysis of Algorithms	PC	3	-	-	3
22CS430	Data Communication and Networks	PC	3	-	-	3
22CS440	Database Management Systems	PC	3	-	-	3
22CS490	Project Management	HSS	3	-	-	3
THEORY CUM PRACTICAL						
22CS450	Web Programming	PC	2	-	2	3
22EG460	Professional Communication	HSS				2
PRACTICAL						
22CS470	Databases Lab	PC	-	-	2	1
22CS480	Algorithms Lab	PC	-	-	2	1
AUDIT COURSE						
		Total	**17**	**1**	**6**	**23**

BSC : Basic Science Courses
PC : Professional Core Courses
ESC : Engineering Science Courses

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 2022-23 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	22CS410	Discrete Mathematics	3	40	60	100	27	50
2	22CS420	Design and Analysis of Algorithms	3	40	60	100	27	50
3	22CS430	Data Communication and Networks	3	40	60	100	27	50
4	22CS440	Database Management Systems	3	40	60	100	27	50
5	22CS490	Project Management	3	40	60	100	27	50
THEORY CUM PRACTICAL								
6	22CS450	Web Programming	3	50	50	100	22.5	50
7	22EG460	Professional Communication						
PRACTICAL								
8	22CS470	Databases Lab	3	60	40	100	18	50
9	22CS480	Algorithms Lab	3	60	40	100	18	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

		Category	L	T	P	Credit
22CS410	**DISCRETE MATHEMATICS**	BSC	3	1	0	4

Preamble

A course in discrete mathematics elaborates 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, sets, functions, relations groups, rings and fields. 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 and generating functions. These methods are very useful in constructing computer programs and in mastering many theoretical topics of computer science.

Prerequisite

Nil

Course Outcomes

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

		TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Apply the concepts of sets, functions and relations to solve the problems in the field of science and technology.	TPS3	B	80
CO2	Translate statements in english into logical expressions and verify theirequivalences.	TPS3	B	80
CO3	Introduce predicate calculus and apply logic rules of inference to check the validity of the propositional calculus, predicate calculus statements and to prove theorems.	TPS3	B	80
CO4	Apply the concept of recursion in recursive algorithims.	TPS3	B	80
CO5	Apply counting techniques to solve combinatorial problems	TPS3	B	80
CO6	Apply the concept of algebraic structures in coding theory.	TPS3	B	80

Mapping with Programme Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	S	M	L		M			L	M	L		M	M	L	L
CO2.	S	M	L		M			L	M	L		M	M	L	L
CO3.	S	M	L		M			L	M	L		M	M	L	L
CO4	S	M	L		M			L	M	L		M	M	L	L

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

S- Strong; M-Medium; L-Low

Assessment Pattern

CO	Assessment 1						Assessment 2						Terminal (%)		
	CAT 1 (%)			Assignment 1 (%)			CAT 2 (%)			Assignment 2 (%)					
TPS	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
	10	30	60	-	-	100	10	30	60	-	-	100	-	30	70
CO1	3	10	20	-	-	40	-	-	-	-	-	-		6	12
CO2	-	10	20	-	-	30	-	-	-	-	-	-		3	12
CO3	-	10	20	-	-	30	-	-	-	-	-	-		3	12
CO4	7	-	-	-	-	-	3	-	14	-	-	20		3	10
CO5	-	-	-	-	-	-	7	20	30	-	-	60		12	12
CO6	-	-	-	-	-	-	-	10	16	-	-	20		3	12
TOTAL	10	30	60	-	-	100	10	30	60	-	-	100	-	30	70

Syllabus

Sets, Relations and Functions: Set- subsets- set operations – cardinality of sets – Relations and their properties – Representing relations – Equivalence relations. Functions-One-one function - Onto function – Bijective function –Inverse function.

Propositional calculus and Proof Techniques: Propositional logic – Applications of propositional logic – propositional equivalences – predicates and quantifiers – Nested quantifier – rules of inferences -Introduction to proofs.

Recursion: Recurrence relations, Recursion: Introduction - Recursively defined functions - Recursively defined sets and structures – Structural and general induction – Recursive algorithms.

Counting: The basics of counting – The Pigeonhole principle, the generalized Pigeonhole principle – Permutations and Combinations - Applications of recurrence relations - Solving linear recurrence relations: Homogeneous and non-homogeneous – Generating functions – Solving recurrence relations using generating functions.

Algebraic Structures: The structure of Algebras- Semigroups, Monoids and Groups, Abelian groups – Homomorphisms – Normal subgroups and congruence relations – Rings, Integral domains and Fields – Quotient and Product algebras – Coding theory – Polynomial codes.

Text Books

1. Kenneth H. Rosen., “Discrete Mathematics and Its Applications”, 8thEdition, McGraw hill publications, 2019.

Reference Books& web resources

1. T.P. Tremblay and R. Manohar, "Discrete Mathematical Structures with application to Computer Science”, Tata McGraw Hill, 2017.
2. Alan Tucker, “Applied Combinatorics", John Wiley & Sons, Incorporated, 2012.
3. Ralph P.Grimaldi, “Discrete and Combinatorial Mathematics, Pearson, 2006.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Periods
1	**Sets, Relations and Functions**	
1.1	Set, Subsets set operations, cardinality of sets	1
1.2	Relations and their properties, Representing relations	1
	Tutorial	1
1.3	Equivalence relations	2
	Tutorial	1
1.4	Functions: one-one, onto, Bijective, inverse	2
2	**Propositional Calculus and Proof Techniques**	
2.1	Propositional logic	1
2.2	Applications of propositional logic	2
	Tutorial	1
2.3	Propositional equivalences	2
	Tutorial	1
2.4	Predicates and quantifiers	1
2.5	Nested quantifiers	1
2.6	Rules of inferences	2
2.7	Introduction to proofs	2
	Tutorial	1
3	**Recursion**	
3.1	Recurrence relations	1
3.2	Recursion: Introduction, recursively defined functions	1

Module No.	Topic	No. of Periods
	Tutorial	1
3.3	Recursively defined sets and structures, Structural and general induction	1
3.4	Recursive algorithms	1
	Tutorial	1
4	**Counting**	
4.1	The basics of counting	2
4.2	The pigeonhole principle, generalized pigeonhole principle, applications of pigeonhole principle	1
	Tutorial	1
4.3	Permutations and combinations	2
	Tutorial	1
4.4	Applications of recurrence relations	1
4.5	Solving linear recurrence relations	2
	Tutorial	1
4.6	Generating functions – Introduction, solve recurrence relations using generating functions.	2
5	**Algebraic Structures**	
5.1	The structure of algebras	1
5.2	Semigroups, Monoids and Groups, Abelian groups	1
	Tutorial	1
5.3	Homomorphisms, Normal subgroups, congruence relations	1
5.4	Rings, integral domains and fields, Quotient and product algebras	1
5.6	Coding theory and polynomial codes	1
	Tutorial	1
	Total	**48**

Course Designer(s):

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22CS420	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

- 22CS240: Problem Solving and Programming
- 22CS340: Data Structures and Algorithms

Course Outcomes

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

CO	Course Outcome	TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Identify the problem and its complexity using frameworks like recurrences and amortized analysis.	TPS3	B	75
CO2	Apply graph algorithms to solve problems and analyze their efficiency.	TPS3	B	75
CO3	Analyze algorithm design techniques like divide and conquer, dynamic programming to solve problems.	TPS4	B	75
CO4	Apply design principles for developing solutions using greedy algorithm approaches.	TPS3	B	75
CO5	Use the state space tree method like backtracking and branch & bound techniques for solving problems.	TPS4	B	75
CO6	Determine the significance of NP complete problems and approximation algorithms.	TPS3	B	75

Mapping with Programme Outcomes

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

CO 6	S	M	L					L	M	M		M	M		M

S- Strong; M-Medium; L-Low

Assessment Pattern

CO	CAT1						Assignment-1	CAT2						Assignment-2	Terminal					
TPS Scale	1	2	3	4	5	6		1	2	3	4	5	6		1	2	3	4	5	6
CO1	8	5	20				30								6		10			
CO2	8	5	20				30								2	5	10			
CO3	4	10		20			40								2	5		10		
CO4								8	5	20				30	2	5	10			
CO5								4	10		20			40	2	5		10		
CO6								8	5	20				30	6		10			

*****Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

Syllabus

INTRODUCTION:

Algorithm analysis: Time and space complexity - Asymptotic Notations and its properties Best case, Worst case and average case analysis – **Amortized Analysis**: Aggregate, Accounting and Potential Method – **Recurrence relation:** substitution method, recursion tree method, Master Theorem – **Searching and sorting algorithms analysis:** linear search, binary search and Insertion sort, heap sort.

GRAPH ALGORITHMS

Elementary Graph algorithms: Representations of graphs - Breadth-first search - Depth-first search - Topological sort - Strongly connected components - **Minimum spanning tree**: Kruskal's and Prim's algorithm, **Shortest path:** Bellman-Ford algorithm - Dijkstra's algorithm - Floyd-Warshall algorithm **Network flow:** Flow networks - Ford-Fulkerson method – **Matching:** Maximum bipartite matching

ALGORITHM DESIGN TECHNIQUES

Divide and Conquer methodology: Find maximum and minimum numbers - Merge sort - Quick sort – Strassen's Matrix Multiplication Algorithm – Karatsuba integer multiplication Algorithm. **Dynamic programming:** Elements of dynamic programming — Matrix-chain multiplication -— Optimal Binary Search Trees – Knapsack Problem. **Greedy Technique:** Elements of the greedy strategy - Activity-selection problem — Huffman Trees – Knapsack Problem.

STATE SPACE SEARCH ALGORITHMS

Backtracking: n-Queens problem - Hamiltonian Circuit Problem - Subset Sum Problem – Graph coloring problem **Branch and Bound:** Solving 15-Puzzle problem - Assignment problem – Knapsack Problem - Travelling Salesman Problem

NP-COMPLETE ALGORITHMS

Tractable and intractable problems: Polynomial time algorithms – Polynomial time verification - Venn diagram representation – NP algorithms - NP-hardness and NP-completeness – Bin Packing problem - Problem reduction: TSP – 3- CNF problem

Text Books

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", 3rd Edition, Prentice Hall of India, 2009.
2. Ellis Horowitz, SartajSahni, SanguthevarRajasekaran “Computer Algorithms/C++” Orient Blackswan, 2nd Edition, 2019.

Reference Books & web resources

1. Anany Levitin, “Introduction to the Design and Analysis of Algorithms”, 3rd Edition, Pearson Education, 2012.
2. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures and Algorithms", Reprint Edition, Pearson Education, 2006.
3. S. Sridhar, “Design and Analysis of Algorithms”, Oxford university press, 2014.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Periods
1	**INTRODUCTION**	
1.1	Time and space complexity- Asymptotic Notations and its properties Best case, Worst case and average case analysis	1
1.2	Amortized Analysis: Aggregate, Accounting and Potential Method with example	1
1.3	Recurrence relation: substitution method, Master Theorem	2
1.4	Searching: linear search, binary search and Interpolation Search	1
1.5	Pattern search: The naïve string matching algorithm	1
1.6	Rabin-Karp algorithm - Knuth-Morris-Pratt algorithm	1
1.7	Sorting: Insertion sort – heap sort	1
2	**GRAPH ALGORITHMS**	
2.1	Shortest path: Bellman-Ford algorithm	1
2.2	Dijkstra’s algorithm - Floyd-Warshall algorithm	2
2.3	Network flow: Flow networks - Ford-Fulkerson method	1
2.4	Matching: Maximum bipartite matching	1

Module No.	Topic	No. of Periods
3	**ALGORITHM DESIGN TECHNIQUES**	
3.1	Divide and Conquer methodology: Finding maximum and minimum - Merge sort, Quick sort	2
3.2	Strassen's Matrix Multiplication Algorithm – Karatsuba integer multiplication Algorithm	2
3.3	Dynamic programming: Elements of dynamic programming — Matrix-chain multiplication	1
3.4	Optimal Binary Search Trees – Knapsack Problem	2
3.5	Greedy Technique: Elements of the greedy strategy - Activity-selection problem	1
3.6	Huffman Trees – Knapsack Problem	2
4	**STATE SPACE SEARCH ALGORITHMS**	
4.1	Backtracking: n-Queens problem - Hamiltonian Circuit Problem	1
4.2	Subset Sum Problem – Graph coloring problem	1
4.3	Branch and Bound: Solving 15-Puzzle problem - Assignment problem	2
4.4	Knapsack Problem - Travelling Salesman Problem	1
5	**NP-COMPLETE AND APPROXIMATION ALGORITHMS**	
5.1	Tractable and intractable problems: Polynomial time algorithms – Venn diagram representation	1
5.2	NP algorithms - NP-hardness and NP-completeness	1
5.3	Bin Packing problem - Problem reduction: TSP – 3-CNF problem	2
5.4	Approximation Algorithms: Travelling Salesman Problem	1
	Total	36

Course Designer(s):

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22CS430	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, reference models, layers, protocols, switching, routing and applications that use Computer Networks. This course introduces the concepts in Computer Networks with emphasis to different layers and the functionality of 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

22CS220 Electronics and Digital Systems

Course Outcomes

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

CO	Course Outcome Statement	TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Explain the operation of network applications with an understanding of the network models, switching techniques and layered architecture.	TPS2	70	85
CO2	Illustrate the concepts for transmission, and multiplexing techniques.	TPS3	70	80
CO3	Solve flow and error control issues in the data link layer, using appropriate techniques.	TPS3	70	80
CO4	Identify the performance implications of multiple access protocols.	TPS3	70	80
CO5	Construct routing and forwarding solutions for packet switching networks, with an understanding of the router architectures, algorithms and protocols.	TPS3	70	80
CO6	Identify the performance of transport layer protocols under given scenario.	TPS4	70	80

Mapping with Programme 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	L		M	M		L
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	L		M	M	L	L

Assessment Pattern

CO	CAT1						CAT2						Terminal					
TPS Scale	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
CO1	10	20						20					5	20				
CO2	10	10	20										5	5	10			
CO3		10	20											5	10			
CO4								20	20					10	10			
CO5									20						10			
CO6										20						10		

CO	Assignment 1						Assignment 2					
TPS Scale	1	2	3	4	5	6	1	2	3	4	5	6
CO1												
CO2												
CO3			100									
CO4												
CO5									50			
CO6										50		

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
Network Types: WAN, MAN, LAN, WLAN - Infrastructured and Ad hoc networks
Physical Layer – Transmission techniques, Multiplexing - TDM, FDM, WDM
Datalink Layer: Framing, Error Detection and Correction: Types of Errors - Error Detection, Cyclic Redundancy Check, Checksum, Forward Error Correction - Data link Control - Media Access Control (MAC): CSMA/CD, CSMA/CA– Channelization: FDMA, TDMA, CDMA
Network Layer - Connecting Devices: Hubs, Link-Layer Switches, Routers – 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 – Internet Control Message Protocol (ICMP) - Address Resolution Protocol (ARP) - RARP
Transport Layer: Transmission Control Protocol, User Datagram Protocol
Presentation Layer: Encryption/Decryption, Authentication, Translation
Application Layer: FTP - TELNET HTTP- Secure Shell (SSH) - Domain Name System (DNS)

Text Book

1. Data Communications and Networking, 5th Edition, BehrouzForouzan, Mc Graw Hill, 2017

Reference Books& web resources

1. Computer Networks: A Systems Approach, Larry L. Peterson, Bruce S. Davie, Elsevier, Mar 2011
2. 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**		
1.1	The OSI Model - TCP/IP Protocol Suite - OSI versus TCP/IP	2	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	**Network Types**		
3.1	WAN, MAN, LAN	1	CO1
3.2	WLAN - Infrastructured and Ad hoc networks	1	CO1
	Physical Layer		
4.1	Transmission techniques	1	CO2
4.2	TDM, FDM, WDM	2	CO2
5	**Datalink Layer**		
5.1	Framing	1	CO3
5.2	Error Detection and Correction - Types of Errors, Error Detection, Cyclic Redundancy Check, Checksum, Forward Error Correction	2	CO3
5.3	Datalink Control	2	CO4
5.4	Media Access Control (MAC): CSMA/CD(Ethernet), CSMA/CA, Controlled Access	1	CO4
5.5	Channelization: FDMA, TDMA, CDMA	2	CO4
6	**Network Layer**		
6.1	Connecting Devices: Hubs, Link-Layer Switches, Routers	2	CO5
6.2	Routing and Forwarding-Distance-Vector and Link-State Routing	2	CO5
6.3	Performance Metrics : Delay, Throughput, Packet Loss, Congestion Control	2	CO5
6.4	Addressing: Internet Protocol –IPV6, IPV4 Addresses: Classful Addressing, Classless Addressing	2	CO5
6.5	Internet Control Message Protocol(ICMP), Address Resolution Protocol (ARP), RARP	2	CO5
7	**Transport Layer**		
7.1	Transmission Control Protocol	2	CO6
7.2	User Datagram Protocol	1	CO6
8	**Presentation Layer**		
8.1	Encryption/Decryption	1	CO1
8.2	Authentication, Translation	1	CO1
9	**Application Layer**		
9.1	FTP	1	CO1
9.2	TELNET	1	CO1
9.3	HTTP,Secure Shell (SSH)	1	CO1
9.4	Domain Name System (DNS)	1	CO1
	Total	36	

Course Designer(s):

1. Dr.C.Senthilkumar, Asso.Prof., CSE cskcse@tce.edu
2. Dr.G.S.R.EmilSelvan, APCSE emil@tce.edu

		Category	L	T	P	Credit
22CS440	**DATABASE MANAGEMENT SYSTEMS**	PC	3	0	0	3

Preamble

This course provides the students to understand the various concepts and functionalities of Database Management Systems. It includes various data models to store & retrieve data and the use of query languages, the effective designing of relational database, creating storage and access structures. Also, the students will learn about the concepts of transaction management, concurrency mechanisms and recovery procedures. This course also introduces about different forms of NoSQL databases.

Prerequisite

22CS340 – Data Structures and Algorithms

Course Outcomes

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

	Course Outcomes	TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Develop data models such as Entity Relationship (ER) model and Relational model for a given application requirement. (Apply)	TPS3	B	85
CO2	Manipulate relational database using Relational languages and PL/SQL sub programs. (Apply)	TPS3	B	85
CO3	Design normalized databases for a given application by incorporating various constraints and normal forms. (Apply)	TPS3	B	85
CO4	Construct data structures like indexes and hash tables to support fast retrieval of data and explain query processing and optimization methods. (Apply)	TPS3	B	85
CO5	Make use of different forms of transactions, concurrency control and recovery mechanisms to maintain data consistency in a multi user environment. (Apply)	TPS3	B	85
CO6	Demonstrate NoSQL models for building the databases. (Apply)	TPS3	B	85

Mapping with Programme Outcomes

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

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

S- Strong; M-Medium; L-Low

Assessment Pattern

CO	CAT1			Assignment 1			CAT2			Assignment 2			Terminal		
TPS Scale	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**
CO1	5	10	15			20							1	5	10
CO2	5	10	25			60							2	5	15
CO3	5	10	15			20							2	5	10
CO4							5	10	25			45	2	5	10
CO5							5	10	25			45	2	5	10
CO6							5	5	10			10	1	5	5
Total	15	30	55				15	25	60				10	30	60

*****Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

Syllabus

Introduction to database and Data Models: Purpose of database system, System Architecture, Components of DBMS, Data Models – ER model, Relational model - Concept of relation, Constraints, Mapping ER model to Relational Model

Relational Languages - Relational algebra, Structured Query Language - DDL, DML – Set operations, Aggregate Functions., Nested Subqueries. Intermediate SQL – Joins, Views, Index, Transactions, Integrity Constraints, Authorization. Advanced SQL – Introduction to PL/SQL – Procedures, Functions and Triggers, Accessing SQL from Programming Languages, Recursive Queries.

Database design: Decomposition, Functional Dependencies - Closure set of FD's for key identification, Decomposition – Lossless decomposition, Normal forms – 1NF, 2NF, 3NF, Dependency Preserving – BCNF, Multivalued Dependencies and 4NF, Join dependencies and 5NF.

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

Data Storage and structures: RAID levels, Database Compression, De-Duplication, File Organization - Indexing – Ordered Index - B+ tree – properties, insertion and deletion, Hashing - Static and dynamic hashing.
Query Processingand Optimization Basics of query processing and optimization.

No SQL databases: CAP Theorem – Document Based systems – Key value Stores – Column Based Systems – Graph Databases. **Database Security:** Security issues – Access control based on privileges – Role Based access control – SQL Injection

Text Book

1. Silberschatz, A, Henry F. Korth, and S. Sudharshan, “Database System Concepts”, 7th Edition, Tata McGraw Hill, 2019.

Reference Books & web resources

1. RamezElmasri and Shamkant B. Navathe, “Fundamentals of Database Systems”, 7thEdition, Pearson/Addisionwesley, 2016
2. C. J. Date, A. Kannan and S. Swamynathan, “An Introduction to Database Systems”, 8thed, Pearson Education, 2006
3. Raghu Ramakrishnan, “Database Management Systems”, Third Edition, McGraw Hill, 2002.
4. Pramod J. Sadalage, Martin Fowler, “NoSQL Distilled - A Brief Guide to the Emerging World of Polyglot Persistence”, Pearson Education, 2012.
5. Andreas Meier, Michael Kaufmann, “ SQL& NoSQL Databases - Models, Languages, Consistency Options and Architectures for Big Data Management” , Springer Fachmedien Wiesbaden, 2019.
6. https://nptel.ac.in/courses/106105175 (Database Management System, IIT Kharagpur)
7. https://nptel.ac.in/courses/106/106/106106220

Course Contents and Lecture Schedule

Module No.	Topic	No. of Periods
1	**Introduction to database and Data Models (5)**	
1.1	Purpose of database system	1
1.2	System Architecture, Components of DBMS	
1.3	Data Models – ER model	1
1.4	Relational model - Concept of relation, Constraints	1
1.5	Mapping ER model to Relational Model	2
2	**Relational Languages (9)**	
2.1	Relational algebra	1
2.2	Structured Query Language - DDL, DML	1
2.3	Set operations, Aggregate Functions	1
2.4	Nested Subqueries	1

Module No.	Topic	No. of Periods
2.5	Intermediate SQL – Joins, Views, Index	1
2.6	Transactions, Integrity Constraints, Authorization	1
2.7	Advanced SQL – Introduction to PL/SQL – Procedures, Functions and Triggers	2
2.8	Accessing SQL from Programming Languages	1
2.9	Recursive Queries	
3	**Database design (6)**	
3.1	Decomposition – Lossless decomposition	1
3.2	Functional Dependencies - Closure set of FD's for key identification	1
3.3	Normal forms – 1NF, 2NF, 3NF	1
3.4	Dependency Preserving – BCNF, Multivalued Dependencies and 4NF	2
3.5	Join dependencies and 5NF	1
4	**Transaction and Concurrency control (6)**	
4.1	Transaction concepts	1
4.2	Concurrent Execution, Serializability	2
4.3	Concurrency Control - Lock based protocol, Deadlock handling	2
4.4	Recovery System - Log-based Recovery, Recovery with Concurrent Transaction	1
5	**Data Storage and structures (6)**	
5.1	RAID levels	1
5.2	Database Compression, De-Duplication	
5.3	File Organization - Indexing – Ordered Index	1
5.4	B+ tree – properties , insertion, deletion	2
5.5	Hashing - Static and dynamic hashing	1
5.6	**Query Processingand Optimization -** Basics of query processing and optimization	1
6	**Introduction to No SQL databases (4)**	
6.1	Introduction – CAP Theorem	1
6.2	Document Based systems – Key value Stores	1

Module No.	Topic	No. of Periods
6.3	Column Based Systems – Graph Databases	1
6.4	Database Security: Security issues – Access control based on privileges, Role Based access control – SQL Injection	1
	Total	**36**

Course Designer(s):

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2. Mr. M. Sivakumar mskcse@tce.edu

22CS450	WEB PROGRAMMING

Category	L	T	P	Credit
PC	2	0	2	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

Programming Fundamentals

Course Outcomes

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

CO	Course Outcome 1 (CO1)	TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Model web pages using HTML and DHTML (Apply)	TPS3	A	80
CO2	Demonstrate client side scripting which interact with users (Apply)	TPS3	A	80
CO3	Build user interfaces using React.(Apply)	TPS3	A	80
CO4	Illustrate multi-tier applications using JSP (Apply)	TPS3	A	80
CO5	Illustrate multi-tier applications using Node JS and Express framework (Apply)	TPS3	A	80
CO6	Develop web application using XML related technologies. (apply)	TPS3	A	80

Mapping with Programme Outcomes

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	S	M	L	-									M	L	L
CO2	S	M	L	-	M		L	L	L	L		L	M	L	L
CO3	S	M	L	-	M		L	L	L	L		L	M	L	L
CO4	S	M	L	-	M		L	L	L	L	L	L	M	L	L
CO5	S	M	L	-	M		L	L	L	L		L	M	L	L
CO6	S	M	L	-	M		L	L	L	L	L	L	M	L	L

S- Strong; M-Medium; L-Low

Assessment Pattern

CO	CAT1(Theory Component)						CAT2(Theory Component)						Model (Lab Component)			OCR			Terminal(Theory Component)					
	100						100						100			100			100					
TPS Scale	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	1	2	3	1	2	3	4	5	6
CO1	10		10												10			10	2	4	10			
CO2	10	10	10												20			20	2	4	10			
CO3	10	20	20												20			20	4	4	10			
CO4							10		10						20			20	4	4	10			
CO5							10	10	10						20			20	4	4	10			
CO6							10	20	20						10			10	4		10			

*****Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

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, HTTP request types.

Client-side programming: Java script: introduction, control statements, functions, objects. Event handling. JQuery: HTML and DOM manipulation, HTML event methods, AJAX.

Building User Interface: React –API, Classes, Arrow Function, Form, List, Sass Styling

Server-Side programming: JSP introduction, programming, Servlets - Introduction, Architecture, Programming with database connectivity.

JavaScript on Server: Node.js – Node JS HTTP Module, File system, URL Module, Events, Upload files, Introduction to the Express framework – Server-side rendering with Templating Engines – Static Files - async/await - Fetching JSON from Express.

XML: XML basics, DTD, XML Schema, XML Parser, XPATH, XMLQuery.

Text Book

1. David Flanagan, “Java Script: The Definitive Guide”, O’Reilly Media, Inc, 7th Edition, 2020
2. Matt Frisbie, "Professional JavaScript for Web Developers", Wiley Publishing, Inc, 4th Edition, ISBN:978-1-119-36656-0, 2019
3. Deitel and Deitel, “Internet and World Wide Web How to Program”, Prentice Hall of India, Fifth Edition, 2018.
4. Paul J.Deitel and Harvey M.Deitel, “AJAX, Rich Internet Applications, and Web Development for Programmers”, Pearson Education, First Edition, 2009.
5. Alex Banks, Eve Porcello, "Learning React", O’Reilly Media, Inc, 2nd Edition, 2020

6. Marc Wandschneider, “Learning Node”, Addison-Wesley Professional, 2nd Edition, 2016

Course Contents and Lecture Schedule

Module No.	Topic	No. of Periods
1	**Web page design:**	
1.1	HTML5: headers, Linking, Images, Image map, meta elements, frameset, HTML forms, cascading style sheet.,	1
1.2	DHTML: object model, Event model, Two tier and Three tier architecture, J2EE architecture, HTTP request types.	1
2	**Client-side programming:**	
2.1	Java script: introduction, control statements, functions, objects. Event handling.	1
2.2	JQuery: HTML and DOM manipulation, HTML event methods, AJAX,	2
3	**Building User Interface:**	
3.1	React –Classes, Arrow Function, Form,	2
3.2	List, Sass Styling	1
4	**Server-Side programming**	
4.1	JSP introduction, programming,	1
4.2	Servlets - Introduction, Architecture,	2
4.3	Programming with database connectivity.	2
5	**Javascript on Server:**	
5.1	Node.js – Node JS HTTP Module,	1
5.2	File system, URL Module,	1
5.3	Events, Upload files,	1
5.4	Introduction to the Express framework	1
5.5	Server-side rendering with Templating Engines	1
5.6	Static Files - async/await, Fetching JSON from Express	2
6	**XML:**	
6.1	XML basics, DTD, XML Schema,	2

Module No.	Topic	No. of Periods
6.2	XML Parser, XPATH, XMLQuery	2
	Total	24

List of Experiments:

S. No.	Experiments	CO mapping	No. of Periods
1.	Implement Client-side form design and validation.	CO1	2
2.	Create a Webpage to handle Events and Objects using Java Script.	CO2	2
3.	Develop application to demonstrate applications of JQuery and Ajax.	CO2	4
4.	Develop client-side application using React API	CO3	4
5.	Develop a multitier application using JSP	CO4	4
6.	Illustrate multi-tier applications using Node JS and Express framework	CO5	4
7.	Implement a program for DOM to Process XML File	CO6	4
		Total	24

Course Designer(s):

1. Mr. M. Siva Kumar, mscse@tce.edu
2. Dr. M. Vijayalakshmi, mviji@tce.edu

22CS470	DATABASES LAB

Category	L	T	P	Credit
PC	0	0	2	1

Preamble

This course aims at facilitating the student to design database applications for the real world problems and perform operations such as creation, manipulation and maintenance of databases using RDBMS tools. It facilitates the students to access databases through high level languages using appropriate APIs. This course also enables students to work with NoSQL databases and execute basic query operations over it.

Prerequisite

Concepts of Databases

Course Outcomes

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

	Course Outcome	TCE Proficiency Scale	Expected Proficiency (%)	Expected Attainment Level (%)
CO1	Create Entity Relationship and Relational models for the given real-world application.	TPS3	A	75
CO2	Design normalized database using various constraints.	TPS3	A	75
CO3	Construct relational database and manipulate them using simple and complex queries in SQL	TPS3	A	75
CO4	Create and use different database objects like Index, View, Sequence, abstract data types , Varray and Nested table using SQL	TPS3	A	75
CO5	Develop sub programs like Procedure, Functions, Triggers and Package using Pl/SQL and manipulate the database through these programs	TPS3	A	75
CO6	Develop a complete database application using higher level language through JDBC /ODBC	TPS3	A	75
CO7	Develop NoSQL database and demonstrate execution of simple queries on it.	TPS3	A	75

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	S	M	L		M	L		M	M	M		L	M	L	M
CO2.	S	M	L		M	L		M	M	M		L	M	L	M
CO3.	S	M	L		S	L		M	M	M		L	M	M	M
CO4.	S	M	L		S			M	M	M		L	M	M	M
CO5.	S	M	L		S	L		M	M	M		L	M	M	M
CO6.	S	M	L		S	L		M	M	M		L	M	M	M
CO7.	S	M	L		M	L		M	M	M		L	M	L	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		

List of Experiments/Activities with CO Mapping

Module No.	Topic	Course Outcomes
1.	Analyse the database application and create relational databases using normalization principles.	CO1
2.	Add the necessary integrity constraints to relational databases and practice with DCL commands.	CO2
3.	Manipulate the database using simple SQL Queries and practice with TCL commands such as COMMIT, ROLLBACK and SAVEPOINT commands	CO3
4.	Manipulate the database using Complex SQL Queries	CO3
5.	Practice with different database objects and complex data types such as BLOB, CLOB, NCLOB, BFILE	CO4
6.	Practice with PL/SQL blocks, programming constructs and composite data types in PL/SQL	CO5
7.	Develop sub programs such as procedures, functions with cursors and demonstrate exceptions using PL/SQL.	CO5
8.	Create Packages and Triggers using PL/SQL	CO5
9.	Develop a web application with database connectivity	CO6

10.	Demonstrate NoSQL database models and execute queries.	CO7
11.	Demonstration of a web application and Report submission	CO1..CO6

Students can take any real time application, create databases and execute queries over it. The application demonstration can be shown at the end of the lab. The sample applications can be:

1. College Management System
2. Railway Reservation System
3. Hospital Management System
4. Inventory Management System
5. Library Management System

Learning Resources

1. https://www.w3schools.com/sql
2. https://www.tutorialspoint.com/sql/index.htm
3. https://practice.geeksforgeeks.org/tag-page.php?tag=SQL
4. https://www.hackerrank.com/domains/sql
5. https://www.hackerearth.com/practice/

Course Designers:

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2. Dr.B.Subbulakshmi bscse@tce.edu

		Category	L	T	P	Credit
22CS480	**ALGORITHMS LAB**	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

- 22CS240: Problem Solving and Programming
- 22CS340: Data Structures and Algorithms
- 22CS370: Data Structures Lab

Course Outcomes

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

CO	Course Outcome	TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Determine the time complexity of various sorting and searching techniques.	TPS3	A	70
CO2	Apply graph algorithms to solve problems and analyze their efficiency.	TPS3	A	70
CO3	Make use of divide and conquer algorithm design techniques like to solve problems	TPS4	A	70
CO4	Use of dynamic programming algorithm design techniques to solve problems	TPS3	A	70
CO5	Identify the problem and design the algorithm using greedy techniques.	TPS3	A	70
CO6	Use the state space tree method for solving problems	TPS4	A	70

Mapping with Programme 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**

C(	S	M	L		M	M	M	M	S	M	M	M	M	M	M
CO2.	S	M	L		M	M	M	M	S	M	M	M	M	M	M
CO3	S	S	M	L	M	M	M	M	S	M	M	M	M	M	M
CO4	S	M	L		M	M	M	M	S	M	M	M	M	M	M
CO5	S	M	L		M	M	M	M	S	M	M	M	M	M	M
CO6	S	S	M	L	M	M	M	M	S	M	M	M	M	M	M

S- Strong; M-Medium; L-Low

Assessment Pattern

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

Course Contents and Lecture Schedule

Module No.	Topic	No. of Periods
	Searching and Sorting Algorithms	
1	Implement Linear Search and Binary search. Analyse their worst-case performance by determine the time required to search for an element. Repeat the experiment for different values of n (in the range 100 to 100000, which is stored in a separate file), the number of elements in the list to be searched and plot a graph of the time taken versus n.	CO1
2	Sort a given set of elements using the Insertion sort and Merge sort methods and determine the time required to sort the elements. Repeat the experiment for different values of n (in the range 100 to 100000, which is stored in a separate file), the number of elements in the list to be sorted and plot a graph of the time taken versus n.	CO1
	Graph Algorithms	
3	For a given unweighted / uniform weighted connected graph, implement (a) BFS to find single source shortest path (b) DFS to detect cycle	CO2
4	From a given vertex in a weighted connected graph, develop a program to find the shortest paths.	CO2
5	From a given vertex in a weighted connected graph, implement a program to find the minimum spanning tree.	CO2
6	Compute the transitive closure of a given directed graph using Warshall's algorithm.	CO2
	Algorithm Design Techniques	

Module No.	Topic	No. of Periods
7	Develop a program to find out the maximum and minimum numbers in a given list of n numbers using the divide and conquer technique.	CO3
8	Implement Merge sort and Quick sort methods to sort an array of elements and determine the time required to sort. Repeat the experiment for different values of n ((in the range 100 to 100000, which is stored in a separate file), the number of elements in the list to be sorted and plot a graph of the time taken versus n.	CO3
9	Implement matrix chain multiplication using dynamic programming	CO4
10	Implementation of 0/1 knapsack problem using knapsack problem	CO4
11	Implementation of fractional knapsack problem using greedy algorithm and analyse its performance for various item selection strategies	CO5
12	Develop Huffman codes using greedy approach.	CO5
	State Space Search Algorithms	
13	Implement N Queens / Hamiltonian Circuit Problem / Subset Sum Problem / Graph coloring problem using Backtracking approach.	CO6
14	Implement Assignment problem / Knapsack Problem / Travelling Salesman Problem using Branch and Bound technique	CO6

Learning Resources

1. Anany Levitin, “Introduction to the Design and Analysis of Algorithms”, 3rd Edition, Pearson Education, 2012.
2. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures and Algorithms", Reprint Edition, Pearson Education, 2006.
3. S. Sridhar, “Design and Analysis of Algorithms”, Oxford university press, 2014.
4. https://www.geeksforgeeks.org/fundamentals-of-algorithms/
5. https://www.hackerrank.com/domains/algorithms
   https://www.codechef.com/wiki/tutorials
6. Steven S. Skiena, The Algorithm Design Manual, Second Edition, Springer,2010

Course Designer(s):

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2. Mrs.RajaLavanya, Assistant Professor,CSE rlit@tce.edu

22CS490 PROJECT MANAGEMENT

Category	L	T	P	Credit
HSS	3	0	0	3

Preamble

This course develops students the principles underlying effective project management, providing the knowledge, skills, and framework necessary to manage a real project in the workplace.

Prerequisite

Nill

Course Outcomes

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

		TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Suggest an organizational structure for managing projects within the organisation	TPS3	70	85
CO2	Develop a project communication plan by defining its scope, priorities, and responsibility matrices	TPS3	70	85
CO3	Construct a work breakdown structure for a given business cases and derive a project network information.	TPS3	70	85
CO4	Develop a project schedule using critical path method and to develop a Gantt chart using any project management tool	TPS3	70	85
CO5	Develop a reschedule for a project based on constraints. Develop a suitable risk response based on the assessment.	TPS3	70	85
CO6	Plan and implement a team-project for developing a complete project schedule using Project management tools like Open Projects, MS project management.	TPS4	70	85

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	S	M	L					S	S	S	S	S	M	M	S
CO2	S	M	L		S			S	S	S	S	S	M	M	S
CO3	S	M	L		S			S	S	S	S	S	M	M	S
CO4	S	M	L		S			S	S	S	S	S	M	M	S
CO5	S	M	L					S	S	S	S	S	M	M	S
CO6	S	S	M	L	S			S	S	S	S	S	S	M	S

S- Strong; M-Medium; L-Low

Assessment Pattern

CO	CAT 1			CAT 2			Assignment 1				Assignment 2				Terminal Examination		
TPS Scale	1	2	3	1	2	3	3	4	5	6	3	4	5	6	1	2	3
CO1	5	9		-	-	-	-	-	-	-	-	-	-	-	4	7	-
CO2	6	12	25	-	-	-	-	-	-	-	-	-	-	-	4	7	-
CO3	6	12	25	-	-	-	-	-	-	-	-	-	-	-	4	7	15
CO4	-	-	-	8	16	25	-	-	-	-		-	-	-	4	7	15
CO5	-	-	-	9	17	25	-	-	-	-		-	-	-	4	7	15
CO6	-	-	-				100	-	-	-	100	-	-	-	-	-	-

*****Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

Syllabus

Modern Project Management

The Project Management Body Of Knowledge (PMBOK), 10 Knowledge Areas, The Project Life Cycle, Organization Structure and Project Management, Organizing Projects within the functional organization, Matrix organisation and projectized organisation, Choosing the right project management structure.

Project Initiation

Project Scope, and Checklist, Project Priorities, Work Breakdown Structure Development, WBS coding, Responsibility Matrices in WBS, Project Communication Plan, Project Estimations

Agile Project Management, Differences between managing a project versus developing a product, Scrum - Defining the Product Vision and Product Roadmap, Planning Releases and Sprints.

Project Planning

Developing the Project Network, WBS to Project Network, Network Computation Process Networks Activity on Arrow, Activity-on-Node, Forward Pass, Earliest Times , Backward Pass—Latest Times, Use of Lags, Lag Relationships, Laddering

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.

Conflict management, **Project Closure**, Types of Project Closure, Final Report, Post-Implementation Evaluation.

Text Books

1. Erik W. Larson, Clifford F. Gray, “Project Management The Managerial Process”, McGraw-Hill/Irwin, Seventh Edition, 2018.
2. Mark C. Layton, Steven J Ostermiller, and Dean J. Kynaston “Agile Project Management For Dummies” John Wiley & Sons, Inc 3rd Edition 2020

Reference Books & web resources

1. Project Management Institute, “A Guide to the Project Management Body of Knowledge (PMBOK® Guide) – Seventh Edition and The Standard for Project Management”, 2021
2. Jack R. Meredith, Samuel J. Mantel, Jr., “Project management A Managerial Approach”., John Wiley & Sons, Inc. Tenth Edition,2017
3. Harold kerzner , “Project Management A systems approach to Planning, scheduling, And controlling”, Tenth edition, John Wiley & Sons, Inc.2009
4. Harold kerzner , “Project management best practices achieving global excellence”, Fourth edition, John Wiley & Sons, Inc.2018
5. A Guide to the Project Management Body of Knowledge (PMBOK® Guide)—Fifth Edition, Project Management Institute.
6. Harold Koontz, Heinz weihrich ”Essentials of Management”, Tata McGraw-Hill Education, 2006 - Management

Course Contents and Lecture Schedule

Module No.	Topic	No. of Periods	CO
1	**Modern Project Management**		
1.1	The Project Management Body Of Knowledge (PMBOK), 10 Knowledge Areas,	1	CO1
1.2	The Project Life Cycle,	1	CO1
1.3	Organization Structure and Project Management, Organizing Projects within the functional organization,	2	CO1
1.4	Matrix organisation and projectized organisation,	2	CO1
1.5	Choosing the right project management structure,	2	CO1
2	**Project Initiation**		
2.1	Project Scope and Checklist, Project Priorities.	2	CO2
2.2	Work Breakdown Structure Development, WBS coding	1	CO3, CO6
2.3	,Responsibility Matrices in WBS, Project Estimations	2	CO2, CO6

Module No.	Topic	No. of Periods	CO
2.4	Project Communication Plan.	1	CO2,
Assignment 1			CO6
3.1	**Agile Project Management**, Differences between managing a project versus developing a product,	1	CO3
3.2	Scrum -.Defining the Product Vision and Product Roadmap, Planning Releases and Sprints.	2	CO3, CO6
4	**Project Planning**		
4.1	Developing the Project Network, WBS to Project Network,	1	CO3, CO6
	Continuous Assessment Test – I		
4.2	Network Computation Process Networks Activity on Arrow.	2	CO4
4.3	Activity-on-Node, Forward Pass, Earliest Times , Backward Pass—Latest Times	2	CO4
4.4	Use of Lags, Laddering. Lag Relationships.	1	CO4
4.5	Gantt chart using a project management tool	2	CO6
5	**Resource optimization**		
5.1	**Scheduling Resources** and Costs, Resource Scheduling Problem,	2	CO5
5.2	Time-Constrained Project, Resource-Constrained Projects.	1	CO5
5.3	Managing Risk**, Risk Management** Process.	2	CO5
5.4	Risk Identification, Assessment, and Response Development.	2	CO5
Assignment 2			CO6
6.1	**Conflict management**, **Project Closure**, Types of Project Closure,	2	CO5
6.2	Final Report, Post-Implementation Evaluation.	2	CO5
Continuous Assessment Test – 2			

Course Designer(s):

1. Dr. N. Shivakumar APCSE shiva@tce.edu
2. Dr. S. Prasanna APCSE sprcse@tce.edu

CURRICULUM AND DETAILED SYLLABI

FOR

B.E DEGREE (Computer Science and Engineering) PROGRAMME

FIFTH SEMESTER

FOR THE STUDENTS ADMITTED FROM THE

ACADEMIC YEAR 2022 - 2023 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. / B.Tech. Degree Programmes

COURSES OF STUDY
(For the candidates admitted from 2022-23 onwards)

FIFTH SEMESTER

Course Code	Name of the Course	Category	No. of Hours / Week			credits
			L	T	P	
THEORY						
22CS510	Modelling and Optimization	ES	3	-	-	3
22CS520	Theory of Computation	ES	3	-	-	3
22CS530	Artificial Intelligence	PC	3	-	-	3
22CSPX0	Programme Elective	PE	3	-	-	3
22XXGX0	Interdisciplinary Elective	OE	3	-	-	3
THEORY CUM PRACTICAL						
22CS560	Software Engineering	PC	3	-	2	4
PRACTICAL						
22CS570	Network Programming Lab	PC	-	-	2	1
22CS580	Artificial Intelligence Lab	PC	-	-	2	1
PROJECT COURSE						
22CS590	Project - I	PW	-	-	6	3
Total			**18**	**-**	**12**	**24**

BS : Basic Science Courses
PC : Professional Core Courses
ES : Engineering Science Courses
PW : Project Work

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 2022-23 onwards)

FIFTHSEMESTER

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	22CS510	Modelling and Optimization	3	40	60	100	27	50
2	22CS520	Theory of Computation	3	40	60	100	27	50
3	22CS530	Artificial Intelligence	3	40	60	100	27	50
4	22CSPX0	Programme Elective	3	40	60	100	27	50
5	22XXGX0	Interdisciplinary Elective	3	40	60	100	27	50
THEORY CUM PRACTICAL								
6	22CS560	Software Engineering	3	50	50	100	22.5	50
PRACTICAL								
7	22CS570	Network Programming Lab	3	60	40	100	18	50
8	22CS580	Artificial Intelligence Lab	3	60	40	100	18	50
PROJECT COURSE								
9	22CS590	Project - I	3	40	60	100	27	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.

		Category	L	T	P	Credit
22CS510	**MODELLING AND OPTIMIZATION**	ES	3	0	0	3

Preamble

Optimization is a scientific approach to decision making that seeks to best design and operate a system, usually under conditions requiring the allocation of scarce resources. Attention is given primarily to techniques applicable to problems in linear and non-linear programming. Modelling refers analysis tool and design tool for various systems. Mathematical models are constructed to solve some real life problem.

Prerequisite

Nil

Course Outcomes

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

COs	Course Outcome	TCE Proficiency Scale	Expected Proficiency	Expected Attainment Level %
CO1	Solve linear programming problems using graphical technique.	TPS3	B	65
CO2	Solve linear programming problems using simplex algorithm.	TPS3	B	65
CO3	Solve linear programming problem using semi definite optimization.	TPS3	B	65
CO4	Solve unconstrained Non-Linear Programming Problems (NLPP) using appropriate techniques.	TPS3	B	65
CO5	Solve constrained Non-Linear Programming Problems (NLPP) using appropriate techniques.	TPS3	B	65
CO6	Construct Mathematical models and solve problems related to science and technology	TPS3	B	65

S- Strong; M-Medium; L-Low

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1.	S	M	L			L		M	M	M		M	M	L	M
CO2.	S	M	L			L		M	M	M		M	M	L	M
CO3.	S	M	L			L		M	M	M		M	M	L	M
CO4	S	M	L			L		M	M	M		M	M	L	M

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

Assessment Pattern

CO	Assessment 1						Assessment 2						Terminal		
	CAT 1 (%)			Assignment 1			CAT 2 (%)			Assignment 2					
TPS	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
CO1	-	10	14	-	-	20	-	-	-	-	-	-	-	-	10
CO2	5	10	23	-	-	40	-	-	-	-	-	-	-	6	12
CO3	5	10	23	-	-	40	-	-	-	-	-	-	-	6	12
CO4	-	-	-	-	-		3	10	20	-	-	35	-	6	12
CO5	-	-	-	-	-		3	10	20	-	-	35	-	6	12
CO6	-	-	-	-	-		4	10	20	-	-	30	-	6	12
TOTAL	10	30	60	-	-	100	10	30	60	-	-	100	-	30	70

Syllabus

Linear programming: Introduction to LPP – Graphical LP solution (Extreme point solution method) – Special cases in Linear programming. The Simplex algorithm (maximization case only) - Unrestricted variables, Degeneracy- Alternative Optimal Solutions, Unbounded solutions, Infeasible solution- - Dual Simplex Method.

Semi definite optimization: Introduction to primal and dual LPP - From linear to semidefinite optimization – spectrahedra - Projected spectrahedra – Primal SDP formulation- optimality solutions for SDP - Properties of Spectrahedra - Conic Programming - Strong Duality.

Non-Linear Programming: Introduction **-** Unconstrained Optimization techniques: One-Dimensional minimization methods: Fibonacci method, Golden selection method – Multivariable optimization: Steepest Descent method and Broyden–Fletcher–Goldfarb–Shanno method(BFGS) – Constrained Optimization techniques: Multivariable Optimization with Equality constrains: Lagrange Multipliers Method - Multivariable optimization with inequality constrains: Kuhn-Tucker conditions - Graphical Solution Method.

Modelling: Introduction to mathematical modelling –- Graph Based Models: Introduction to graphs and graph models. Matrix based model: Represent the data using curve of best fit using least square method. Linear Programming Models: Formulation of LPP model.

Text Books

1. J.K.Sharma., “Operations Research Theory and Applications”, 6th Edition, Trinity Press, India, 2017.
2. G.Blekherman, Pablo.A.Parrilo, R. Thomas., “Semidefinite Optimization and Convex Algebraic Geometry”, SIAM Publisher, 2012.
3. S.S.Rao., “Engineering Optimization Theory & Practice”, Fourth edition, John Wiley & sons publications, 2009.

4. Kenneth H. Rosen., “Discrete Mathematics and Its Applications”, 8th Edition, McGraw hill publications, 2019.
5. Steven J. Leon., “Linear Algebra with Application” Ninth Edition, Pearson, 2015.

Reference Books & web resources

1. Frederick S.Hillier and Gerald J. Lieberman., “ Introduction to Operations research” Tenth edition, Mc GrawHill Education, 2015.
2. Hamdy A. Taha, “Operations Research - An Introduction”, Tenth Edition, Pearson, 2017.
3. J. Nocedal and S. Wright, “Numerical optimization”, Second Edition, Springer, 2006.
4. Radhika Ranjan Roy, “Handbook of SDP for Multimedia Session Negotiations”, Kindle Edition, (2018)

Course Contents and Lecture Schedule

Module No.	Topic	No. of Periods
1	**Linear programming**	
1.1	Introduction to LPP	1
1.2	Graphical LP solution (Extreme point solution method)	2
1.3	Special cases in Linear programming	1
1.4	The Simplex algorithm (maximization case only)	2
1.5	Unrestricted variables, Degeneracy	1
1.6	Alternative optimal Solutions, Unbounded solutions, Infeasible solution	2
1.7	Dual simplex method	2
2	**Semi definite optimization**	
2.1	Introduction to primal and dual LPP	1
2.2	From linear to semidefinite optimization – spectrahedra - Projected spectrahedra	1
2.3	Primal SDP formulation	1
2.4	optimality solutions for SDP	1
2.5	Properties of Spectrahedra - Conic Programming	1
2.6	Strong Duality	2
3	**Non-Linear Programming**	
3.1	Unconstrained Optimization One-Dimensional: Fibonacci method	1
3.2	Golden search method	1

Module No.	Topic	No. of Periods
3.3	Unconstrained Optimization Multi variable: Steepest Descent method	2
3.4	BFGS method, Introduction to LBFGS method	2
3.5	Constrained Optimization Equality Constrains: Lagrange Multiplier Method	2
3.6	Constrained Optimization inequality Constrains: Kuhn-Tucker conditions.	2
3.7	Constrained Optimization inequality Constrains: Graphical method.	2
4	**Modelling**	
4.1	Introduction to mathematical modelling	1
4.2	Linear programming model: Formulation of LPP model	1
4.3	Graphs and Graph based models: Introduction to graphs and graph models	2
4.4	Matrix based Models: Represent the data using curve of best fit using least square method	2
	Total	**36**

Course Designer(s):

1. Dr. C. S. Senthilkumar kumarstays@tce.edu
2. Dr. P. Victor pvmat@tce.edu
3. Dr. P. Krishnapriya pkamat@tce.edu

22CS520	THEORY OF COMPUTATION	Category	L	T	P	C
		ES	3	0	0	3

Preamble

This syllabus on "Theory of Computations" is designed to introduce students to the fundamental concepts and applications of automata theory, formal languages, and computability. The syllabus emphasizes the basics of automata theory, including finite automata, regular expressions, and context-free grammars, and provides an overview of the fundamental concepts of computability theory, including Turing machines and the Church-Turing thesis. The modules in the syllabus reflect an approach to problem-solving via automata theory, and the syllabus focuses on the strategies, techniques, and limitations in solving computational problems. The goal is to equip students with the knowledge and skills required to work with automata theory and apply it in their respective fields, including computer science, mathematics, and related disciplines.

Prerequisite

- Nil

Course Outcomes

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

COs	Course Outcomes	TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Design Finite Automata machines for given problems	TPS3	B	80
CO2	Find regular expressions and language for any given Finite Automata machines	TPS3	B	80
CO3	Implement Pushdown Automata for given Context Free language and generate the strings of a given context-free languages using its grammar	TPS3	B	80
CO4	Construct Turing machine for any given computational problem	TPS3	B	80

CO5	Differentiate between decidable and undecidable problems based on the complexity of problems when solved using these machines	TPS4	B	80
CO6	Examine the hierarchy of classes of problems or formal languages (regular, context-free, context-sensitive, decidable, and undecidable)	TPS4	B	80

Mapping with Programme Outcomes

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

S- Strong; M-Medium; L-Low

Assessment Pattern

CO	CAT1						CAT2						Terminal					
TPS Scale	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
CO1	5	10	10										2	5	10			
CO2	5	10	10										2	5	10			
CO3	5	10	10										2	5	10			
CO4	5	10	10				5	10	20				2	5	10			
CO5							5	10		20			2	5		10		
CO6								10		20				5		10		
Total	20	40	40				10	30	20	40			10	30	40	20		

CO	Assignment 1						Assignment 2					
TPS Scale	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	**6**
CO1			20									
CO2			30									
CO3			20									
CO4			30						40			
CO5										30		
CO6										30		
Total			100						40	60		

*****Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

Syllabus

Automata and Regular Expressions Need for automata theory - Introduction to formal proof Finite Automata (FA) – Deterministic Finite Automata (DFA) – Non-deterministic Finite Automata (NFA) – Equivalence between NFA and DFA – Finite Automata with Epsilon transitions – Equivalence of NFA and DFA- Equivalence of NFAs with and without ε-moves- Conversion of NFA into DFA – Minimization of DFAs

Regular Expressions and Languages Regular expression – Regular Languages- Equivalence of Finite Automata and regular expressions– Proving languages to be not regular (Pumping Lemma) – Closure properties of regular languages.

Context Free Grammar and Push Down Automata Types of Grammar - Push Down Automata (PDA): Definition – Moves - Instantaneous descriptions -Languages of pushdown automata – Equivalence of pushdown automata and CFG-CFG to PDA-PDA to CFG – Deterministic Pushdown Automata.

Normal Forms and Turing Machines Normal forms for CFG – Simplification of CFG- Chomsky Normal Form (CNF) and Greibach NormalForm (GNF) – Pumping lemma for CFL – Closure properties of Context Free Languages –Turing Machine: Basic model – definition and representation – Instantaneous Description – Language acceptance by TM

Undecidability Unsolvable Problems and Computable Functions –PCP-MPCP- Recursive and recursively enumerable languages – Properties - Universal Turing machine -Tractable and Intractable problems - P and NP completeness – Kruskal's algorithm – Travelling Salesman Problem- 3-CNF SAT problems.

Unconventional Computing - Membrane Computing, DNA Computing, Quantum Computing Models

Text Books

1. Hopcroft J.E., Motwani R. & Ullman J.D., "Introduction to Automata Theory, Languages and Computations", 3rd Edition, Pearson Education, 2008.
2. John C Martin , "Introduction to Languages and the Theory of Computation", 4th Edition,Tata McGraw Hill, 2011.

Reference Books

1. Harry R Lewis and Christos H Papadimitriou, "Elements of the Theory of Computation",2nd Edition, Prentice Hall of India, 2015.
2. Peter Linz, "An Introduction to Formal Language and Automata", 6th Edition, Jones & Bartlett, 2016.
3. K.L.P.Mishra and N.Chandrasekaran, “Theory of Computer Science: Automata Languages and Computation”, 3rd Edition, Prentice Hall of India, 2006.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Lectures
1	**Automata and Regular Expressions**	**(6)**
1.1	Need for automata theory - Introduction to formal proof – Finite Automata (FA)	1
1.2	Deterministic Finite Automata (DFA) – Non-deterministic Finite Automata (NFA)	1
1.3	Equivalence between NFA and DFA – Finite Automata with Epsilon transitions	1
1.4	Equivalence of NFA and DFA- Equivalence of NFAs with and without ε-moves	1
1.5	Conversion of NFA into DFA – Minimization of DFAs	2
2	**Regular Expressions and Languages**	**(6)**
2.1	Regular expression – Regular Languages	1
2.2	Equivalence of Finite Automata and regular expressions	2
2.3	Proving languages to be not regular (Pumping Lemma)	2
2.4	Closure properties of regular languages.	1
3	**Context Free Grammar and Push Down Automata**	**(6)**
3.1	Types of Grammar	2
3.2	Push Down Automata (PDA): Definition – Moves	1

3.3	Instantaneous descriptions -Languages of pushdown automata	1
3.4	Equivalence of pushdown automata and CFG-CFG to PDA-PDA to CFG - Deterministic Pushdown Automata	2
4	**Normal Forms and Turing Machines**	**(6)**
4.1	Normal forms for CFG – Simplification of CFG	1
4.2	Chomsky Normal Form (CNF) and Greibach Normal Form (GNF)	2
4.3	Pumping lemma for CFL – Closure properties of Context Free Languages	1
4.4	Turing Machine: Basic model – definition and representation	1
4.5	Instantaneous Description – Language acceptance by TM	1
5	**Undecidability**	**(6)**
5.1	Unsolvable Problems and Computable Functions –PCP-MPCP-Recursive and recursively enumerable languages	2
5.2	Properties - Universal Turing machine	1
5.3	Tractable and Intractable problems	1
5.4	P and NP completeness – Kruskal's algorithm – Travelling Salesman Problem- 3-CNF SAT problems.	2
6	**Unconventional Computing**	**(6)**
6.1	Membrane Computing, ,	2
6.2	DNA Computing	2
6.3	Quantum Computing Models	2

Course Designer(s):

1. Dr.K.Sundarakantham, Professor, CSE kskcse@tce.edu
2. Mr. S.Santhana Hari, AP, CSE sshcse@tce.edu

22CS530	ARTIFICIAL INTELLIGENCE	Category	L	T	P	C
		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

- Basic Programming knowledge in Python
- Knowledge of search algorithms like BFS, DFS
- Graph data structures

Course Outcomes

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

COs	Course Outcomes	TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Demonstrate a fundamental understanding of the history of artificial intelligence (AI) and its foundations	TPS2	B	80
CO2	Interpret AI problems as a state space representation and solve using AI techniques like searching and game playing	TPS3	B	75
CO3	Construct knowledge representations using logic to facilitate inference in the given problem domain	TPS3	B	75
CO4	Formulate solutions for problems involving uncertain inputs or outcomes	TPS3	B	75
CO5	Apply basic principles of AI in solutions that require problem solving by learning	TPS3	B	75
CO6	Examine real-world problems and apply suitable AI techniques to develop intelligent systems	TPS4	B	75

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				M	M	L	L
CO2	S	M	L		L			M	L	L		M	M	M	L
CO3	S	M	L		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	S	M	L	M	L		M	L	L		M	S	M	L

S- Strong; M-Medium; L-Low

Assessment Pattern

CO	CAT 1						Assignment 1			CAT 2						Assignment 2				Terminal					
TPS Scale	1	2	3	4	5	6	1	2	3	1	2	3	4	5	6	1	2	3	4	1	2	3	4	5	6
CO 1	10	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		2	5		-	-	-
CO 2	10	10	25	-	-	-	-	-	50	-	-	-	-	-	-	-	-	-		2	5	10	-	-	-
CO 3	-	10	25	-	-	-	-	-	50	-	-	-	-	-	-	-	-	-		2	5	10	-	-	-
CO 4	-	-	-	-	-	-	-	-	-	10	10	15	-	-	-	-	-	30		2	5	10	-	-	-
CO 5	-	-	-	-	-	-	-	-	-	10	10	15	-	-	-	-	-	30		2	5	10	-	-	-
CO 6	-	-	-	-	-	-	-	-	-	10	-	-	20	-	-	-	-	-	40		5		20		

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

Syllabus

Introduction: Turing Test – Intelligent Agents, Characteristics of Intelligent Agents – Environments properties – Future of AI – Typical AI problems – Problem-Solving Approach to Typical AI problems.

Problem-Solving Methods: Search Strategies – Informed Search – Local Search – Searching with Partial Observations – Constraint Satisfaction Problems – Constraint Propagation,

Backtracking Search – Game Playing – Optimal Decisions in Games, Alpha - Beta Pruning – Stochastic games.

Knowledge Representation: First Order Predicate Logic – Unification – Forward Chaining – Backward Chaining – Resolution. Rule-Based Systems – Rete Graph. Classical planning.

Uncertain knowledge and Reasoning: Quantifying Uncertainty – Acting under Uncertainty – Inference using Full Joint Distributions – Bayes' rule. Probabilistic Reasoning – Bayesian Models – Relational and First-Order Probability Models – Time and Uncertainty.

Learning: Learning from Examples – Supervised Learning – Reinforcement Learning.

Case study: Large Language models - ChatGPT, Computer Vision, Automation.

Reference Books

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. NPTEL Lectures

Course Contents and Lecture Schedule

Module No.	Topic	No. of Lectures	CO Mapped
1	**Introduction** (5)		
1.1	Turing Test – Intelligent Agents	1	CO1
1.2	Characteristics of Intelligent Agents – Environments properties – Future of AI	2	CO1
1.3	Typical AI problems – Problem-Solving Approach to Typical AI Problems	2	CO1
2	**Problem-Solving Methods** (9)		
2.1	Search Strategies – Informed Search	2	CO2
2.2	Local Search – Searching with Partial Observations	2	CO2
2.3	Constraint Satisfaction Problems	2	CO2

	Constraint Propagation, Backtracking Search		
2.4	Game Playing – Optimal Decisions in Games Alpha - Beta Pruning	2	CO2
2.5	Stochastic Games	1	CO2
3	**Knowledge Representation** (5)		
3.1	First-Order Predicate Logic	1	CO3
3.2	Unification – Forward Chaining Backward Chaining – Resolution	1	
3.3	Rule-Based Systems	1	CO3
3.4	Rete Graph	1	CO3
3.5	Classical planning	1	CO3
4	**Uncertain Knowledge and Reasoning** (8)		
4.1	Quantifying Uncertainty	1	CO4
4.2	Acting under Uncertainty	1	CO4
4.3	Inference using Full Joint Distributions	1	CO4
4.4	Bayes' rule	1	CO4
4.5	Probabilistic Reasoning	1	CO4
4.6	Bayesian models	1	CO4
4.7	Relational and First-Order Probability Models	1	CO4
4.8	Time and Uncertainty	1	CO4
5	**Learning** (5)		
5.1	Learning from Examples	1	CO5
5.2	Supervised Learning	2	CO5
5.3	Reinforcement Learning	2	CO5
	Mini Project Reviews	4	CO6

	Total Hours	**36**	

Course Designer(s):

1. Dr. K.Sundarakantham kskcse@tce.edu
2. Dr. M.Suguna mscse@tce.edu

22CS560 SOFTWARE ENGINEERING

Category	L	T	P	Credit
PC	3	0	2	4

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 , Planning and developing the software. Consequently, student's take up a group project, working through a number of stages for the development of software.

Prerequisite

21CS490 Project management

Course Outcomes

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

		TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Explain various software development process and management techniques.	TPS2	B	90
CO2	Design system boundaries using activity diagrams and Use case diagrams.	TPS3	B	85
CO3	Design interactions between actors and the system and between system components using Sequence diagrams, Class diagrams and State diagrams.	TPS3	B	85
CO4	To design a system considering the key issues in Components, architectural patterns for distributed systems and Software as a service	TPS3	B	85
CO5	Build a project report as a team which contains therequirement specification, plan, schedule and designdocuments	TPS3	B	85
CO6	Estimate the list of activities, users, milestone for a project and develop a project plan using Gantt chart tool	TPS4	B	85

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	L							L	L	L	L	M		L
CO2	S	M	L		S	M	M	M	M	M	L	L	M	L	M
CO3	S	M	L				M	M	M	M	L	L	M	L	M
CO4	S	M	L				M	M	M	M	L	L	M	L	M
CO5	S	M	L		S	M	M	M	M	S	S	S	M	L	M

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

S- Strong; M-Medium; L-Low

Assessment Pattern

CO	CAT 1				CAT 2				Terminal Examination			
TPS Scale	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
CO1	7	16							4	10		
CO2	7	16	20						4	10		
CO3	6	18	20						4	10	15	
CO4					10	25	15		4	10	15	
CO5					10	25			4	10		
CO6								15				10

CO	LAB MODEL TEST						OCR					
TPS Scale	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	**6**
CO1												
CO2			10						10			
CO3			20						20			
CO4												
CO5			50						50			
CO6				20						20		

*****Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

Syllabus

Software process models

Professional software development- Software engineering ethics- Process activities - Software Life cycle- Iterative, Spiral, Prototyping-Agile method- Agile developing techniques- Agile project management

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.

Software Project Planning

Software pricing, Plan-driven development, Project scheduling, requirements to activities, activities to Gantt chart Agile planning 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

Reliability Engineering

Fault tolerance Architectures- Programming for reliability- Secure systems design and programming- Secure testing and assurance-.

Lab Content:

- Develop a mini project for a real world problem in which a software solution can be obtained (ateam of 3 members) and do the following.
- Collect requirements for the chosen problem
- Model the system through interaction, structural diagrams and develop softwarearchitecture.
- 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 & web resources

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 withchange- Process Improvement	2	CO1
1.2	Software Life cycle models- Iterative, Spiral and Prototyping models	2	CO1
1.3	Agile method- Agile developing techniques- Agileproject management- Scaling Agile methods	2	CO1
2	**System Modelling**		
2.1	Functional and non- functional requirements.	2	CO3
2.2	Software Requirement Specification.	2	CO3
2.3	Developing Context models, Interaction models.	2	CO3
2.4	Structural models and Behavioral models.	2	CO3
2.5	Architectural patterns, Application architectures.	2	CO3
2.6	Object oriented design- Design patterns.	2	CO3
	Continuous Assessment Test 1		
3	**Software Project Planning**		
3.1	Software pricing, Plan-driven development.	2	CO4
3.2	Project scheduling, requirements to activities, activities to Gantt chart	2	CO4
3.3	Agile planning Software Reuse- Risk Management	2	CO1
4	**Component based Software Engineering**		
4.1	Components and component models	2	CO2
4.2	CBSE processes- Component composition	2	CO2
5	**Distributed Software Engineering**		
5.1	Distributed systems- Client-server computing-	2	CO2
5.2	Architectural patterns for distributed systems-Software as a service	**2**	
6	**Reliability Engineering**		
6.1	Fault tolerance Architectures- Programming for reliability	2	CO2
6.2	Secure systems design and programming	1	
6.3	Secure testing and assurance	1	CO2
		36	

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 teamof 3 members) and do the following, Collect requirements for the chosen problem	4	CO6	
2	Develop Software Requirements specification	**4**	CO6	

	document			
3	Develop level models and software contex tarchitecture.	4	CO6	
4	Model the system through structural diagrams	4	CO6	
5	Model the system through interaction diagrams	4	CO6	
6	Propose a project plan Using gantt chart.	4	CO4	

Course Designer(s):

1. Dr. N. Shivakumar APCSE shiva@tce.edu
2. Dr. S. Prasanna APCSE sprcse@tce.edu

22CS570	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	Course Outcome	TCE Proficiency Scale	Expected Proficiency (%)	Expected Attainment Level (%)
CO1	Perform Configuration of networking components and installing device drivers and build a Local Area Network	TPS3	A	85
CO2	Perform port scanning and identify IP and MAC Address.	TPS3	A	85
CO3	Implement client server communication using socket programming	TPS3	A	85
CO4	Perform DNS server host name identification and resolve given host name	TPS3	A	85
CO5	Implement File transfer and RMI.	TPS3	A	85
CO6	Simulate a network topology using CISCO Packet tracer	TPS3	A	85

Mapping with Programme 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		M	M	L	M
CO2.	S	M	L		L	-	-	M	M	M		M	M	L	M
CO3.	S	M	L		L	-	-	M	M	M		M	M	L	M
CO4.	S	M	L		L	-	-	M	M	M		M	M	L	M
CO5.	S	M	L		L	-	-	M	M	M		M	M	L	M
CO6.	S	M	L		L	-	-	M	M	M		M	M	L	M

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Model Examination	Terminal Examination
Remember		
Understand		

Apply	100	100
Analyze		
Evaluate		
Create		

List of Experiments/Activities with CO Mapping

1. Establishment of a LAN: Preparation of network cables and installation and configuration of network.
2. Perform network commands like NETSTAT, NSLOOKUP, TRACERT, ARP, IPCONFIG and verify their need and usage
3. Develop a program to identify your machine's host name and IP address
4. Develop a program to locate the next hop router's IP address and MAC address
5. Develop a program to find which port is currently used, by scanning the port.
6. Develop a program to obtain local DNS server's host name and IP address and resolve a given host name.
7. Develop a program to illustrate a simple client/server communication and Time server.
8. Develop a program to implement ECHO and PING commands and time server.
9. Develop a program to implement a file transfer using TCP..
10. Develop a program to implement a file transfer using UDP.
11. Develop a program to implement Remote Method Invocation.
12. Simulate a network for the given specification using CISCO Packet tracer

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 Designers:

1. Dr.C.Senthilkumar ,Associate Professot, CSE, cskcse@tce.edu
2. Dr.G.S.R.EmilSelvan , AssIstant Professot, CSE emil@tce.edu

22CS580	ARTIFICIAL INTELLIGENCE LAB	Category	L	T	P	C
		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

- Fundamentals of Python programming

Course Outcomes

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

CO	Course Outcome	TCE Proficiency Scale	Expected Proficiency (%)	Expected Attainment Level (%)
CO1	Formulate the given problem as PEAS description	TPS3	A	75
CO2	Implement Heuristic search algorithms to solve given state space representable AI Problems	TPS3	A	75
CO3	Solve given 2-ply game using Min-max algorithm and optimize using alpha-beta pruning	TPS3	A	75
CO4	Represent the given Constraint Satisfaction Problem as Constraint graph and solve using Backtracking, forward checking or arc consistency	TPS3	A	75
CO5	Construct rule based systems for any application using logic programming language	TPS3	A	75
CO6	Examine the given use case and develop an intelligent system using suitable learning approach	TPS4	A	75

Mapping with Programme 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	PS O1	PS O2	PS O3
CO 1	S	M	L		M	L		S	S	S		M	M	L	M
CO 2	S	M	L		M	L		S	S	S		M	M	L	M
CO 3	S	M	L		M	L		S	S	S		M	M	L	M
CO 4	S	M	L		M	L		S	S	S		M	M	L	M
CO 5	S	M	L		M	L		S	S	S		M	M	L	M
CO 6	S	S	M	L	M	L		S	S	S	L	M	M	L	M

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Model Examination	Terminal Examination
Remember		
Understand		
Apply	80	80
Analyze	20	20
Evaluate		
Create		

List of Experiments/Activities with CO Mapping

Sl.No	Experiments	CO
1.	Select an AI problem and formulate it as PEAS description	CO1
2.	Implement A*search strategy to reach goal state in the given application	CO2
3.	Implement Local search strategy to reach goal state in the given application	CO2
4.	Solve 2-ply games like Alpha Go using APIs	CO3
5.	Solve Constraint Satisfaction Problems like Crypt arithmetic problem, Water jug problem, etc..	CO4
6.	Construct knowledge base for the given use case and apply inference in First Order Logic	CO5
7.	Solve classification problem using Bayesian models	CO6
8.	Implement Cart-Pole with Reinforcement learning	CO6
9.	Make use of suitable Large AI models in Language / Vision / Control with Prompt Engineering for the given application (Mini-Project)	CO6

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.

3. Elain Rich and Kevin Knight, “Artificial Intelligence ", Tata McGraw Hill, Third Edition, 2008

Course Designers:

1. Dr. K. Sundarakantham (kskcse@tce.edu)
2. Dr. M. Suguna (mscse@tce.edu)

CURRICULUM AND DETAILED SYLLABI

FOR

B.E DEGREE (Computer Science and Engineering) PROGRAMME

SIXTH SEMESTER

FOR THE STUDENTS ADMITTED FROM THE

ACADEMIC YEAR 2022 - 2023 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. / B.Tech. Degree Programmes

COURSES OF STUDY
(For the candidates admitted from 2022-23 onwards)

SIXTH SEMESTER

Course Code	Name of the Course	Category	No. of Hours / Week			credits
			L	T	P	
THEORY						
22CS610	Cryptography and Network Security	PC	3	-	-	3
22CS620	Distributed Computing	PC	3	-	-	3
22CS630	Compiler Design	PC	3	-	-	3
22CSPX0	Programme Elective	PE	3	-	-	3
22CSPX0	Programme Elective	PE	3	-	-	3
22XXGX0	Basic Science Elective	OE	3	-	-	3
PRACTICAL						
22CS670	Distributed Computing Lab	PC	-	-	2	1
PROJECT COURSE						
22CS690	Project - II	PW	-	-	6	- 3
Total			**18**	**-**	**8**	**22**

BSC : Basic Science Courses
PC : Professional Core Courses
ESC : Engineering Science Courses
PW : Project work

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 2022-23 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	22CS610	Cryptography and Network Security	3	40	60	100	27	50
2	22CS620	Distributed Computing	3	40	60	100	27	50
3	22CS630	Compiler Design	3	40	60	100	27	50
4	22CSPX0	Programme Elective	3	40	60	100	27	50
5	22CSPX0	Programme Elective	3	40	60	100	27	50
6	22XXGX0	Basic Science Elective	3	40	60	100	27	50
PRACTICAL								
7	22CS670	Distributed Computing Lab	3	60	40	100	18	50
PROJECT COURSE								
8	22CS690	Project - II	3	40	60	100	27	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.

22CS610	CRYPTOGRAPHY AND NETWORK SECURITY	Category	L	T	P	C
		PC	3	0	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

- Discrete Mathematics
- Basic knowledge in Computer Networks

Course Outcomes

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

CO. No	Course Outcomes (COs)	TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Demonstrate the fundamental theory of modern cryptography.	TPS3	B	85
CO2	Demonstrate the mathematical foundations of security mechanisms.	TPS3	B	85
CO3	Encrypt and Decrypt messages using Private key cryptosystems.	TPS3	B	85
CO4	Encrypt and Decrypt messages using Public key cryptosystems.	TPS3	B	85
CO5	Ensure authentication and data integrity security services through signing and hashing mechanisms.	TPS3	B	85
CO6	Examine the strength of any cryptographic algorithm and design a variant for given requirements.	TPS4	B	85
CO7	Describe the application of cryptographic algorithms in real world protocols	TPS2	B	90

Mapping with Programme 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		M	M	L	L
CO2	S	M	L		L			L	L	L		M	M		L
CO3	S	M	L		L	L		L	L	L		M	M	L	L
CO4	S	M	L		L	L		L	L	L		M	M	L	L
CO5	S	M	L		L	L		L	L	L		M	M	L	L
CO6	S	S	M	L	L			M	M	M		M	M	L	M
CO7	M	L			M	L						M	L	L	

S- Strong; M-Medium; L-Low

Assessment Pattern

CO	CAT 1						Assignment 1				CAT 2						Assignment 2				Terminal					
TPS Scale	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**5**	**6**
CO1	5	5	15	-	-	-	-	-	20	-	-	-	-	-	-	-	-	-	-	-	2	-	10	-	-	-
CO2	5	5	15	-	-	-	-	-	30	-	5	-	-	-	-	-	-	-	10	-	2	5	10	-	-	-
CO3	-	5	25	-	-	-	-	-	30	-	-	-	-	-	-	-	-	-	-	-	-	-	15	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	25	-	-	-	-	-	25	-	2	-	15	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	25	-	-	-	-	-	25	-	-	-	15	-	-	-
CO6	-	5	-	15	-	-	-	-	-	20	-	-	-	20	-	-	-	-	-	10	-	5	-	10	-	-
CO7	-	-	-	-	-	-	-	-	-	-	5	20	-	-	-	-	-	30	-	-	4	5	-	-	-	-

Syllabus

Introduction: Security attacks and threats, OSI Security Architecture – mechanisms and services. Need for perfect secrecy, Shannon's theory - Classical encryption techniques, Modular Arithmetic – Hill cipher, Common attacks on Cryptosystems – CPA, CCA, Side channel attack. Semantic Security and Message Indistinguishability.

Block cipher Mechanisms: Feistal network - Data Encryption Standard, Introduction to Finite Fields: Groups - Rings and Fields - Galois Fields, Advanced Encryption Standard, Block cipher modes operation. **Stream Cipher Mechanisms**: One-time pad, 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: One-way function, Message Authentication Codes, Hash function - SHA algorithm. **Non-Repudiation:** Digital Signature – provably secure signature schemes, Zero knowledge protocols.

Real world applications: Authentication Application – Kerberos, Electronic Mail Security – PGP, IP Security - IP Security Architecture. Web Security- Secure Socket Layer and Transport layer, Secure Electronic Transaction, Blockchain architecture.

Reference Books& web resources

1. William Stallings, Cryptography and Network Security: Principles and Practice, Global Edition, Pearson Education, 2022.
2. Behrouz A. Forouzan and Debdeep Mukhopadhyay, Cryptography and Network Security,Mc Graw Hill, 2015.
3. Douglas R. Stinson and Maura B. Paterson, Cryptography: Theory and Practice, Fourth edition, CRC Press, Taylor and Francis Group, 2019.
4. https://www.coursera.org/learn/crypto offered by Dan Boneh - Professor, Computer Science, Stanford University.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Lectures
1	**Introduction (8)**	
1.1	Security attacks and threats	1
1.2	OSI Security Architecture - Mechanisms and services	1
1.3	Need for perfect secrecy - Shannon's theory	1
1.4	Classical encryption techniques	2
1.5	Modular Arithmetic - Hill cipher	1
1.6	Common attacks on Cryptosystems- CPA, CCA, Side channel attack	1
1.7	Semantic Security and Message Indistinguishability	1
2	**Block cipher Mechanisms (5)**	
2.1	Feistal network - Data Encryption Standard	1
2.2	Introduction to Finite Fields - Galois Fields	1
2.3	Advanced Encryption Standard	2
2.4	Block cipher modes of operation	1

Module No.	Topic	No. of Lectures
3	**Stream Cipher Mechanisms (3)**	
3.1	One-time pad	1
3.2	Pseudo Random Number Generation algorithms	1
3.3	RC4 Stream Cipher	1
4	**Public Key Encryption (5)**	
4.1	Introduction to Number Theory	1
4.2	Prime Numbers, Fermat's and Euler's Theorem, Testing for Primality	1
4.3	Public key ciphers - RSA Cryptosystem	1
4.4	Elliptic Curve Arithmetic	1
4.5	Elliptic Curve Cryptography	1
4.6	**Key Management (3)**	
4.6.1	Diffie Hellman Key Exchange - ECDSA	2
4.6.2	Distribution of public keys	1
5	**Data Integrity (4)**	
5.1	One-way function	1
5.2	Message Authentication Codes	1
5.3	Hash function - SHA algorithm	2
	Non-Repudiation (3)	
5.4	Digital Signature – provably secure signature schemes	2
5.5	Zero knowledge protocols	1
6	**Real world applications (5)**	
6.1	Authentication Application – Kerberos	1
6.2	Electronic Mail Security – PGP, IP Security - IP Security Architecture	1

Module No.	Topic	No. of Lectures
6.3	Web Security- Secure Socket Layer and Transport layer, Secure Electronic Transaction	2
6.4	Blockchain Architecture	1
	Total Hours	**36**

Course Designers:

1. Dr.M.Suguna mscse@tce.edu
2. Dr.M.P.Ramkumar ramkumar@tce.edu

22CS620	DISTRIBUTED COMPUTING	Category	L	T	P	C
		PC	3	0	0	3

Preamble

This course will cover both fundamental concepts in distributed computing and discuss system designs enabling distributed applications. The objectives of the course include: In-depth understanding of core concepts of distributed computing, including study of both abstract concepts and practical techniques for building system support for distributed applications

Prerequisite

- 22CS360 Operating Systems (Theory cum Practical)
- 22CS430 Data Communication and Networks
- 22CS570 Network Programming Lab

Course Outcomes

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

CO No.	Course Outcome	TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Illustrate the design principles and architectures for distributed systems.	TPS2	B	85
CO2	Implement distributed algorithms for concurrent task termination (Apply)	TPS3	B	80
CO3	Practice Mutual Exclusion and deadlock detection algorithms that reveals concurrent programming error (Apply)	TPS3	B	80
CO4	Use appropriate protocols in a set of servers involving distributed Transaction (Apply)	TPS3	B	80
CO5	Apply, Recovery and Check pointing techniques for Fault tolerant distributed systems. (Apply)	TPS3	B	80
CO6	Examine distributed system issues to handle and process large data volumes through appropriate tools (Analyze)	TPS4	B	80

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1.	M	L										L	L		
CO2.	S	M	L		L			M	M	M		M	M		M
CO3	S	M	L		L			M	M	M		M	M		M
CO4	S	M	L					M	M	M		M	M		M
CO5	S	M	L					M	M	M		M	M		M
CO6	S	S	M	L	M	L		M	M	M	L	M	S	L	M

S- Strong; M-Medium; L-Low

Assessment Pattern

CO	CAT1						Ass1	CAT2						Ass2	Terminal					
TPS Scale	1	2	3	4	5	6		1	2	3	4	5	6		1	2	3	4	5	6
CO1	10	10	-	-	-	-	-	-	-	-	-	-	-	-	-	15	-	-	-	-
CO2	5	5	30	-	-	-	50	-	-	-	-	-	-	-	-	5	12	-	-	-
CO3	5	5	30	-	-	-	50	-	-	-	-	-	-	-	-	5	12	-	-	-
CO4	-	-	-	-	-	-	-	5	5	-	-	-	-	40	-	5	12	-	-	-
CO5	-	-	-	-	-	-	-	5	5	50	-	-	-	40	-	5	12	-	-	-
CO6	-	-	-	-	-	-	-	-	10	-	20	-	-	20	-	5	-	12	-	-

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

Syllabus

Introduction – Distributed System Models and Enabling Technologies, Multi/Many-Core Computing, Memory System Parallelism for Data Intensive and Data-Driven Applications, Goals and Challenges in Distributed System

Logical Time and Global State – Clock Synchronization, Logical Clocks -Global State and Snapshot Recording Algorithm -Message ordering and group communication: Message ordering paradigms -- Asynchronous execution with synchronous communication – Synchronous program order on an asynchronous system.

Distributed Mutex And Deadlock – Distributed mutual exclusion algorithms - Ricart–Agrawala algorithm -- Quorum-based mutual exclusion algorithms -- Token-based algorithms -- Suzuki–Kasami's broadcast algorithm; Deadlock detection in distributed systems: System model – Models of deadlocks -- Knapp's classification of distributed deadlock detection algorithms -- Mitchell and Merritt's algorithm for the single resource model -- Chandy–Misra–Haas algorithm –AND,OR Models

Distributed Transaction and Recovery – Flat and nested distributed Transactions-Atomic Commit protocols-Concurrency Control- Transaction with replicated data-- Consensus and agreement algorithms -- Checkpointing and rollback recovery: Issues in failure recovery -- Checkpoint-based recovery -- Log based rollback recovery - coordinated checkpointing algorithm -- asynchronous checkpointing and recovery.

Distributed File Systems – Name Services - File Models, File Accessing Models, File-sharing Semantics, File-caching Schemes, File Replication,- Sun's network file system, Andrews file system-Naming- Directory services.- Security:Techniques **Case Study**: Peer to Peer Computing-Distributed Object Based System, Distributed Web Based System, Distributed Coordinated System

Text Book

1. Ajay D. Kshemkalyani and Mukesh Singhal, Distributed Computing: Principles, Algorithms and Systems, Cambridge University Press, 2011.
2. George Coulouris, Jean Dollimore, Tim Kindberg and Gordon Blair, Distributed Systems: Concepts and Design, Fifth Edition, Pearson Education, 2017.

Reference Books & web resources

1. M. Van Steen, A.S. Tanenbaum, Distributed Systems, Third Edition, CreateSpace Independent Publishing Platform, 2017.
2. Garg VK. Elements of distributed computing. John Wiley & Sons, 2002.
3. Pradeep K Sinha, "Distributed Operating Systems: Concepts and Design", Prentice Hall of India, 2007
4. Liu M.L., ―Distributed Computing, Principles and Applications‖, Pearson Education, 2004
5. Fokkink W. Distributed algorithms: an intuitive approach, Second Edition, MIT Press, 2018.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Periods
1	**Introduction**	
1.1	Distributed System Models and Enabling Technologies	1
1.2	Multi/Many-Core Computing	1
1.3	Memory System Parallelism for Data Intensive and Data-Driven Applications	2

Module No.	Topic	No. of Periods
1.4	Goals and Challenges in Distributed System	1
2	**Logical Time and Global State**	
2.1	Clock Synchronization, Logical Clocks	2
2.2	Global State and Snapshot Recording Algorithm	
2.3	Message ordering and group communication: Message ordering paradigms	2
2.4	Asynchronous execution with synchronous communication – Synchronous program order on an asynchronous system	2
3	**Distributed Mutex And Deadlock**	
3.1	Distributed mutual exclusion algorithms -Lamport's algorithm -- Ricart–Agrawala algorithm	2
3.2	Quorum-based mutual exclusion algorithms -- Maekawa's algorithm -- Token-based algorithms -- Suzuki–Kasami's broadcast algorithm	2
3.3	Deadlock detection in distributed systems: System model – Models of deadlocks	1
3.4	Knapp's classification of distributed deadlock detection algorithms	1
3.5	Mitchell and Merritt's algorithm for the single resource model -- Chandy–Misra–Haas algorithm – AND,OR Models	3
4	**Distributed Transaction and Recovery**	
4.1	Flat and nested distributed Transactions-Atomic Commit protocols-Concurrency Control	2
4.2	Transaction with replicated data-- Consensus and agreement algorithms	2
4.3	Checkpointing and rollback recovery: Issues in failure recovery --Checkpoint-based recovery -- Log based rollback recovery	1
4.4	Coordinated checkpointing algorithm -- asynchronous checkpointing and recovery.	2

Module No.	Topic	No. of Periods
5	**Distributed File Systems**	
5.1	File Models, File Accessing Models, File-sharing Semantics, File-caching Schemes	2
5.2	File Replication,- Sun's network file system, Andrews file system	2
5.3	Naming- Directory services.- Security:Techniques	2
6	**Case Study**	
6.1	Peer to Peer Computing,Distributed Object Based System, Distributed Web Based System, Distributed Coordinated System	2
	Total	36

Course Designer(s):

1. Dr.R. Leena Sri (rlsit@tce.edu)
2. Mr.D.Nagendra Kumar (dnkcse@tce.edu)

22CS630 COMPILER DESIGN

Category	L	T	P	Credit
PC	3	0	0	3

Preamble

The objective of this course is to learn basic principles and advanced techniques of compiler design. It focuses on general phases of a compiler such as lexical analysis, syntactic analysis, semantic analysis, abstract syntax tree and code-generation as well as basic optimizations.

Prerequisite

- 22CS520 - Theory of Computation

Course Outcomes

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

No.	Course Outcomes	TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Describe the role of compilers for converting the high level language to machine level language and summarize the phases of compilers	TPS2	B	80
CO2	Exhibit the working of lexical analyser for recognizing the tokens of a given language	TPS3	B	75
CO3	Demonstrate different types of parsers to perform the syntax analysis.	TPS3	B	75
CO4	Construct Syntax directed definition and dependency graph with type checking	TPS3	B	75
CO5	Make use of runtime memory elements for storage allocation strategies which includes procedure calls, variable allocation and memory allocation	TPS3	B	75
CO6	Develop intermediate code generators to translate the source code to an intermediate code using register allocation.	TPS3	B	75
CO7	Devise algorithms for generating target code by analysing different code optimization techniques	TPS4	B	75

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				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
CO7	S	S	M	L	M	L		M	L	L		M	S	M	L

S- Strong; M-Medium; L-Low

Assessment Pattern

CO	CAT1						CAT2						Terminal					
TPS Scale	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
CO1	5	10											3	5				
CO2	5	10	15										3	5	5			
CO3	5	10	15										3	5	5			
CO4	5	10	10										3	5	10			
CO5							5	10	20				3	5	10			
CO6							5	10	20					5	10			
CO7								10		20				5		10		
Total	20	40	40				10	30	40	20			15	35	40	10		

CO	Assignment 1						Assignment 2					
TPS Scale	1	2	3	4	5	6	1	2	3	4	5	6
CO1												
CO2			30									
CO3			30									
CO4			40									
CO5									40			
CO6									40			
CO7										20		
Total			100						80	20		

*****Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

Syllabus

Compiler structure: The analysis-synthesis model of compilation, various phases of a compiler, and tool-based approach to compiler construction.

Lexical analysis: interface with input, parser and symbol table, token, lexeme and patterns. Difficulties in lexical analysis. Error reporting. Implementation. Regular definition, Transition diagrams.

Syntax analysis: Review on CFGs, ambiguity, associativity, precedence, top-down parsing, recursive descent parsing, transformation on the grammars, predictive parsing, bottom-up parsing, LR parsers (SLR, LALR, CLR).

Syntax-directed definitions: inherited and synthesized attributes, dependency graph, evaluation order, bottom-up and top-down evaluation of attributes, L- and S-attributed definitions, Circularity disambiguation.

Type checking: Type system, type expressions, structural and name equivalence of types, type resolution, type conversion, overloaded functions, operators, polymorphic functions.

Run time system: storage organization, activation tree, activation record, stack allocation of activation records, parameter passing mechanisms.

Intermediate code generation: Intermediate representations, translation of declarations, assignments, control flow, boolean expressions, and procedure calls, Backpatching.

Code generation and instruction selection: Issues, basic blocks, flow graphs, register allocation, code generation, DAG representation of programs, code generation from DAGs, peephole optimization, code optimization for machine architectures, Sethi-Ullman algorithm and Aho-Johnson dynamic programming algorithms, code generator generators. Case study on COOL compiler.

Text Books

1. A.V. Aho, R. Sethi, J.D. Ullman, “Compilers: Principles, Techniques and Tools”, Pearson Education, Second Edition, 2014.
2. AW Appel, M Ginsburg, Modern Compiler Implementation in C, Cambridge University Press, 2004.

Reference Books & Web resources

1. K Cooper, L Torczon, Engineering a Compiler, 2nd Ed., Morgan Kaufmann, 2011
2. Michael L Scott, Programming Language Pragmatics, 3rd Ed., Morgan Kaufmann, 2009
3. Santanu Chattopadhyay, “Compiler Design”, PHI Learning Pvt. Ltd., 2015.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Periods
1	**Compiler structure (2)**	
1.1	Analysis-synthesis model of compilation, Phases of a compiler	1
1.2	Tool-based approach to compiler construction	1
2	**Lexical analysis (3)**	
2.1	Interface with input, parser, and symbol table	1
2.2	Token, lexeme and patterns, Difficulties in lexical analysis, Error reporting	1

Module No.	Topic	No. of Periods
2.3	Implementation. Regular definition, Transition diagrams.	1
3	**Syntax analysis (8)**	
3.1	Review on CFGs, ambiguity, associativity	1
3.2	Precedence, top-down parsing	1
3.3	Recursive descent parsing	1
3.4	Transformation on the grammar, predictive parsing, bottom-up parsing	2
3.5	LR parsers (SLR, LALR, CLR).	3
4	**Syntax-directed definitions (4)**	
4.1	Inherited and synthesized attributes, dependency graph	2
4.2	Evaluation order, bottom-up and top-down evaluation of attributes, L- and S-attributed definitions, Circularity disambiguation	2
5	**Type checking (3)**	
5.1	Type system, type expressions, structural and name equivalence of types, type resolution, type conversion	2
5.2	Overloaded functions and operators, polymorphic functions	1
6	**Run time system (4)**	
6.1	Storage organization, activation tree, activation record	2
6.2	Stack allocation of activation records, parameter passing mechanisms	2
7	**Intermediate code generation (5)**	
7.1	Intermediate representations	1
7.2	Translation of declarations, assignments	2
7.3	Translation of control flow, boolean expressions, and procedure calls, Backpatching	2
8	**Code generation and instruction selection (7)**	
8.1	Issues, basic blocks, and flow graphs,	1
8.2	Register allocation, code generation, DAG representation of programs, code generation from DAGs	2

Module No.	Topic	No. of Periods
8.3	Peephole optimization, code optimization for machine architectures, Sethi-Ullman algorithm and Aho-Johnson dynamic programming algorithms	2
8.4	code generator generators, Case study on COOL compiler.	2
	Total	**36**

Course Designer(s):

1. Dr.K.Sundarakantham kskcse@tce.edu
2. Dr.B.Subbulakshmi bscse@tce.edu

22CS670	DISTRIBUTED COMPUTING LAB	Category	L	T	P	C
		PC	0	0	2	1

Preamble

This Practical course will enable students clearly understands broad range of concepts related to distributed computing including architecture, programming paradigms, algorithms and other applications of distributed computing.

Prerequisite

- 22CS360 Operating Systems (Theory cum Practical)
- 22CS430 Data Communication and Networks
- 22CS570 Network Programming Lab

Course Outcomes

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

CO	Course Outcome	TCE Proficiency Scale	Expected Proficiency (%)	Expected Attainment Level (%)
CO1	Design an Application programming Interface for multi-processing and multi programing environment. (Apply)	TPS3	A	85
CO2	Demonstrate a framework for a concurrent system using logical time and global state. (Apply)	TPS3	A	85
CO3	Implement Mutual Exclusion and deadlock detection algorithms in Distributed Systems. (Apply)	TPS3	A	85
CO4	Implement File sharing, caching and accessing mechanism in Distributed File systems. (Apply)	TPS3	A	85
CO5	Design distributed Object Based systems (Apply)	TPS3	A	85
CO6	Design distributed Web Based systems (Apply)	TPS3	A	85

Mapping with Programme Outcomes

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

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

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

List of Experiments/Activities with CO Mapping

Sl.No	Experiments	CO
1.	Implementation of application programming interface with OpenMP pogramming	CO1
2.	Implementation of application programming interface with MPI programming	CO1
3.	Implementation of functioning of Logical and Vector clock.	CO2
4.	Implementations of Distributed Mutual exclusion algorithm	CO3
5.	Implementation of Non Token/ Token based algorithm in Distributed system	CO3
6.	Implementation of the Distributed Deadlock Detection algorithm	CO3
7.	Implementation of Hadoop –Map Reduce Programming	CO4
8.	Implementation of Implement 'RPC' mechanism for accessing methods of remote systems	CO5
9.	Implement CORBA mechanism by using C++ program at one end and Java Program on the other	CO5
10.	Implement Web Service for an web application	CO6

Learning Resources

1. Ajay D. Kshemkalyani and Mukesh Singhal, Distributed Computing: Principles, Algorithms and Systems, Cambridge University Press, 2011.
2. George Coulouris, Jean Dollimore, Tim Kindberg and Gordon Blair, Distributed Systems: Concepts and Design, Fifth Edition, Pearson Education, 2017.
3. M. Van Steen, A.S. Tanenbaum, Distributed Systems, Third Edition, CreateSpace Independent Publishing Platform, 2017.
4. Garg VK. Elements of distributed computing. John Wiley & Sons, 2002.
5. Pradeep K Sinha, "Distributed Operating Systems: Concepts and Design", Prentice Hall of India, 2007

Course Designers:

1. Dr.R. Leena Sri (rlsit@tce.edu)
2. Mr.D.Nagendra Kumar (dnkcse@tce.edu)

CURRICULUM AND DETAILED SYLLABI

FOR

B.E DEGREE (Computer Science and Engineering) PROGRAMME

SEVENTH and EIGHTH SEMESTERS

FOR THE STUDENTS ADMITTED FROM THE

ACADEMIC YEAR 2022 - 2023 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. / B.Tech. Degree Programmes
COURSES OF STUDY
(For the candidates admitted from 2022-23 onwards)

SEVENTH SEMESTER

Course Code	Name of the Course	Category	No. of Hours / Week			credits
			L	T	P	
THEORY						
22CS710	Engineering Economics	HSS	3	-	-	3
22CS720	Human Computer Interaction	ESC	2	-	-	2
22CSPX0	Programme Elective	PE	3	-	-	3
22CSPX0	Programme Elective	PE	3	-	-	3
22CSPX0	Programme Elective	PE	3	-	-	3
22CSPX0	Programme Elective	PE	3	-	-	3
PROJECT COURSE						
22CS790	Project - III	PW	-	-	6	3
Total			**17**	**-**	**6**	**20**

EIGHTH SEMESTER

Course Code	Name of the Course	Category	No. of Hours / Week			credits
			L	T	P	
THEORY						
22CSPX0	Programme Elective	PE	3	-	-	3
22CSPX0	Programme Elective	PE	3	-	-	3
PROJECT COURSE						
22CS890	Project - IV	PW	-	-	6	3
Total			**6**	**-**	**6**	**9**

BSC : Basic Science Courses
PC : Professional Core Courses
ESC : Engineering Science Courses
PW : Project Work

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 2022-23 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	22CS710	Engineering Economics	3	40	60	100	27	50
2	22CS720	Human Computer Interaction	3	40	60	100	27	50
3	22CSPX0	Programme Elective	3	40	60	100	27	50
4	22CSPX0	Programme Elective	3	40	60	100	27	50
5	22CSPX0	Programme Elective	3	40	60	100	27	50
6	22CSPX0	Programme Elective	3	40	60	100	27	50
PROJECT COURSE								
7	22CS790	Project - III	3	40	60	100	27	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	22CSPX0	Programme Elective	3	40	60	100	27	50
2	22CSPX0	Programme Elective	3	40	60	100	27	50
PROJECT COURSE								
3	22CS890	Project - IV	3	40	60	100	27	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.

		Category	L	T	P	Credit
22CS710	**ENGINEERING ECONOMICS**	HSS	3	0	0	3

Preamble

Efficient functioning of any business organization would enable it to provide goods/services at a lower price. In the process of managing organizations, the managers at different levels should take appropriate economic decisions which will help in minimizing investment, operating and maintenance expenditures besides increasing the revenue, savings and such other gains of the organization. These can be achieved through Engineering Economics which deals with the methods that enable one to make economic decisions towards minimizing costs and/or maximizing benefits to business organizations. The required techniques and methods are discussed in this course. Also, AI is becoming more and more important in making an impact on economic and finance theories. Hence, a few case studies are also discussed.

Prerequisite

Nil

Course Outcomes

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

CO	Course Outcomes	**TCE Proficiency Scale**	**Expected Proficiency in %**	**Expected Attainment Level %**
CO1	Determine the cut off production volume for a company to make profit by performing break even analysis with an understanding of various costs involved.	TPS3	A	70
CO2	Make investment decisions by applying interest formulas	TPS3	A	70
CO3	Choose the best project option from among a set of competing alternatives.	TPS3	A	70
CO4	Perform replacement / maintenance analysis to minimize the maintenance cost in an organization	TPS3	A	70
CO5	Perform depreciation accounting to obtain the book value of an asset.	TPS3	A	70
CO6	Build machine learning models for aiding economic policy design with a comprehension of the impact of AI in economic and finance theories.	TPS3	A	70

Mapping with Programme Outcomes

COs	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1.	S	M	L					L	M	M	M	L	L		M
CO2.	S	M	L					L	M	M	M	L	L		M
CO3	S	M	L					L	M	M	M	L	L		M
CO4	S	M	L					L	M	M	M	L	L		M
CO5	S	M	L					L	M	M	M	L	L		M
CO6	S	M	L		L	L		L	M	M	M	M	L	L	M

S- Strong; M-Medium; L-Low

Assessment Pattern

CO	CAT1			CAT2			ASSIGNMENT 1			ASSIGNMENT 2			TERMINAL		
TPS Scale	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
CO1	5		16						20				3		8
CO2	5	10	30						45				2	5	15
CO3		10	24						35					5	12
CO4				5		16						20		5	12
CO5				5	10	30						45	2	5	15
CO6					10	24						35	3		8

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

Syllabus

Introduction to Economics: Flow in an Economy- Law of Supply and Demand - Concept of Engineering Economics- Types of Efficiency- Definition and Scope of Engineering Economics - Elements of Costs- Other Costs/Revenues- Marginal Cost- Marginal Revenue- Sunk Cost- Opportunity Cost- Break-Even Analysis - Profit/Volume Ratio (P/V Ratio)- Application in make or buy decision.

Interest Formulas and Their Applications: Introduction -Time Value of Money- Interest Formulas - Single-Payment Compound Amount Single-Payment Present Worth Amount - Equal-Payment Series Compound Amount - Equal Payment Series Sinking Fund- Equal-Payment Series Present Worth Amount- Equal-Payment Series Capital Recovery Amount - Uniform Gradient Series Annual Equivalent Amount -Effective Interest Rate.

Comparison of Project Alternatives: Present worth method - Future worth method - Annual equivalent method - Rate of return method.

Replacement and Maintenance Analysis: Introduction - Types of Maintenance - Types of Replacement Problem - Determination of Economic Life of an Asset - Replacement of Existing Asset with a New Asset - Capital Recovery with Return- Concept of Challenger and Defender.

Depreciation: Introduction- Methods of Depreciation - Straight Line Method of Depreciation - Declining Balance Method of Depreciation - Sum-of-the-Years-Digits Method of Depreciation - Sinking Fund Method of Depreciation - Service Output Method of Depreciation.

Application of Machine Learning in Economics: Types of machine learning- Use Cases- Case Studies on prediction of real estate prices, market basket analysis and economic growth.

Text Book

Panneerselvam R, Engineering Economics, PHI Learning Private Limited; 2nd edition, 2013.

Reference Books & web resources

1. Chan S Park, Contemporary Engineering Economics, Pearson, 5th edition, 2015.

2. NPTEL course on Engineering Economic Analysis - https://nptel.ac.in/courses/112107209

3. Sendhil Mullainathan and Jann Spiess, Machine Learning: An applied Econometric Approach , *Journal of Economic Perspectives-Volume 31, Number 2-Spring 2017-Pages 87–106*

Course Contents and Lecture Schedule

Module No.	Topic	No. of Periods
1	**Introduction to Economics:**	
1.1	Flow in an Economy- Law of Supply and Demand - Concept of Engineering Economics-Types of Efficiency-Definition and Scope of Engineering Economics	1
1.2	Elements of Costs- Other Costs/Revenues- Marginal Cost- Marginal Revenue- Sunk Cost- Opportunity Cost	1
1.3	Break-Even Analysis-Profit/Volume Ratio (P/V Ratio)	1
1.4	Application in make or buy decision.	1
2	**Interest Formulas and Their Applications:**	
2.1	Introduction -Time Value of Money- Interest Formulas - Single-Payment Compound Amount- Single-Payment Present Worth Amount .	2

Module No.	Topic	No. of Periods
2.2	Equal-Payment Series Compound Amount - Equal Payment Series Sinking Fund- Equal-Payment Series Present Worth Amount- Equal-Payment Series Capital Recovery Amount .	4
2.3	Uniform Gradient Series - Annual Equivalent Amount - Effective Interest Rate.	2
3	**Comparison of Project Alternatives:**	
3.1	Present worth method - Future worth method.	3
3.2	Annual equivalent method - Rate of return method.	3
4	**Replacement and Maintenance Analysis:**	
41	Introduction - Types of Maintenance - Types of Replacement Problem - Determination of Economic Life of an Asset	3
4.2	Replacement of Existing Asset with a New Asset - Capital Recovery with Return- Concept of Challenger and Defender.	3
5	**Depreciation:**	
5.1	Introduction- Methods of Depreciation - Straight Line Method of Depreciation - Declining Balance Method of Depreciation.	4
5.2	Sum-of-the-Years-Digits Method of Depreciation - Sinking Fund Method of Depreciation - Service Output Method of Depreciation.	4
6	**Application of Machine Learning in Economics:**	
6.1	Types of machine learning- Use Cases	1
6.2	Case Studies on prediction of real estate prices, market basket analysis and economic growth.	3
	Total	36

Course Designer(s):

C.Sridharan, Associate Professor of Computer Science and Engineering, cscse@tce.edu

22CS720	HUMAN COMPUTER INTERACTION

Category	L	T	P	Credit
ES	2	0	0	2

Preamble

The objective of this course is to introduce the basic theories and concepts of human-computer interaction (HCI). 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

COs	Course Outcomes	TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Acquire fundamental concepts of computer component functions regarding interaction with human and vice versa	TPS2	B	85
CO2	Choose the appropriate standards for HCI systems preferred by the user	TPS3	B	80
CO3	Categorize the given problem and design the interface using suitable interaction styles	TPS4	B	80
CO4	Using the interface to assess the extent and accessibility of the system functionality	TPS3	B	80
CO5	Apply evaluation strategies and validate the interfaces to meet ethical standards	TPS3	B	80
CO6	Design and implement usable and engaging interfaces	TPS3	B	80

Mapping with Programme 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		
CO3	S	S	M	L	M	L	L	M	L	L	L	L	M	M	M
CO4	S	M	L		L			M	L	L		L	M	L	L
CO5	S	M	L		L			M	L	L		L	M	L	L

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

S- Strong; M-Medium; L-Low

Assessment Pattern

CO	CAT1						CAT2						Assignment1						Assignment2						Terminal					
TPS Scale	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
CO1	10	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	5	-	-	-	-
CO2	5	10	20	-	-	-	-	-	-	-	-	-	-	-	15	-	-	-	-	-	-	-	-	-	2	5	10	-	-	-
CO3	10	10	10	20	-	-	-	-	-	-	-	-	-	-	15	70	-	-	-	-	-	-	-	-	2	5		20	-	-
CO4	-	-	-	-	-	-	10	10	15	-	-	-	-	-	-	-	-	-	-	-	15	-	-	-	2	5	10	-	-	-
CO5	-	-	-	-	-	-	5	10	15	-	-	-	-	-	-	-	-	-	-	-	15	-	-	-	2	5	10	-	-	-
CO6	-	-	-	-	-	-	10	10	15	-	-	-	-	-	-	-	-	-	-	-	70	-	-	-	-	5	10	-	-	-

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

Syllabus

Foundations: History-Goals-Tools - User-oriented approach-Interface- Elements and methods - Relationship between HCI and AI.
Requirements: Components - Characteristics - Usability- Understandability – Correctness - Completeness- Scalability and Concurrency-Problems in Multi-Portal Systems - Error handling.
Design: Basics - User Focus – Scenarios – Navigation – Layout and Menu design - Usability Engineering - Design Rules – Interaction Models – Ergonomics - HCI Patterns - Perceptions and experiences of using AI – Cognitive Design Models using AR/VR.
Evaluation: Principles - Expert Reviews – Usability and Acceptance Testing – Evaluation of Spastic Devices Interaction Panels.

Visualization: Basics-Attention and overreliance on AI- Ambiguity in human intent and communication- Interpretability and Explainability - Interactive visualization – Understanding model behaviour.
Ethics and Safety: Ethics- Fairness and Equity- Privacy- Transparency-Bias- Reliability and Trustworthiness.
Case Study –Web Design Interface, Conversational AI and Explainable AI

Reference Books & web 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

Module No.	Topic	No. of Periods
1	**Foundations (2)**	
1.1	History	1
1.2	Goals	
1.3	Tools	
1.4	User-oriented approach	1
1.5	Interface	
1.6	Elements and methods	
1.7	Relationship between HCI and AI	
2	**Requirements (3)**	
2.1	Components	1
2.2	Characteristics	
2.3	Usability	1
2.4	Understandability	
2.5	Correctness	
2.6	Completeness	
2.7	Scalability and Concurrency	
2.8	Problems in Multi-portal Systems	1
2.9	Error handling	
3	**Design (7)**	
3.1	Basics	1
3.2	User Focus	
3.3	Scenarios	

Module No.	Topic	No. of Periods
3.4	Navigation	
3.5	Layout and Menu design	2
3.6	HCI in Software Process	
3.7	Usability Engineering	1
3.8	Design Rules	
3.9	Interaction Models	
3.10	Ergonomics	1
3.11	HCI Patterns	
3.12	Perceptions and experiences of using AI	
3.13	Cognitive Design Models using AR/VR	2
4	**Evaluation (3)**	
4.1	Principles	1
4.2	Expert Reviews	
4.3	Usability and Acceptance testing	2
4.4	Evaluation of Spastic Devices Interaction Panels	
5	**Visualization (4)**	
5.1	Attention and overreliance on AI	1
5.2	Ambiguity in human intent and communication	1
5.3	Interpretability and Explainability	1
5.4	Interactive visualization	
5.5	Understanding model behaviour	1
6	**Ethics and Safety (2)**	
6.1	Ethics	1
6.2	Fairness and Equity	
6.3	Privacy	

Module No.	Topic	No. of Periods
6.4	Transparency	1
6.5	Bias	
6.6	Reliability and Trustworthiness	
	Case Study –Web design Interface, Conversational AI and Explainable AI	3
	Total	**24**

Course Designer(s):

1. Dr.M.Suguna, Assistant Professor,CSE mscse@tce.edu

2. Ms.C.Santhiya, Assistant Professor, CSE csit@tce.edu

CURRICULUM AND DETAILED SYLLABI

FOR

B.E DEGREE (Computer Science and Engineering) PROGRAMME

PROGRAMME ELECTIVES

FOR THE STUDENTS ADMITTED FROM THE

ACADEMIC YEAR 2022 - 2023 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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		Category	L	T	P	Credit
22CSPA0	**DATA MINING**	PSE	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. It helps the students to learn about constructing and querying over data warehouse, preparing data for analysis, concepts and methodology of different data mining techniques. Students can also learn and practice the applications of data mining algorithms over different types of data.

Prerequisite

- Knowledge in Databases

Course Outcomes

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

COs	Course Outcomes	TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Construct a data warehouse for the given requirements and execute various OLAP operations on the data warehouse.	TPS3	B	80
CO2	Identify suitable data pre-processing methods to extract insights from the given data.	TPS3	B	80
CO3	Generate association rules using frequent pattern mining algorithms from the given dataset.	TPS3	B	80
CO4	Employ different classification and prediction algorithms to build analytical models for real-life problems.	TPS3	B	80
CO5	Develop clusters using appropriate clustering methods to handle outliers present in the given data set.	TPS3	B	80
CO6	Use suitable mining algorithms to extract insights from different types of data such as text, web, and sequence data.	TPS3	B	80
CO7	Experiment with various data mining techniques using modern tools such as Orange, Rapid Miner, Weka.	TPS4	B	80

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L		M	L		M	M	M		M	M	L	M
CO2	S	M	L		M	L		M	M	M		M	M	L	M
CO3	S	M	L		M	L		M	M	M		M	M	L	M
CO4	S	M	L		M	L		M	M	M		M	M	L	M
CO5	S	M	L		M	L		M	M	M		M	M	L	M
CO6	S	M	L		M	L		M	M	M		M	M	L	M
CO7	S	S	M	L	M	M		M	M	M	M	M	S	M	M

S- Strong; M-Medium; L-Low

Assessment Pattern

CO	CAT1						CAT2						Terminal					
TPS Scale	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
CO1	5	10	20										2	5	10			
CO2	5	10	10											5	10			
CO3	10	10	20										2	5	10			
CO4							10	10	20				2	5	10			
CO5							5	10	20				2	5	10			
CO6							5	10	10				2	10	5			
CO7																		
Total	**20**	**30**	**50**				**20**	**30**	**50**				**10**	**35**	**55**			

CO	Assignment I						Assignment II					
TPS Scale	1	2	3	4	5	6	1	2	3	4	5	6
CO1			20									
CO2			30									
CO3			30									
CO4									30			
CO5									30			

CO6									20			
CO7				20						20		
Total			**80**	**20**					**80**	**20**		

*****Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

Syllabus

Data warehousing and OLAP: Data warehousing architecture and Implementation, ETL process, OLTP, OLAP, ROLAP, MOLAP, SQL support for OLAP, OLAP operations Multidimensional data model – Data cubes computation methods, Attribute oriented induction, Schema structures – star, snowflake, galaxy schemas, concept hierarchy.

Data Mining and KDD Process -: Data Mining basics, KDD process, Mining on different types of data and patterns, Related technologies, Applications and Issues in data mining. **Data Pre-processing:** Data objects and attribute types, Data Cleaning, Data Integration, Data Reduction, Data Transformation, and Discretization.

Mining Frequent Patterns, Associations, and Correlations: Concepts, Frequent pattern mining methods - Apriori and FP-Growth algorithm, mining using vertical data format, closed and maximal patterns - Pattern evaluation methods -Pattern mining in multilevel, multidimensional space.

Classification: Decision tree Induction - Bayesian classification–Rule-based classification, Support vector machines, K-NN classifier, Associative Classification - Model evaluation methods

Clustering: Cluster Analysis, measuring data similarity and dissimilarity, Partition based Methods: K-Means, K-Medoids, Hierarchical Methods: AGNES, DIANA, BIRCH, Density-based Methods: DBSCAN, Model-based clustering – COBWEB, Outlier Analysis - Outlier detection methods.

Other mining methods: Sequential Pattern Mining – SPADE, GSP, Text Mining – Pre-processing, Text classification, and clustering, Web Mining – Web Structure, Web content, and Web usage mining, Overview of data stream mining.

CO7 will be evaluated by the Mini project.

Guidelines for the Mini-project:

Group formation: Students are split into project groups with around 3 members in each group. A team can execute the project with various data mining algorithms and improve the efficiency of the algorithm by pre-processing methods using any of the data mining software like Orange, Weka and Rapid Miner etc. At the end of the semester, the team members have to present their project, submit their report and share their lessons learned/best practices with other teams.

Some of the activities may include: (but not limited to)

- ✓ Application identification and data set collection
- ✓ Select relevant data mining algorithms to extract knowledge from the data set.
- ✓ Design a diagram of knowledge extraction from raw data.
- ✓ Results and performance analysis for the chosen data mining technique.
- ✓ Documentation

Some of the Mini-project titles may include: (but are not limited to)

- ✓ e-governance
- ✓ Health care
- ✓ Banking
- ✓ University data analysis
- ✓ Social media

Text Books

1. Jiawei Han, MichelineKamber, Jian Pei, “Data Mining Concepts and Techniques”, Third Edition, Elsevier,2011.
2. Arun K. Pujari, “Data Mining Techniques”, Second Edition, University Press, 2013.

Reference Books

1. Alex Berson and Stephen J. Smith “Data Warehousing, Data Mining & OLAP”, Tata McGraw – Hill Edition, Tenth Reprint 2007.
2. Ian H.Witten, Eibe Frank, Mark.A. Hall, “Data Mining: Practical Machine Learning Tools and Techniques”, Elsevier, Fourth Edition, 2016.
3. G. K. Gupta, “Introduction to Data Mining with Case Studies”, Prentice Hall India Learning Private Limited, Third Edition, 2014.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Lecture Hours
1	**Data warehousing and OLAP (6)**	
1.1	Data warehousing concepts and architecture, Implementation	1
1.2	ETL process, OLTP, OLAP, ROLAP, MOLAP, SQL support for OLAP, OLAP operations	2
1.3	Multidimensional data model – Data cube computation methods, Attribute oriented induction	2
1.4	Schema structures – star, snowflake, galaxy schemas, concept hierarchy	1
2	**Data Mining and KDD Process, Data Pre-processing (6)**	
2.1	Data Mining Basics, KDD process, Mining on different types of data and patterns	1
2.2	Related technologies, Applications and issues in data mining	1
2.3	**Data Pre-processing:** Data objects and attribute types, Data Cleaning	1
2.4	Data Integration and Data Reduction	2
2.5	Data Transformation, Data discretization	1
3	**Mining Frequent Patterns, Associations, and Correlations(6)**	
3.1	Concepts, Frequent pattern mining methods - Apriori algorithm	2
3.2	FP-Growth Algorithm, Mining using vertical data format, closed and maximal patterns	2
3.3	Pattern evaluation methods	1
3.4	Pattern mining in multilevel, multidimensional space	1
4	**Classification (7)**	

4.1	Decision tree Induction	2
4.2	Bayesian classification	1
4.3	Rule-based classification, Support vector machines	2
4.4	K-NN classifier , Associative Classification	1
4.5	Model evaluation methods	1
5	**Clustering(7)**	
5.1	Cluster Analysis, measuring data similarity and dissimilarity, Partition-based Methods: K-Means, K-Medoids	2
5.2	Hierarchical Methods: AGNES, DIANA, BIRCH	1
5.3	Density-based Methods: DBSCAN	1
5.4	Model-based clustering – COBWEB	2
5.5	Outlier Analysis, Outlier detection methods	1
6	**Other mining methods (4)**	
6.1	Sequential Pattern Mining – SPADE, GSP	1
6.2	Text Mining – Pre-processing, Text classification, and clustering	1
6.3	Web Mining – Web Structure, Web content, and Web usage mining	1
6.4	Overview of data stream mining	1
	Total Hours	**36**

Course Designer(s):

1. Dr.B.Subbulakshmi, AP,CSE bscse@tce.edu
2. Dr.M.Nirmala Devi, AP,CSE mnit@tce.edu

22CSPB0 INTERACTIONS DESIGN FOR XR

Category	L	T	P	Credit
PSE	3	0	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	TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Create 3D graphics objects and to lay them out to create an environment.	TPS3	B	75
CO2	Interact with a VR world, including the concepts and technologies of VR interaction.	TPS3	B	70
CO3	Build simple, interactive mobile applications with augmented reality functions.	TPS3	B	70
CO4	Develop a walkthrough for a model and view it on a mobile.	TPS3	B	70
CO5	Discuss the applications of VR in Business, Manufacturing, Architecture and Construction and Entertainment	TPS3	B	70
CO6	Evaluate current trends of AR and VR media delivery to propose options to potential clients, and discuss the benefits, challenges and misconceptions involved with working in AR and VR.	TPS4	B	70

Mapping with Programme Outcomes

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

S- Strong; M-Medium; L-Low

Assessment Pattern

CO	CAT1						CAT2						Terminal					
TPS Scale	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
CO1	10	20											4	10				
CO2		20	10										4	10				
CO3		20	20										4	10				
CO4							10	20	15				4		15			
CO5							10	20	15				4		15			
CO6										10						10		

CO	ASSIGNMENT 1	ASSIGNMENT2

TPS Scale	1	2	3	4	5	6	1	2	3	4	5	6
CO1												
CO2		50										
CO3			50									
CO4									50			
CO5												
CO6										50		

*Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

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, WEB3, 5G and other technologies. Metaverse - 3D virtual space where humans can experience.

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. Mobile Walkthrough.

AR applications – Building AR experience and build as android application, 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.

Case study:
Create components, integrate color or textures, use the 3D Warehouse to import images.
create a VR walk-through of your Sketch Up Model an AR application to move a character off its marker and control it's animation.

Text Books

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

Reference Books & web resources

1. William R.Sherman, Alan B.Craig, "Understanding Virtual Reality – Interface, Application, Design”, The Morgan Kaufmann Series, 2003.
2. John Vince, "Introduction in Virtual Reality", Springer, 2004.
3. Gerard Jounghyun Kim, "Designing Virtual Reality Systems, the Structured Approach" Springer London, 2005. Course Contents and Lecture Schedule
4. Steve Aukstakalnis, “Practical Augmented Reality”, Addision Wesley 2017.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours
1	**AR VR, XR ENVIRONMENTS**	
1.1	Virtual environments, Requirements for VR,	1
1.2	benefits of Virtual reality, Augmented Reality, Computer-Generated Worlds,	1
1.3	Defining Position and Orientation, The Three I's of Virtual Reality, A Short History of Early Virtual Reality,	1
1.4	WEB3, 5G and other technologies.	1
1.5	Metaverse - 3D virtual space where humans can experience.	1
2	**Representing the Virtual World**	
2.1	Understanding the Human Senses and Their Relationship to Output / Input Devices.	1
2.2	Component Technologies of Head-Mounted Displays,	1
2.3	Augmenting Displays, Fully Immersive Displays,	1
2.4	Sensors for Tracking Position,	1
2.5	Orientation, and Motion, Devices to Enable Navigation	1
3	**Visual Perception & Rendering**	
3.1	Creating a 3D Model, Drawing Lines, Shapes,	2
3.2	3D Objects, drawing and design models,	2

3.3	anchoring , scaling , and rotating of models,	1
3.4	Immersive Walking through a model, jump/ walkthrough the models	1
4.1	**AR applications** Building AR experience and build as android application	2
4.2	transform the objects in your scene, Modify the virtual environment,	2
4.3	Load and display 3D models,	2
4.4	Design an Augmented Reality experience that can be used to visualize products and narratives, at any time from your mobile phone	2
5.1	**Business and Manufacturing** Using Augmented Reality for advertising	1
5.2	virtual prototyping system, the cave to examine the aesthetics of an automobile interior.	1
5.3	**science and technology** virtual wind tunnel, telepresence.	1
5.4	**Education Applications**, Tangible Skills development in Education, Knowledge Acquisition, and Concept Formation	1
	Lab activities	
1	Create 3D objects and transforms to lay out a 3D scene	2
2	Create a VR walk-through of your SketchUp Model	2
3	An AR application to move a character off its marker and control its animation.	4
	Total	36

Course Designer(s)

1. Dr.N.Shivakumar AP/CSE shiva@tce.edu
2. Mrs.G.Bhavani AP/CSE gbicse@tce.edu

22CSPC0	**CLOUD COMPUTING**

		Category	L	T	P	Credit
		PSE	3	0	0	3

Preamble

This course provides a strong foundation of knowledge on Cloud Computing concepts and services, facilitating the usage of Cloud based services and tools in application development and deployment. Students will able to learn how to build, deploy and manage container-based applications on cloud.

Prerequisite

NIL

Course Outcomes

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

COs	Course Outcomes	TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Utilize the main concepts, key technologies, strengths and limitations to understand cloud computing environment	TPS3	B	80
CO2	Choose suitable cloud architectures, delivery and deployment models for the given scenario	TPS3	B	80
CO3	Identify the virtualization technology that enhance cloud computing	TPS3	B	80
CO4	Categorize and demonstrate the concept of containerization using Docker	TPS3	B	80
CO5	Illustrate the data availability, data replication, and data footprint reduction techniques of cloud storage services	TPS3	B	80
CO6	Examine cloud environment using cloudsim	TPS4	B	80

Mapping with Programme Outcomes

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

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

S- Strong; M-Medium; L-Low

Assessment Pattern

CO	CAT1						CAT2						Assignment1						Assignment2						Terminal					
TPS Scale	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
CO1	10	5	10	-	-	-	-	-	-	-	-	-	-	-	30	-	-	-	-	-	-	-	-	-	2	5	10	-	-	-
CO2	5	10	20	-	-	-	-	-	-	-	-	-	-	-	30	-	-	-	-	-	-	-	-	-	2	5	10	-	-	-
CO3	10	10	20	-	-	-	-	-	-	-	-	-	-	-	40	-	-	-	-	-	-	-	-	-	2	5	10	-	-	-
CO4	-	-	-	-	-	-	10	10	15	-	-	-	-	-	-	-	-	-	-	5	5	-	-	-	2	5	10	-	-	-
CO5	-	-	-	-	-	-	15	10	15	-	-	-	-	-	-	-	-	-	-	15	30	-	-	-	2	5	10	-	-	-
CO6	-	-	-	-	-	-	-	10	5	10	-	-	-	-	-	-	-	-	-	15	05	25	-	-	-	5	-	10	-	-

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

Syllabus

Introduction: Cloud components - Essential characteristics - Architectural and Technological Influences – Benefits – Limitations - Policies - Comparing cloud providers with traditional IT service providers.

Architecture, Services and Models: Architecture - NIST Cloud Computing Reference Model, Utility Computing and Federated Computing - Services: Software as a Service (SaaS), Platform as a Service (PaaS), Infrastructure as a Service (IaaS) - Challenges and risks in cloud adoption- Cloud deployment model: Public clouds, Private clouds, Community clouds, Hybrid clouds-Capex Vs OpEx in cloud.

Data Center and Virtualization: IT Service management - Design considerations – Scalability, On-demand services – Energy efficiency- Components and Benefits of Virtualization - Types of Virtualizations (Storage and Desktop) – VM Provisioning and Migration.

Containerization: Overview – Virtualization Vs Containers - Features -Components-Creating Containerized Services - Managing Containers - Orchestration in docker-Cluster management in Kubernetes.

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.

Cloud Applications: Simulating a cloud environment using cloudsim, Case Study - Use cases of Cloud in various domains.

Text Book

1. Thomas Erl, Zaigham Mahmood, Ricardo Puttini, “Cloud Computing: Concepts, Technology & Architecture”,Prentice Hall Service Technology Series, 2013.
2. Nelson Ruest, Danielle Ruest, “Virtualization, A Beginner’s Guide”, McGraw-Hill Companies,2009.

Reference Books & web resources

1. John Rittinghouse, James Ransome, “Cloud Computing: Implementation, Management and Security”, CRC Press 2010.
2. Greg Schulz, “Cloud and Virtual Data Storage Networking”, CRC Press, 2012.
3. Nelson Ruest, Danielle Ruest, “Virtualization, A Beginner’s Guide”, McGraw-Hill Companies,2009.
4. https://www.edx.org/learn/cloud-computing.
5. https://www.coursera.org/browse/information-technology/cloud-computing
6. https://docs.docker.com/

Course Contents and Lecture Schedule

Module No.	Topic	No. of Periods
1	**Introduction (3)**	
1.1	Cloud components	1
1.2	Essential characteristics	

1.3	Architectural and Technological Influences	
1.4	Benefits	1
1.5	Limitations	
1.6	Policies	
1.7	Comparing cloud providers with traditional IT service providers.	1
2	**Architecture, Services and Models (6)**	
2.1	NIST Cloud Computing Reference Model	1
2.2	Utility and Federated Computing Architecture	1
2.3	Services-SaaS, PaaS and IaaS	1
2.4	Challenges and risks in cloud adoption	1
2.5	Cloud deployment models- Public clouds, Private clouds, Community clouds, Hybrid clouds	1
2.6	Capex Vs OpEx in cloud	1
3	**Data Center and Virtualization (9)**	
3.1	IT Service management	1
3.2	Design considerations	1
3.3	Scalability	1
3.4	On-demand services	1
3.5	Energy efficiency	
3.6	Components and Benefits of Virtualization	1
3.7	Types of Virtualizations	2
3.8	VM Provisioning and Migration	2
4	**Containerization (9)**	
4.1	Overview	1
4.2	Virtualization Vs Containers	1
4.3	Features	

4.4	Components	1
4.5	Creating Containerized Services	1
4.6	Managing Containers	1
4.7	Orchestration in docker	2
4.8	Cluster management in Kubernetes	2
5	**Cloud Security and Storage (5)**	
5.1	Security concerns in cloud computing	1
5.2	Cloud data security	
5.3	Security patterns and Architectural elements	1
5.4	Cloud storage services and functionalities	1
5.5	Storage system architectures	1
5.6	Data Footprint Reduction Techniques	1
6	**Cloud Applications (4)**	
6.1	Simulating a cloud environment using cloudsim	2
6.2	Case Study - Use cases of Cloud in various domains	2
	Total	**36**

Course Designer(s):

1. C.Santhiya, Assistant Professor, CSE csit@tce.edu

22CSPD0 KERNEL PROGRAMMING

Category	L	T	P	Credit
PSE	3	0	0	3

Preamble

This course introduces the fundamental design of kernel components in structuring the operating system. The course is structured on a widely used open source operating system Linux. 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

COs	Course Outcomes	TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Show the role of kernel in the booting process and initialization of operational computer system	TPS3	B	80
CO2	Configure and tune the kernel daemon and networking service	TPS3	B	80
CO3	Utilize the system calls and libraries of Linux kernel to perform system related tasks	TPS3	B	80
CO4	Construct Synchronization solutions to achieve consistent access to shared resource	TPS3	B	80
CO5	Construct and Configure the interrupt handlers of Linux kernel	TPS3	B	80
CO6	Examine and infer the file system organization and design of kernel modules	TPS4	B	80

Mapping with Programme Outcomes

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

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

S- Strong; M-Medium; L-Low

Assessment Pattern

CO	CAT1						CAT2						Assignment1						Assignment2						Terminal					
TPS Scale	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
CO1	5	10	15	-	-	-	-	-	-	-	-	-	-	10	10	-	-	-	-	-	-	-	-	-	2	5	6	-	-	-
CO2	5	10	15	-	-	-	-	-	-	-	-	-	-	15	25	-	-	-	-	-	-	-	-	-	2	5	10	-	-	-
CO3	10	10	20	-	-	-	-	-	-	-	-	-	-	15	25	-	-	-	-	-	-	-	-	-	2	5	10	-	-	-
CO4	-	-	-	-	-	-	10	10	15	-	-	-	-	-	-	-	-	-	-	5	5	-	-	-	2	5	10	-	-	-
CO5	-	-	-	-	-	-	5	10	15	-	-	-	-	-	-	-	-	-	-	15	30	-	-	-	2	5	10	-	-	-
CO6	-	-	-	-	-	-	10	10	15	-	-	-	-	-	-	-	-	-	-	15	30	-	-	-	2	5	12	-	-	-

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

Syllabus

Basics of Kernel: Overview of Kernel - Linux kernel design and modes of operation, Boot Process – Boot Loaders and Loading of Kernel – Case study: Initialization of the Linux Kernel.

Linux Kernel services and networking: Daemon Services, Service Configuration and tuning, Networking devices - The TCP/IP protocol stack communication- Obtaining System IP address.

Linux Kernel in Process and File management: Process, Threads, Process Address Space, Processes Scheduling – System Calls and Libraries: APIs, POSIX, and the C Library, Syscalls, System Call Handler, System call context.

Linux Kernel Synchronization: Basics of Kernel Synchronization, Kernel Synchronization Methods – Kernel Locking mechanism, Atomic Operations, Spin Locks, Semaphore.

Device Management: Device Types and Device Drivers, Interrupts and Interrupt handlers, Timers and Time management: Jiffies, Hardware Clocks and Timers.

Linux Kernel in Virtual File System and Kernel Modules: File Systems Interface and Abstraction, VFS objects: Superblock object, Inode object, Dentry object and File object, Kernel modules – Dynamic Loading and unloading of kernel modules, Case Study Building Kernel module.

Text Book

1. Kaiwan N Billimoria, “Linux Kernel Programming”, Packt Publisher,2021.
2. Robert Love, “Linux Kernel Development: A thorough guide to the design and implementation of the Linux Kernel”, Third Edition, Addison-Wesley.

Reference Books & web resources

1. Daniel P.Bovet, Marco Cesati, “Understanding the Linux Kernel”, , O`Reilly, Third Edition, 2006.
2. Gary Nutt , “Kernel projects for Linux”, Addison Wesley, First edition, 2001.
3. Peter Jay Salzman Michael Burian Ori Pomerantz, “The Linux Kernel Module Programming Guide”, 2001.
4. Linux with Operating System Concepts, Richard Fox, CRC Press, Taylor & Francis, A Chapman & Hall Book, 2015.
5. Linux Kernel Development, Robert Love, Pearson Education, Third Edition, 2010.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Periods
1	**Basics of Kernel**	
1.1	Overview of Kernel	1
1.2	Linux kernel design and modes of operation	1
1.3	Boot Process – Boot Loaders and Loading of Kernel	1
1.4	Case study: Initialization of the Linux Kernel	1
2	**Linux Kernel services and networking**	
2.1	Daemon Services	1
2.2	Service Configuration and tuning	2
2.3	Networking devices	1
2.4	The TCP/IP protocol stack communication	1
2.5	Obtaining System IP address	1
3	**Linux Kernel in Process and File management**	
3.1	Process, Threads and Process Address Space	2
3.2	Linux Processes Scheduling	2
3.3	System Calls and Libraries: APIs, POSIX, and the C Library	1
3.4	Syscalls and System Call Handler	2
3.5	System call context	1
4	**Linux Kernel Synchronization**	

4.1	Basics of Kernel Synchronization	2
4.2	Kernel Synchronization Methods – Kernel Locking mechanism	1
4.3	Atomic Operations	1
4.4	Spin Locks	1
4.5	Semaphore	2
5	**Device Management**	
5.1	Device Types and Device Drivers	1
5.2	Interrupts and Interrupt handlers	2
5.3	Timers and Time management: Jiffies, Hardware Clocks and Timers	2
6	**Linux Kernel in Virtual File System and Kernel Modules**	
6.1	File Systems Interface and Abstraction	1
6.2	VFS objects: Superblock object, Inode object, Dentry object and File object	2
6.3	Kernel modules – Dynamic Loading and unloading of kernel modules	1
6.4	Case Study Building Kernel module	2
	Total	36

Course Designer(s):

1. Dr. G.Madhupriya, Associate Professor, CSE — gmadhupriya@tce.edu

22CSPE0	WIRELESS NETWORKS

Category	L	T	P	Credit
PSE	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	Course Outcome	TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Explain the generations of wireless networks, principles of IEEE 802.11 standards for WLAN, GPRS, wireless local loops and operation of Bluetooth.	TPS2	B	70
CO2	Construct a suitable multiplexing/duplexing technique for a given specification.	TPS3	B	65
CO3	Determine the capacity of a CDMA system, along with its output based on a spread spectrum technique.	TPS3	B	65
CO4	Develop a suitable mechanism to increase the capacity of a cellular network.	TPS3	B	65
CO5	Determine the handoff transitions in a cellular network based on different algorithms.	TPS4	B	65
CO6	Examine the security mechanisms in IEEE802.11 wireless LAN and GSM.	TPS3	B	65

Mapping with Programme 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
CO3	S	M	L	-	-	L	-	L	L	L	-	L	M	-	L
CO4	S	M	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	M	-	L

S- Strong; M-Medium; L-Low

Assessment Pattern

CO	CAT1						CAT2						Assignment		Terminal					
													1	2						
TPS Scale	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	**6**	**3**	**3**	**1**	**2**	**3**	**4**	**5**	**6**
CO1	20	20													10	15				
CO2	5	10	20													5	10			
CO3	5	10	10													10	5			
CO4							10	10	20							5	10			
CO5							10	10	10	10						5	5	5		
CO6								10	10							10	5			

*****Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

Syllabus

Generations of wireless networks- 1G wireless systems- FDMA, 2G wireless systems-TDMA, GSM architecture- Mechanism to support Mobile Environment-GPRS – Reference Architecture-Mobility Support in GPRS- Spread spectrum –FHSS, DSSS, CDMA, 3G wireless systems,4G and beyond

Multiple Access Techniques-Comparison of TDMA,FDMA and CDMA-Capacity of CDMA - Duplexing techniques FDD and TDD and comparison

IEEE 802.11 LAN standard- IEEE 802.11 Protocol architecture and services, OFDM and MAC.- Bluetooth overview, Protocol architecture =, Wireless Local loop

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 management- location update algorithms- Paging Scheme- Location information Disseminations-Hand off Management – Architecture- algorithms- Handoff management process- Mobile IP -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. Jochen Schiller, “Mobile Communications”, Pearson Education, Second Edition, 2003
5. 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,	1	CO1
2.2	OFDM and MAC	2	CO1
2.3	Bluetooth overview	1	CO1
2.4	Bluetooth protocol architecture	1	CO1
3	**Infrastructure Network Topology**		
3.1	Cellular topology and cell fundamentals	2	CO4
3.2	Signal to interference ratio calculation,	2	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:

1. Dr.C.Sridharan,,Associate Professor, CSE,cscse@tce.edu
2. Dr.C.Senthilkumar, Associate Professor, CScskcse@tce.edu

		Category	L	T	P	Credit
22CSPF0	**INTERNET OF THINGS AND ITS APPLICATIONS**	PSE	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 Networking and Programming

Course Outcomes

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

CO	Course Outcome (CO)	TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Describe the general IoT architecture and connected domains. (Understand)	TPS3	B	85
CO2	Analyze the requirements to figure out the suitable communication technology and protocols required for an IoT application. (Analyze)	TPS4	B	85
CO3	Develop an IoT management System using network management protocol. (Apply)	TPS3	B	85
CO4	Design a step by step Model Specifications for an IoT System based on IoT – A reference model. (Apply)	TPS3	B	85
CO5	Develop an IoT application using Raspberry Pi for the given specification applying the IoT technologies. (Apply)	TPS3	B	85
CO6	Design a Web API for transaction of data and services in cloud. (Apply)	TPS3	B	85

Mapping with Programme Outcomes

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

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

S- Strong; M-Medium; L-Low

Assessment Pattern

CO	CAT1						CAT2						Assignment1						Assignment2						Terminal					
TPS Scale	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
CO1	10	10													30										5	10				
CO2	10	10		10												30									5			12		
CO3	10	20	20												40												12			
CO4							10		10												30					10	12			
CO5							10	10	20												30				5		12			
CO6							10	20	10												40				5		12			

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

Syllabus

Introduction to IoT: Introduction, Physical Design of IoT, Logical Design of IoT, IoT Enabling Technologies, Types of Sensors, Types of Actuators, IoT Networking, IoT Levels and Deployment Templates, IoT and M2M, SDN and NFV for IoT. Wireless Protocol for IoT, Communication Technologies - NFC, Bluetooth, Wi-Fi, ZigBee, Z-wave, 6LoWPAN, HTTP, AMQP, Features & Functions of CoAP, MQTT, OAuth2, XMPP, CoAP vs HTTP, Digital Twins, Federated Computing.

IoT System Management with NETCONF: Need for IoT System Management, SNMP, Network Operator Requirements, NETCONF, YANG, NETOPEER, Managing Home Intrusion Detection IoT System with NETCONF-YANG

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, Device and Component Integration, Application Development. IoT Systems – Logical Design using Python - Introduction to Python, Python Classes, Packages of Interest for IoT- JSON, XML, HTTLib, URLLib, SMTPLib

IoT Physical Devices and Endpoint: Basic Building Block of an IoT Device, Exemplary Device: Raspberry Pi, About the board, Linux on Raspberry Pi, Raspberry Pi Interfaces, Programming Raspberry Pi with Python, Other IoT Devices- pcDuino, BeagleBone Black, Cubieboard.

IoT Physical Server and Cloud: Cloud Storage Models and Communication API, WAMP, Xively Cloud, Designing RESTful Web API, AWS for IoT, SkyNet IoT Messaging platform.

Case Studies Illustrating IoT Design and Deployment: Home Automation, Smart city, Environment, Agriculture, Healthcare, IIoT, Multi-Tier Deployment.

Text Book

1. Sudip Misra, Anandarup Mukherjee, Arijit Roy,"Introduction to IoT", Cambridge University Press,2022.
2. Arshdeep Bahga, Vijay Madisetti, Internet of Things: A Hands on Approach, 2014
3. Uckelmann, Dieter, Mark Harrison, and Florian Michahelles, Architecting the Internet of Things. Springer Science & Business Media, 2011.
4. Jean-Philippe Vasseur, Adam Dunkels, Interconnecting Smart Objects with IP: The Next Internet, Morgan Kuffmann, 2010
5. Jonathan L. Zittrain, The Future of the Internet, Yale University Press & Penguin UK 2008.
6. Samuel Greengard, The Internet of Things (The MIT Press Essential Knowledge series), MIT Press, 2015

Course Contents and Lecture Schedule

Module No.	Topic	No. of Periods
1	**Introduction to IoT**	
1.1	Introduction, Physical Design of IoT, Logical Design of IoT,	1
1.2	IoT Enabling Technologies, Types of Sensors, Types of Actuators, IoT Networking,	1
1.3	IoT Levels and Deployment Templates, IoT and M2M, SDN and NFV for IoT.	1
1.4	Wireless Protocol for IoT, Communication Technologies - NFC, Bluetooth, Wi-Fi, ZigBee, Z-wave,	1
1.5	6LoWPAN, HTTP, AMQP, Features & Functions of CoAP, MQTT, OAuth2, XMPP, CoAP vs HTTP.	1
1.6	Digital Twins, Federated Computing.	1
2	**IoT System Management with NETCONF**	
2.1	Need for IoT System Management, SNMP	1
2.2	Network Operator Requirements	1

Module No.	Topic	No. of Periods
2.3	NETCONF, YANG	1
2.4	NETOPEER	1
2.5	Managing Home Intrusion Detection IoT System with NETCONF-YANG	2
3	**IoT Platforms Design Methodology**	
3.1	IoT Design Methodology	1
3.2	Purpose and Requirement Specification, Process Model Specification, Domain Model Specification, Information Model Specification	1
3.3	Service Specification, IoT Level Specification, Functional and Operational View Specification,	1
3.4	Device and Component Integration, Application Development.	1
3.5	IoT Systems – Logical Design using Python -	1
3.6	Introduction to Python, Python Classes,	1
3.7	Packages of Interest for IoT- JSON, XML, HTTLib, URLLib, SMTPLib	1
4	**IoT Physical Devices and Endpoint**	
4.1	Basic Building Block of an IoT Device, Exemplary Device: Raspberry Pi, About the board, Linux on Raspberry Pi, Raspberry Pi Interfaces.	1
4.2	Programming Raspberry Pi with Python	4
4.3	Other IoT Devices- pcDuino, Beagle Bone Black, Cubieboard	1
5	**IoT Physical Server and Cloud:**	
5.1	Cloud Storage Models	1
5.2	Communication API	1
5.3	Xively Cloud	1

Module No.	Topic	No. of Periods
5.4	Designing RESTful Web API	2
5.5	AWS for IoT	1
5.6	SkyNet IoT Messaging platform	1
6	**Case Studies Illustrating IoT Design and Deployment:**.	
6.1	Home Automation, Smart city	1
6.2	Environment	1
6.3	Agriculture, Multi-Tier Deployment	1
6.4	Healthcare, IIoT	1
	Total	36

Course Designers:

1. M.Vijayalakshmi mviji@tce.edu
2. G.S.R.Emil Selvan emil@tce.edu

22CSRA0	DEEP LEARNING	Category	L	T	P	C
		PEES	3	0	0	3

Preamble

This syllabus on "Deep Learning" is intended for students with a background in computer science and provides an in-depth exploration of Artificial Neural Networks, Convolutional Neural Networks (ConvNets), and Recurrent Neural Networks (RNNs). The syllabus emphasizes on the practical aspects of Deep Learning, including applications of ConvNets in image recognition, object detection, and segmentation, as well as the use of RNNs in natural language processing (NLP) tasks.

Prerequisite

- Python Programming

Course Outcomes

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

COs	Course Outcomes	TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Construct training algorithms for Neural Networks using the Perceptron learning algorithm and Feed-Forward Networks	TPS 3	B	70
CO2	Illustrate optimization methods for Deep Learning Algorithms	TPS 3	B	70
CO3	Illustrate Convolutional Neural Networks algorithms and solve real-world problems	TPS 3	B	70
CO4	Analyse the Deep Learning algorithms to solve complex problems with an understanding of the trade-offs involved	TPS 4	B	70
CO5	Construct learning algorithms for Recurrent Neural Networks	TPS 3	B	70
CO6	Analyse the Deep Learning algorithms which are more appropriate for various types of learning tasks in domains like Vision and NLP	TPS 4	B	70

Mapping with Programme 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	M	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	S	M	L	M	L		M	L	L		M	S	M	L
CO5	S	M	L		M	L		M	L	L		M	M	M	L
CO6	S	S	M	L	M	L		M	L	L		M	S	M	L

S- Strong; M-Medium; L-Low

Assessment Pattern

CO	**CAT 1**						**Assignment 1**			**CAT 2**						**Assignment 2**			**Terminal**					
TPS Scale	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**1**	**2**	**3**	**4**	**5**	**6**
CO1	-	10	20	-	-	-	-	-	20	-	-	-	-	-	-	-	-	-	2	5	-	-	-	-
CO2	-	10	20	-	-	-	-	-	20	-	-	-	-	-	-	-	-	-	2	5	12	-	-	-
CO3	-	20	20	-	-	-	-	-	60	-	-	-	-	-	-	-	-	-	2	5	12	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	10	20	-	-	-	-	-	10	2	5	-	12	-	-
CO5	-	-	-	-	-	-	-	-	-	-	10	20	-	-	-	-	-	30	2	5	12	-	-	-
CO6	-	-	-	-	-	-	-	-	-	-	20	20	-	-	-	-	-	60	-	5	-	12	-	-

*****Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

Syllabus

Artificial Neural Networks: Basic concepts of Artificial Neurons, single and multi-layer perceptron, perceptron learning algorithm, its convergence proof, different Activation Functions, softmax cross entropy loss function.

Optimization: Types of errors, bias-variance trade-off, overfitting-underfitting, brief review of concepts from optimization, variants of gradient descent, momentum-based methods

ConvNets, ConvNet Architectures and Dropout/Regularization/BatchnormConvNets: Basic concepts of Convolutional Neural Networks starting from filtering. Convolution and pooling operation and arithmetics of these. ConvNet Architectures: Discussions on famous ConvNet architectures - AlexNet, GoogLeNet, ResNet, MobileNet-v2 Discussion on regularization, Dropout, Batch normalization – Introduction to GCNN (Graph Convolutional Neural Network) - Multiclass Classification Model for Computer Vision (CV)

CNN Detection and Segmentation Applications: Basics on detection, segmentation problem definition, challenges, Evaluation, Datasets and Localization by regression. Discussion on detection as classification, region proposals, RCNN and YOLO architectures, fully convolutional segmentations, Mask-RCNNs

Recurrent Architectures and NLP Applications: Discussion on Recurrent Neural Networks (RNNs) – Gated Neural Network (GRU), Long-Short Term Memory (LSTM) architectures – Auto Encoders - Generative Adversarial Network (GAN)
Transformers: Vision Transformers, Attention Model types, Transformer (BERT)

CO6 will be evaluated by Mini project - Guidelines for the Mini-project:

Group formation: Students are split into project groups with around 3 members in each group. A team can execute the project using DL algorithms and improve the efficiency of the algorithm by pre-processing methods using any of the DL frameworks like Keras, TensorFlow. At the end of the semester, the team members have to present their project, submit their report and share their lessons learnt/best practices with other teams.

Some of the activities may include: (but not limited to)

- ✓ Image Classification with different DL namely, Multilayer perceptron, Convolutional Neural Networks, Recurrent Neural Networks and Transformers
- ✓ Language Translation with Sequence-to-Sequence Models, Auto encoders and GPT2 model

Some of the Mini-project titles may include: (but not limited to)

- ✓ Image recognition for autonomous vehicles
- ✓ Speech recognition for virtual assistants
- ✓ Real-time emotion detection in videos for marketing analysis

Text Books

1. Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep learning, In preparation for MIT Press, Available online: http://www.deeplearningbook.org, 2016

Reference Books

1. S. Haykin, Neural Networks and Learning Machines, Prentice Hall of India, 2010
2. Satish Kumar, Neural Networks - A Class Room Approach, Second Edition, Tata McGraw-Hill, 2013
3. B. Yegnanarayana, Artificial Neural Networks, Prentice- Hall of India, 1999
4. C.M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006

Course Contents and Lecture Schedule

Module No.	Topic	No. of Lectures
1	**Artificial Neural Networks**	**(6)**
1.1	Basic concepts of Artificial Neurons	1
1.2	Single and multi-layer perceptron's	2
1.3	Perceptron learning algorithm, its convergence proof	1
1.4	Activation Function - different Activation Functions	1
1.5	Softmax cross entropy loss function.	1
2	**Optimization**	**(6)**
2.1	Types of errors	1

2.2	Bias-variance trade-off	1
2.3	Overfitting–Underfitting	1
2.4	Brief review of concepts from optimization	1
2.5	Variants of gradient descent	1
2.6	Momentum based methods	1
3	**ConvNets, ConvNet Architectures and Dropout/Regularization/Batchnorm.**	**(6)**
3.1	ConvNets: Basic concepts of Convolutional Neural Networks starting from filtering	1
3.2	Convolution and pooling operation and arithmetic's of these	1
3.3	ConvNet Architectures: Discussions on famous ConvNet architectures - AlexNet, GoogLeNet, ResNet, MobileNet-v2	1
3.4	Discussion on regularization, Dropout, Batch normalization etc.	1
3.5	Introduction to Graph Convolutional Neural Network (GCNN)	1
3.6	Multiclass Classification Model for Computer Vision (CV)	1
4	**Applications: Detection and Segmentation**	**(6)**
4.1	Discussion on detection, Segmentation problem definition, challenges	1
4.2	Evaluation, Datasets and Localization by regression	1
4.3	Discussion on detection as classification, region proposals	1
4.4	RCNN and YOLO architectures	2
4.5	Fully convolutional segmentations, Mask-RCNNs	1
5	**Recurrent Architectures and NLP Applications**	**(6)**
5.1	Introduction to NLP	1
5.2	Discussion on Recurrent Neural Networks (RNNs)	1
5.3	Gated Neural Network (GRU) Architecture	1
5.4	Long-Short Term Memory (LSTM) architectures	1
5.5	Auto Encoders - Generative Adversarial Networks (GAN)	2
6	**Transformers**	**(6)**
6.1	Introduction to Vision Transformers	1
6.2	Discussion on Attention Model types	2
6.3	Discussion on Transformers (BERT)	2
	Mini Project on various Deep Learning Algorithms/ Applications	1
Total Hours		**36**

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