CURRICULUM AND DETAILED SYLLABI

FOR

B.Tech DEGREE (Computer Science and Business Systems) PROGRAMME

FIRST SEMESTER

FOR THE STUDENTS ADMITTED FROM THE

ACADEMIC YEAR 2020 - 2021 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.Tech (Computer Science and Business systems) Programme
COURSES OF STUDY
(For the candidates admitted from 2020 - 21 onwards)

FIRST SEMESTER

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	No.of Hours / Week			Credits
				L	T	P	
THEORY COURSES							
1	20CB110	Discrete Mathematics	BS	3	1	0	4
2	20CB120	Introductory Topics in Statistics, Probability and Calculus	BS	3	0	0	3
3	20CB130	Fundamentals of Computer Science	ES	3	0	0	3
4	20CB140	Principles of Electrical Engineering	ES	2	0	0	2
5	20CB150	Business Communication & Value Science - I	Project	2	0	0	2
THEORY CUM PRACTICAL COURSES							
6	20CB160	Fundamentals of Physics	BS	2	0	2	3
PRACTICAL COURSES							
7	20CB170	Fundamentals of Computer Science Lab	ES	0	0	4	2
8	20CB180	Principles of Electrical Engineering Lab	ES	0	0	2	1
Induction Program (Non Credit)							
TOTAL				**15**	**1**	**8**	**20**

BS : Basic Science
HSS : Humanities and Social Science
ES : Engineering Science
PC : Program Core
PE : Program Elective
OE : Open Elective

L : Lecture
T : Tutorial
P : Practical

Note:

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

THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015
B.Tech (Computer Science and Business systems) Programme

SCHEME OF EXAMINATIONS
(For the candidates admitted from 2020 - 21 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	20CB110	Discrete Mathematics	3	50	50	100	25	50
2	20CB120	Introductory Topics in Statistics, Probability and Calculus	3	50	50	100	25	50
3	20CB130	Fundamentals of Computer Science	3	50	50	100	25	50
4	20CB140	Principles of Electrical Engineering	3	50	50	100	25	50
5	20CB150	Business Communication & Value Science - I	-	100	-	100	-	50
THEORY CUM PRACTICAL								
6	20CB160	Fundamentals of Physics	3	50	50	100	25	50
PRACTICAL								
7	20CB170	Fundamentals of Computer Science Lab	3	50	50	100	25	50
8	20CB180	Principles of Electrical Engineering Lab	3	50	50	100	25	50

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

20CB110	DISCRETE MATHEMATICS	CATEGORY	L	T	P	CREDIT
		BS	3	1	0	4

Preamble

Discrete Mathematics is the branch of mathematics that provides mathematical framework on discrete objects. Computer Science and Engineering rely mainly on the working principle of discrete objects. This course introduces four modules **Boolean Algebra** which provides techniques for the minimization of digital circuits, **Abstract Algebra** which takes vital role in application part of computer science such as cryptography, coding theory etc and also introduces **Counting principles** such as basic counting, pigeonhole principle & **Generating functions**, **Recurrence relations** which are used to determine the complexity of algorithms and to solve counting problems. Combinatorial arguments are made a little easier by the use of pictures of the graphs. The concept of Graph Theory has wide range of applications in Networks, computer architecture, compiling techniques, model checking, artificial intelligence, software engineering, expert systems, software/hardware correctness problem, DBMS, designing concepts, storage methods etc.

Prerequisite

Higher Secondary Level Mathematics

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Demonstrate the given Boolean expression by means of truth table, logic gates and also simplify it into minimum number of literals	15
CO2	Simplify the given Boolean expression/function using Karnaugh maps	10
CO3	Verify the given set with the operations for relations, groups, rings and fields using elementary properties if necessary	15
CO4	Use the principle of basic counting and Pigeonhole on problems related to counting	10
CO5	Solve recurrence relations using generating functions	10
CO6	Illustrate the types of graphs, digraphs and its properties	20
CO7	Obtain PCNF and PDNF of given logical expression	10
CO8	Rephrase real world statements as logical propositions and demonstrate whether the proposition is satisfiable, tautology or a contradiction.	10

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value	-	1.1.1, 1.2.7, 2.1.1
CO2	TPS3	Apply	Value	-	1.1.1, 1.2.7, 2.1.1
CO3	TPS3	Apply	Value	-	1.1.1 , 1.2.7, 2.1.1
CO4	TPS3	Apply	Value	-	1.1.1, 1.2.7, 2.1.1
CO5	TPS3	Apply	Value	-	1.1.1, 1.2.7, 2.1.1
CO6	TPS3	Apply	Value	-	1.1.1, 1.2.7, 2.1.1
CO7	TPS3	Apply	Value	-	1.1.1, 1.2.7, 2.1.1
CO8	TPS3	Apply	Value	-	1.1.1, 1.2.7, 2.1.1

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO 1	S	M	M	M									M		
CO 2	S	S	S	S									S		
CO 3	S	S	S	S									S		
CO 4	S	S	S	S									S		
CO 5	S	S	S	S									S		
CO 6	S	S	S	S									S		
CO 7	S	S	S	S									S		
CO 8	S	S	S	S									S		

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

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

Sample Questions for Course Outcome Assessment

Course Outcome 1(CO1)

1. Demonstrate by means of truth tables the validity of the following identities.
   i) De Morgan's law for 3 variables: $(xyz)' = x' + y' + z'$
   ii) Second distributive law: $(x + yz) = (x + y)(x + z)$
2. Simplify the following Boolean expression to a minimum number of literals.
   $x'y' + xy + x'y$
3. Given the following Boolean function $F = xy'z + x'y'z + w'xy + wxy$
   i) Obtain the truth table of the function
   ii) Draw the logic diagram using the original Boolean expression
   iii) Simplify the function to minimum number of literals
   iv) Obtain the truth table of the function from the simplified expression and show that it is the same as the one in subdivision i).

Course Outcome 2(CO2)

1. Simplify the following Boolean functions using three variable maps $F(x, y, z) = \sum(1,2,3,6,7)$
2. Simplify the following Boolean expression using 3-variable maps $xy + x'y'z' + x'yz'$

3. Simplify the following Boolean functions in product of sums $F(w,x,y,z)=\sum(0,2,5,6,7,8,10)$

Course Outcome 3(CO3)

1. Given A = {1,2,3,4} and R ={(1,2),(1,1),(1,3),(2,4)}, S={(1,4),(1,3),(2,3), (3, 1),(4,1)} are relations on A. Find $S\circ R, R\circ S, M_R, M_S, M_{(R\circ S)^{-1}}$ and graph of R & S.
2. Prove that the set of all real numbers of the form $a+b\sqrt{3}$ where $a \,\&\, b \in Q$ under usual addition and multiplication is a ring.
3. Verify whether $(Z,+,.)$ is a field or not under usual addition and multiplication.

Course Outcome 4 (CO4)

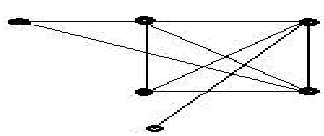
1. How many different license plates can be made if each plate contains a sequence of 3 upper case English letters followed by 3 digits?
2. How many students must be in a class to guarantee that at least 2 students receive the same score on the final exam, if the exam is graded on a scale from 0 to 100 points?
3. Let $a_1, a_2, ...a_n$ be positive real numbers. The arithmetic mean of these numbers is defined by $A=\frac{a_1+a_2+......+a_n}{n}$ and the geometric mean of these numbers is defined by $G=(a_1a_2.......a_n)^{1/n}$. Use mathematical induction to prove that $A \geq G$

Course Outcome 5(CO5)

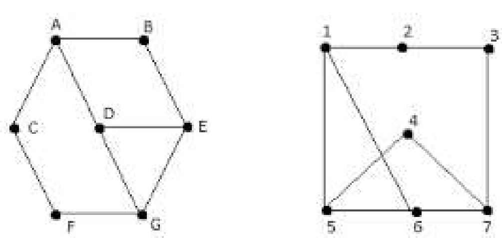
1. Find the generating functions of $(1+x)^{-n}$ & $(1-x)^{-n}$ where n is a positive integer.
2. Solve the recurrence relation $a_k = 3a_{k-1}$ $for\ k=1,2,......$ and initial condition $a_0=2$
3. Determine the generating function of a numeric function a_r, where
$$a_r=\begin{cases} 2^r & if\ r\ is\ even \\ -2^r & if\ r\ is\ odd \end{cases}$$

Course Outcome 6(CO6)

1. Verify whether the following graphs are Eulerian or Hamiltonian graphs



2. Determine whether the following graphs are isomorphic or not.



3. What is the procedure to find the chromatic polynomial for the given graph

Course Outcome 7(CO7)

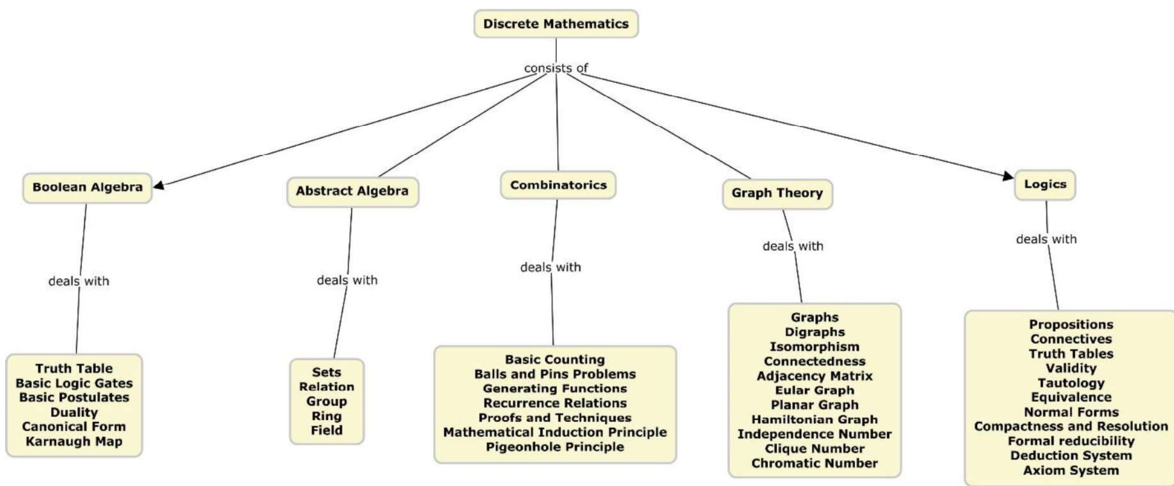
1. Estimate the PCNF and PDNF of the given formula

2. Construct the Truth table of the formula $(7P \vee Q) \wedge (7Q \vee P)$
3. Obtain principal disjunctive normal form of P $\rightarrow$ ((P $\rightarrow$Q) $\wedge$ 7(7Q $\vee$ 7P)) and hence obtain principal conjunctive normal form.

Course Outcome 8(CO8)

1. Prove p → (p ∨ q) is a Tautology.
2. Check if the following arguments is sound.
   a. All rabbits are mammals.
   b. Bugs Bunny is a rabbit.
   c. Therefore, Bugs Bunny is a mammal.
3. Show that the following set of premises is inconsistent**.**
   If the contract is valid, then john is liable for penalty. If john is liable for penalty, he will go bankrupt. If the bank will loan him money, he will not go bankrupt. As a matter of fact, the contract is valid and the bank will loan him money

Concept Map



Syllabus

Boolean algebra: Introduction of Boolean algebra, truth table, basic logic gate, basic postulates of Boolean algebra, principle of duality, canonical form, Karnaugh map.

Abstract algebra: Set, relation, group, ring, field.

Combinatorics: Basic counting, balls and bins problems, generating functions, recurrence relations. Proof techniques, principle of mathematical induction, pigeonhole principle.

Graph Theory: Graphs and digraphs, complement, isomorphism, connectedness and reachability, adjacency matrix, Eulerian paths and circuits in graphs and digraphs, Hamiltonian paths and circuits in graphs and tournaments, trees; Planar graphs, Euler's formula, dual of a planer graph, independence number and clique number, chromatic number, statement of Four-color theorem.

Logic: Propositional calculus - propositions and connectives, syntax; Semantics - truth assignments and truth tables, validity and satisfiability, tautology; Adequate set of connectives; Equivalence and normal forms; Compactness and resolution; Formal reducibility - natural deduction system and axiom system; Soundness and completeness.

Learning Resources

1. Topics in Algebra, I. N. Herstein, John Wiley and Sons.
2. Digital Logic & Computer Design, M. Morris Mano, Pearson.
3. Elements of Discrete Mathematics, (Second Edition) C. L. LiuMcGraw Hill, New Delhi.
4. Graph Theory with Applications, J. A. Bondy and U. S. R. Murty, Macmillan Press, London.
5. Mathematical Logic for Computer Science, L. Zhongwan, World Scientific, Singapore.
6. Introduction to linear algebra. Gilbert Strang.
7. Introductory Combinatorics, R. A. Brualdi, North-Holland, New York.
8. Graph Theory with Applications to Engineering and Computer Science, N. Deo, Prentice Hall, Englewood Cliffs.
9. Introduction to Mathematical Logic, (Second Edition), E. Mendelsohn, Van-Nostrand, London.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1.	**BOOLEAN ALGEBRA**		
1.1	Introduction	1	CO1
1.2	Truth Table	1	CO1
1.3	Basic Logic Gates	1	CO1
	Tutorial	1	
1.4	Basic Postulates of Boolean Algebra	1	CO1
1.5	Principle of Duality	1	CO1
1.6	Canonical Forms	1	CO1
	Tutorial	1	
1.7	Karnaugh Map	2	CO2
2.	**ABSTRACT ALGEBRA**		
2.1	Sets	1	CO3
2.2	Relations	1	CO3
2.3	Group	1	CO3
	Tutorial	1	
2.4	Ring	1	CO3
2.5	Field	1	CO3
	Tutorial	1	
3.	**COMBINATORICS**		
3.1	Mathematical Induction	1	CO4
3.2	Balls and Bins Problem	1	CO4
3.3	Pigeonhole Principle	1	CO4
	Tutorial	1	
3.4	Generating Functions	2	CO5
3.5	Recurrence Relations	2	CO5
	Tutorial	1	
4.	**GRAPH THEORY**		
4.1	Graphs and digraphs	1	CO6
4.2	Complement, Isomorphism	1	CO6
4.3	Connectedness and Reachability	1	CO6
	Tutorial	1	
4.4	Adjacency matrix	1	CO6
4.5	Eulerian paths and circuits in graphs and digraphs, Hamiltonian paths and circuits in graphs	1	CO6

4.6	Tournaments, Trees	1	CO6
	Tutorial	1	
4.7	Planar graphs, Euler's formula, dual of a planer graph	1	CO6
4.8	Independence number and clique number	1	CO6
4.9	Chromatic number, statement of Four-color theorem.	1	CO6
	Tutorial	1	
5.	**LOGIC**		
5.1	Propositional calculus - propositions and connectives, syntax	1	CO7
5.2	Semantics - truth assignments and truth tables, validity and satisfiability, tautology	1	CO8
5.3	Adequate set of connectives	1	CO7
	Tutorial	1	
5.4	Equivalence and normal forms	2	CO7
5.5	Compactness and resolution	1	CO8
	Tutorial	1	
5.6	Formal reducibility - natural deduction system and axiom system	1	CO8
5.7	Soundness and completeness	1	CO8
	Total	48	

Course Designers:

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20CB120	INTRODUCTORY TOPICS IN STATISTICS, PROBABILITY AND CALCULUS

Category	L	T	P	Credit
BS	3	0	0	3

Preamble

Statistics as a subject is a science of learning from data and provides tools for making decisions when conditions of uncertainty prevail. Statistical techniques are an important tool in these activities because they provide the engineer with both descriptive and analytical methods for dealing with the variability in observed data. The main objective of this course is to provide students with the foundations of statistical and probabilistic analysis mostly used in various applications in engineering and science. It introduces students to cognitive learning in statistics, calculus and develops skills on analyzing the different types of data.

Prerequisite

- Higher secondary level -probability concepts

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Understand the types of data by graphical representation and Frequency curves, central tendency and dispersion, Scatter diagram	15
CO2	Apply the concept of correlation analysis and least square method in fitting regression curves to engineering problems	20
CO3	Apply Bayes theorem to invert conditional probabilities	20
CO4	Determine mass and density functions for discrete and continuous distributions	15
CO5	Identify expected values, moments and moment generating functions	10
CO6	Find areas enclosed between two curves and volumes enclosed between surfaces using integrals of multivariable	20

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	-	1.1.1, 2.1.1
CO2	TPS3	Apply	Value	-	1.1.1,2.1.1.1, 2.1.4
CO3	TPS3	Apply	Value	-	1.1.1, 2.1.4
CO4	TPS3	Apply	Value	-	1.1.1, 2.1.4
CO5	TPS2	Understand	Respond	-	1.1.1, 2.1.4
CO6	TPS3	Apply	Value	-	1.1.1, 1.2.7, 2.1.1

Mapping with Programme Outcomes and Programme Specific Outcomes

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

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

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

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

Assessment Pattern: Psychomotor

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

Sample Questions for Course Outcome Assessment**

Course Outcome 1(CO1):

1. Define Statistics and state it's objective
2. The following are the number of transistors failing a quality check per hour during 72 observed hours of production:
   2 4 6 8 1 2 1 8 5 4 6 1
   0 1 8 2 3 4 1 2 5 1 1 8
   2 1 9 1 4 2 5 6 8 1 7 1
   4 9 1 8 2 4 1 1 8 5 5 3
   0 9 1 9 7 1 8 8 7 7 7 2
   7 1 2 7 3 5 8 8 5 9 9 0
   Group these data into a frequency distribution showing how often each of the values occurs and draw a bar chart.
3. Find the mean and the standard deviation of the following miles per gallon (mpg) obtained in 20 test runs performed on urban roads with an intermediate-size car:

19.7 21.5 22.5 22.2 22.6
21.9 20.5 19.3 19.9 21.7
22.8 23.2 21.4 20.8 19.4
22.0 23.0 21.1 20.9 21.3

Course Outcome 2(CO2):

1. Suppose we have a linear equation through the origin. Estimate the regression line passing through the origin for the following data. Suppose it is not known whether the true regression should pass through the origin. Estimate the regression line.

x	0.5	1.5	3.2	4.2	5.1	6.5
y	1.3	3.4	6.7	8.0	10.0	13.2

2. A study was done on a diesel-powered light-duty pickup truck to see if humidity, air temperature, and barometric pressure influence emission of nitrous oxide (in ppm). Emission measurements were taken at different times, with varying experimental conditions. The data are given in Table 12.2. The model is $y_i = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \beta_3 x_{3i} + \_i$, $i = 1, 2, \ldots, 20$. Fit this multiple linear regression model to the given data and then estimate the amount of nitrous oxide emitted for the conditions where humidity is 50%, temperature is 76◦F, and barometric pressure is 29.30.

Nitrous Oxide y	Humidity x_1	Temp., x_2	Pressure x_3	Nitrous Oxide y	Humidity x_1	Temp., x_2	Pressure x_3
0.90	72.4	76.3	29.18	1.07	23.3	76.8	29.38
0.91	41.6	70.3	29.35	0.94	47.4	86.6	28.35
0.96	34.3	77.1	29.24	1.10	31.5	76.9	29.63
0.89	35.1	68.0	29.27	1.10	10.6	86.3	29.56
1.00	10.7	79.0	29.78	1.10	11.2	86.0	29.48
1.10	12.9	67.4	29.39	0.91	73.3	76.3	29.40
1.15	8.3	66.8	29.69	0.87	75.4	77.9	29.28
1.03	20.1	76.9	29.48	0.78	96.6	78.7	29.29
0.77	72.2	77.7	29.09	0.82	107.4	86.8	29.03
1.07	24.0	67.7	29.60	0.95	54.9	70.9	29.37

Course Outcome 3(CO3):

1. A system may become infected by some spyware through the internet or e-mail. Seventy percent of the time the spyware arrives via the internet, thirty percent of the time via email. If it enters via the internet, the system detects it immediately with probability 0.6. If via e-mail, it is detected with probability0.8. What percentage of times is this spyware detected?
2. One box contains six red balls and four green balls, and a second box contains seven red balls and three green balls. A ball is randomly chosen from the first box and placed in the second box. Then a ball is randomly selected from the second box and placed in the first box.
   a. What is the probability that a red ball is selected from the first box and a red ball is selected from the second box?

   b**.** At the conclusion of the selection process, what is the probability that the numbers of red and green balls in the first box are identical to the numbers at the beginning?

3. In a certain city, sports bikes are being targeted by thieves. Assume that the probability of a sports bike being stolen is 0.09 while the probability is only 0.5 for a regular bike. Taking, as an approximation for all bikes in that area, the nationwide proportion 0.19 of sports bikes, find (a) the probability that a bike will be stolen. (b) the probability that a stolen bike is a sports bike.

Course Outcome 4 (CO4):

1. If the probability is 0.05 that a certain wide-flange column will fail under a given axial load, what are the probabilities that among 16 such columns
   (a) at most two will fail;
   (b) at least four will fail?
2. The substrate concentration of influent to a reactor is normally distributed with μ =0.30 and $\sigma = 2.8$
   a. Identify the probability that the concentration exceeds 0.25?
   b. Identify the probability that the concentration is at most0 .10?
   c. Characterize the largest 5% of all concentration values?
3. Let X denote the distance (m) that an animal moves from its birth site to the first territorial vacancy it encounters. Suppose that for banner-tailed kangaroo rats, X has an exponential distribution with parameter $\lambda = 0.01386$ (i).Compute the probability that the distance is between 100 and 200 m? (ii). Identify the probability that distance exceeds the mean distance by more than 2 standard deviations? (iii). Calculate the value of the median distance?

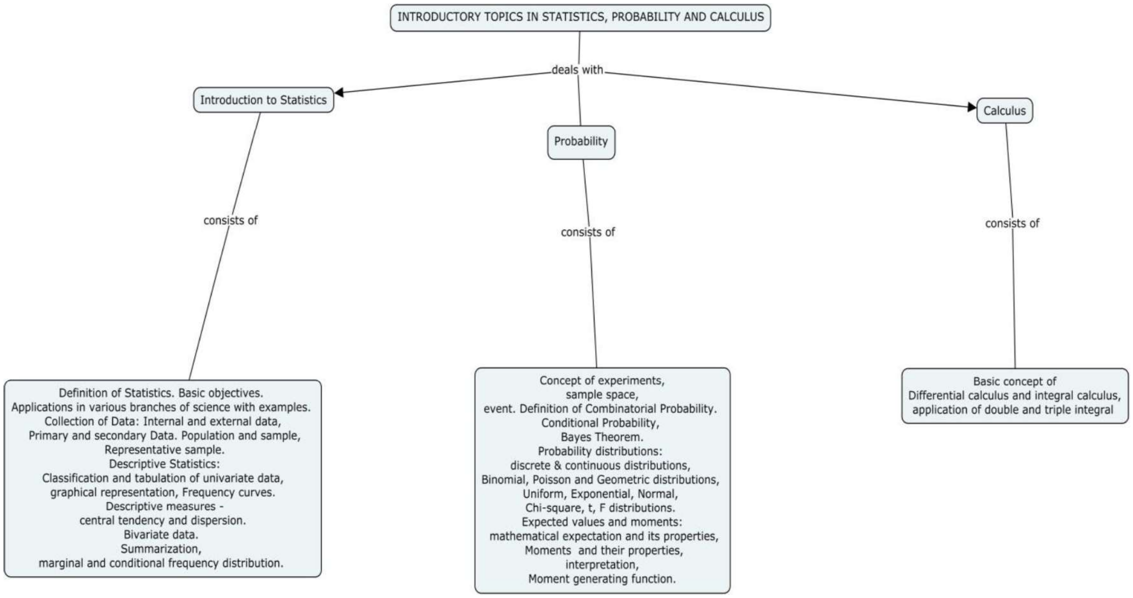
Course Outcome 5 (CO5):

1. If X_1 has mean 8 and variance 2 while X_2 has mean −12.5 and variance 2.25, and the two are independent, find
   (a) $E(X_1 - X_2)$;
   (b) $Var (X_1 - X_2)$.
2. Let $f(x) = 0.2$ for $x = 0, 1, 2, 3, 4$.
   (a) Find the moment generating function
   (b) Obtain $E(X)$ and $E(X^2)$ by differentiating the moment generating function.
3. Let $f(x) = 0.40\binom{4}{x}$ for x = 0, 1, 2, 3, 4
   (a) Find the moment generating function and hence obtain $E(X)$ and $E(X^2)$

Course Outcome 6(CO6):

1. Evaluate the integral $\int_0^1\int_x^1 e^{\frac{x}{y}}\,dydx$ by reversing the order of integration
2. Estimate the area enclosed by the curves $y = x^2$ $x + y = 2$
3. Use triple integral to find the volume of the tetrahedron by the planes $x + 2y + z = 2;\ x = 2y; x = 0\ \&\ z = 0$.

Concept Map



Syllabus

Introduction to Statistics: Definition of Statistics. Basic objectives. Applications in various branches of science with examples. Collection of Data: Internal and external data, Primary and secondary Data. Population and sample, Representative sample. Descriptive Statistics: Classification and tabulation of univariate data, graphical representation, Frequency curves. Descriptive measures - central tendency and dispersion. Bivariate data. Summarization, marginal and conditional frequency distribution.

Probability: Concept of experiments, sample space, event. Definition of Combinatorial Probability. Conditional Probability, Bayes Theorem. Probability distributions: discrete & continuous distributions, Binomial, Poisson and Geometric distributions, Uniform, Exponential, Normal, Chi-square, t, F distributions. Expected values and moments: mathematical expectation and its properties, Moments (including variance) and their properties, interpretation, Moment generating function.

Calculus: Basic concept of Differential calculus and integral calculus, application of double and triple integral.

Learning Resources

1. Introduction of Probability Models, S. M. Ross, Academic Press, N.Y.
2. Fundamentals of Statistics, vol. I & II, A. Goon, M. Gupta and B. Dasgupta, World Press.
3. Higher Engineering Mathematics, B. S. Grewal, Khanna Publication, Delhi.
4. A first course in Probability, S. M. Ross, Prentice Hall.
5. Probability and Statistics for Engineers, (Fourth Edition), I. R. Miller, J.E. Freund and R. Johnson, PHI.
6. Introduction to the Theory of Statistics, A. M. Mood, F.A. Graybill and D.C. Boes, McGraw Hill Education.
7. Advanced Engineering Mathematics, (Seventh Edition), Peter V. O'Neil, Thomson Learning.

8. Advanced Engineering Mathematics, (Second Edition) M. D. Greenberg, Pearson Education.
9. Applied Mathematics, Vol. I & II, P. N. Wartikar and J. N. Wartikar, Vidyarthi Prakashan.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1.	**Introduction to Statistics**		
1.1	Definition of Statistics , its objectives and applications	2	CO1
1.2	Collection of Data: Internal and external data, Primary and secondary Data	2	CO1
1.3	Population and sample, Representative sample	1	CO1
1.4	Classification and tabulation of univariate data, graphical representation, Frequency curves.	2	CO1
1.5	central tendency and dispersion	1	CO1
1.6	Summarization, marginal and conditional frequency distribution. Scatter diagram.	2	CO1
1.7	Linear correlation, Rank correlation	2	CO2
1.8	Linear regression- Least squares method	2	CO2
	Case studies in correlation and data analysis – Assignment I	1	
2.	**Probability**		
2.1	Concept of experiments, sample space, event	1	CO3
2.2	Combinatorial Probability and Conditional Probability	1	CO3
2.3	Bayes Theorem	2	CO3
2.4	Discrete distributions- Binomial, Poisson and Geometric	2	CO4
2.5	Continuous Distributions- Uniform, Exponential, Normal	2	CO4
2.6	Continuous Distributions - Chi-square, t, F	2	CO4
2.7	Expected values, variance, covariance, moments, mathematical expectation and its properties	2	CO5
2.8	Moment generating function	1	CO5
	Case studies in Bayesian Application – Assignment II	1	
3.	**Calculus**		
3.1	Basic Concepts of Differential Calculus	2	CO6
3.2	Integral Calculus	1	CO6
3.3	Applications of Double Integral	2	CO6
3.4	Applications of Triple Integral	2	CO6
	Assignment III		
	Total hours	36	

Course Designers:

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		Category	L	T	P	Credit
20CB130	**FUNDAMENTALS OF COMPUTER SCIENCE**	ES	3	0	0	3

Preamble

This course aims to provide exposure to problem solving through programming. It also aims to train the students with basic programming skills. This course enables the students to solve real world computational problems using C-programming language.

Prerequisite

NIL

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Explain the algorithms and draw flowcharts for solving Mathematical and Engineering problems. (Understand)	15
CO2	Develop Computer programs using different types of Operator and Expressions in C (Apply)	20
CO3	Identify the appropriate control structure and interpret modularization, recursion-using functions to solve real time problems. (Apply)	20
CO4	Implement Programs with pointers and arrays.(Apply)	15
CO5	Write programs using Structures ,Unions and files.(Apply)	15
CO6	Illustrate the Unix system Interface using C programs. (Understand)	15

*** Weightage depends on Bloom's Level, number of contact hours

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	Guided Response	1.2,2.1.2,2.4.6,2.5.2,3.2.3,4.4.3
CO2	TPS3	Apply	Value	-	1.2,2.1.5,3.2.3
CO3	TPS3	Apply	Value	-	1.2,2.1.5, 3.2.3,4.3.2
CO4	TPS3	Apply	Value	-	1.2,2.1.5, 3.2.3,4.5.1
CO5	TPS3	Apply	Value	-	1.2, 2.1.5,3.2.3,4.5.3
CO6	TPS2	Understand	Respond	Guided Response	1.2,2.1.2,2.4.6,4.4.3

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO 1	M	-	-	-	-	-	-		-	-	-	-	L		
CO 2	S	L	-	-	-	L	-	L	-	-	L	L	L	L	L
CO 3	S	L	-	-	-	L	-	L	-	-	L	L	L	L	L
CO	S	L	-	-	-	L	-	L	-	-	L	L	L	L	L

4															
CO 5	S	L	-	-	-	L	-	L	-	-	L	L	L	L	L
CO 6	M	-	-	-	-	L	-	L	-	-	L	L	L	L	L

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Assignment			Terminal Examination
	1	**2**	**3**	1	2	3	
Remember	30	15	15	-	-	-	20
Understand	40	30	35	50	50	50	35
Apply	30	55	50	50	50	50	45
Analyse	-	-	-	-	-	-	-
Evaluate	-	-	-	-	-	-	-
Create	-	-	-	-	-	-	-

Assessment Pattern: Psychomotor

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

Sample Questions for Course Outcome Assessment**

Course Outcome 1 (CO1):
1. Explain the symbols of Flowchart
2. Write the pseudo code to count the digits of an integer
3. Illustrate the flow chart to exchange the values of variables

Course Outcome 2 (CO2):
1. Explain about the simple data types in C.
2. Determine the values of c and d.
   int a=18,b=26,c;
   float d;
   c=(++a)-(b++);d=(c+b)*a+c+b*a;

3. Write a C Program to convert temperature in degrees Celsius to degrees Fahrenheit.

Course Outcome 3 (CO3):
1. Explain the conversion of 'while loop' into 'for loop' with the help of flow charts.
2. Draw the flowchart for finding factorial without wit out recursion
3. Construct a C program to read a positive integer, determine the number of digits in it and perform either summation of digits of an integer or reversing the integer value or squaring the value or testing whether it is odd or even based on the number of digits.

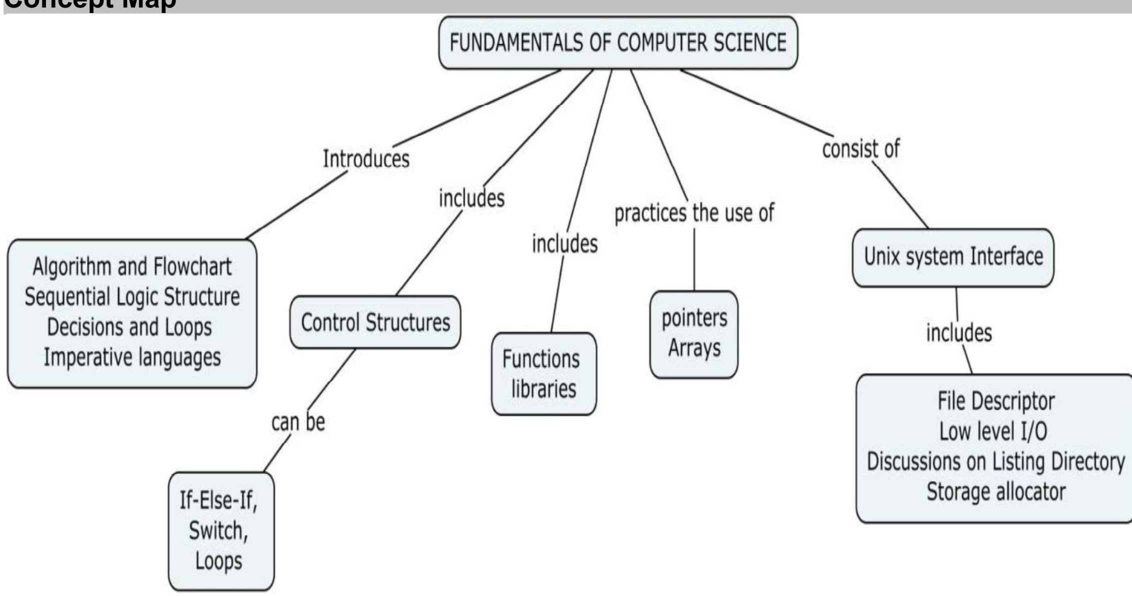
Assume that the entered value has a maximum of 4 digits. Use Relevant Control Structure

Course Outcome 4 (CO4):
1. Write the importance of pointers? Assume q=20 which is stored in location R=100 and find *R,(q).. Explain call by value and call by reference.
2. Write the algorithm to determine the first two largest elements from the given array. Use pointer notation to access the elements.
3. Develop a C program to multiply two nxn matrices using arrays and pointers.

Course Outcome 5 (CO5):
1. Write the syntax for structure type variable within another structure
2. Construct a C program to print the following message:[Use string manipulation functions]
   “Whatsapp or Gmail for communication is preferable.
   St1: I am using Gmail for communication
   St2: People are using Whatsapp or Gmail.
   St3: Any mode of communication is preferable
3. Develop a C program to create a text file to store records of addresses of N persons and retrieve and display the records with status=”covid positive”.

Course Outcome 6 (CO6):
1. What are the responsibilities of a shell?
2. Specify the difference between absolute path and related path?
3. Describe links and symbolic links in UNIX?

Concept Map



Syllabus

General problem Solving concepts: Algorithm, and Flowchart for problem solving with Sequential Logic Structure, Decisions and Loops- **Problem Solving using Fundamental Algorithms:** Exchanging the values of two variables, counting
Imperative languages: **Introduction to imperative language;** syntax and constructs of a specific language (ANSI C) -**Types Operator and Expressions with discussion of variable naming and Hungarian Notation:** Variable Names, Data Type and Sizes (Little Endian Big Endian), Constants, Declarations, Arithmetic Operators, Relational Operators,

Logical Operators, Type Conversion, Increment Decrement Operators, Bitwise Operators, Assignment Operators and Expressions, Precedence and Order of Evaluation, proper variable naming and Hungarian Notation
Control Flow and Functions - Control Flow with discussion on structured and unstructured programming: Statements and Blocks, If-Else-If, Switch, Loops – while, do, for, break and continue, Go to Labels, structured and un- structured programming - **Functions and Program Structure with discussion on standard library:** Basics of functions, parameter passing and returning type, C main return as integer, External, Auto, Local, Static, Register Variables, Scope Rules, Block structure, Initialisation, Recursion, Pre-processor, Standard Library Functions and return types- Summation of a set of numbers- Reversing Digits of an Integer- Factoring Methods for smallest divisor and prime number - Modularization and recursion –string handling functions
Pointers and Arrays: Pointers and address, Pointers and Function Arguments, Pointers and Arrays, Address Arithmetic, character Pointers and Functions, Pointer Arrays, Pointer to Pointer, Multi-dimensional array and Row/column major formats, Initialisation of Pointer Arrays, Command line arguments, Pointer to functions, complicated declarations – Evaluation - Array order reversal, Array Counting, Finding maximum and the minimum value in a set- Sorting – Searching
Structures: Basic Structures, Structures and Functions, Array of structures, Pointer of structures, Self-referral Structures, Table look up, Typedef, Unions, Bit-fields -**Input and Output:** Standard I/O, Formatted Output – printf, Formated Input – scanf, Variable length argument list, file access including FILE structure, fopen, stdin, sdtout and stderr, Error Handling including exit, perror and error.h, Line I/O, related miscellaneous functions
Unix system Interface: File Descriptor, Low level I/O – read and write, Open, create, close and unlink, Random access – lseek, Discussions on Listing Directory, Storage allocator, **Programming Method:** Debugging, Macro, User Defined Header, User Defined Library Function, makefile utility.

Learning Resources

1. "C: The Complete Reference", Herbert Schildt, Fourth Edition, , McGraw Hill, 2017
2. "Let Us C", YashavantKanetkar , Sixteenth edition, BPB Publication, 2017
3. "Programming in C",B. Gottfried, Third Edition, Schaum Outline Series, 2017
4. "The C Programming Language", B. W. Kernighan and D. M. Ritchi, Second Edition, PHI,1988.
5. "How to solve it by Computer", R.G Dromey, Pearson education, Delhi, 2008.
6. "Simple Program Design", A Step-by-Step Approach, Lesley Anne Robertson, 5th Edition, Thomson, 2007

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1	**General problem Solving concepts**		
1.1	Algorithm, and Flowchart for problem solving with Sequential Logic Structure, Decisions and Loops	3	CO1
1.2	**Problem Solving using Fundamental Algorithms:** Exchanging the values of two variables, counting	2	CO1
2	**Imperative languages**		
2.1	**Introduction to imperative language-** syntax and constructs of a specific language (ANSI C)	1	CO2
2.2	**Types Operator and Expressions with discussion of variable naming and Hungarian Notation:** Variable Names, Data Type and Sizes (Little Endian Big Endian), Constants, Declarations	2	CO2

2.3	Arithmetic Operators, Relational Operators, Logical Operators	1	CO2
2.4	Type Conversion, Increment Decrement Operators, Bitwise Operators	1	CO2
2.5	Assignment Operators and Expressions, Precedence and Order of Evaluation	1	CO2
2.6	Proper variable naming and Hungarian Notation	1	CO2
3	**Control Flow and Functions**		
3.1	**Control Flow with discussion on structured and unstructured programming:** Statements and Blocks, If-Else-If	1	CO3
3.2	Switch , Loops – while, do, for, break and continue, Go-to Labels, structured and un- structured programming	2	CO3
3.3	**Functions and Program Structure with discussion on standard library:** Basics of functions, parameter passing and returning type	1	CO3
3.4	C main return as integer, External, Auto, Local, Static, Register Variables, Scope Rules, Block structure, Initialisation	1	CO3
3.5	Recursion, Pre-processor, Standard Library Functions and return types-Summation of a set of numbers- Reversing Digits of an Integer	1	CO3
3.6	Factoring Methods for smallest divisor and prime number -Modularization and recursion –string handling functions	1	
4	**Pointers and Arrays**		
4.1	Pointers and address, Pointers and Function Arguments ,Pointers and Arrays, Address Arithmetic	1	CO4
4.2	character Pointers and Functions, Pointer Arrays, Pointer to Pointer	1	CO4
4.3	Multi-dimensional array and Row/column major formats, Initialisation of Pointer Arrays	1	CO4
4.4	Command line arguments, Pointer to functions	1	CO4
4.5	Complicated declarations –Evaluation - Array order reversal	1	CO4
4.6	Array Counting, Finding maximum and the minimum value in a set- Sorting - Searching	1	CO4
5	**Structures**		
5.1	Basic Structures, Structures and Functions, Array of structures	1	CO5
5.2	Pointer of structures, Self-referral Structures, Table look up, Type def, Unions, Bit-fields	2	CO5
5.3	**Input and Output:** Standard I/O, Formatted Output – printf, Formated Input – scanf	1	CO5
5.4	Variable length argument list, file access including FILE structure, fopen, stdin, sdtout and stderr,	1	CO5
5.5	Error Handling including exit, perror and error.h, Line I/O, related miscellaneous functions	1	CO5
6	**Unix system Interface**		
6.1	File Descriptor, Low level I/O – read and write, Open, create, close and unlink	2	CO6

6.2	Random access – lseek, Discussions on Listing Directory, Storage allocator	1	CO6
6.3	**Programming Method:** Debugging, Macro, User Defined Header, User Defined Library Function, makefile utility.	2	CO6
	Total Hours	**36**	

Course Designers:

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20CB140	PRINCIPLES OF ELECTRICAL ENGINEERING

Category	L	T	P	Credit
ES	2	0	0	2

Preamble

Principles of electrical engineering are a fundamental course for all the circuit branches in engineering. This course covers the various network theorems to study the behavior of the electrical circuits. In order to find the behavior of AC circuits, the steady state and transient responses are discussed. By applying basic circuit laws, the performance of Electric and Magnetic field is determined in free space and in material space. Students will get an idea about transformer, various measuring instruments and sensors, electrical wiring, earthing and illumination system with some practical applications.

Prerequisite

Nil

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Apply various network theorems and laws to interpret the behavior of the given DC circuits.	20
CO2	Find the steady and transient response of the given AC circuits.	20
CO3	Apply basic circuit laws to find the behavior of Electric and Magnetic field in free space and in material space.	20
CO4	Explain the construction, working principle and applications of transformer.	10
CO5	Explain the construction, working principle and applications of various measuring Instruments and sensors.	15
CO6	Demonstrate the concept of Electrical Wiring, role of earthing, safety devices and system in practical applications.	15

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value		1.2.4 , 2.3.1
CO2	TPS3	Apply	Value		1.2.4 , 2.3.1
CO3	TPS3	Apply	Value		1.2.2, 2.3.1
CO4	TPS2	Understand	Respond		1.2.2
CO5	TPS2	Understand	Respond		1.2.2
CO6	TPS3	Apply	Value		1.2.1 , 2.3.1, 3.2.6

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO1 2	PSO 1	PSO 2	PSO 3
CO1	S	M	M	L	S			M	M				M	L	L
CO2	S	M	M	L	S			M	M				M	L	L
CO3	S	M	M	L	S			M	M				M	L	L

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

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Assignment			Terminal Examination
	1	2	3	1	2	3	
Remember	20	20	20	-	-	-	20
Understand	40	40	40	-	-	-	40
Apply	40	40	40	100	100	100	40
Analyse							
Evaluate							
Create							

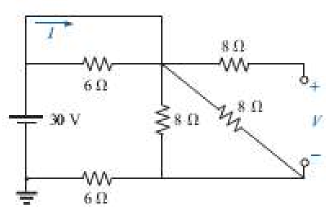
Assessment Pattern: Psychomotor

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

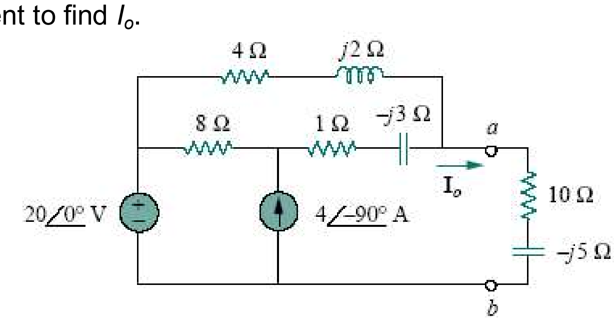
Sample Questions for Course Outcome Assessment

Course Outcome 1(CO1):

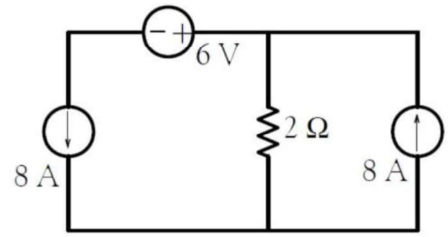
1. Determine the voltage V and current I for the network in figure below using Thevenin's theorem



2. Determine the Norton equivalent of the circuit in Fig. Given as seen from terminals a-b. Use the equivalent to find I_o.



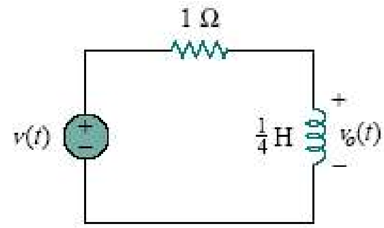
3. The voltage across the 2Ω resistor is equal to



(A) 3V
(B) -3V
(C) 8V
(D) None of the above

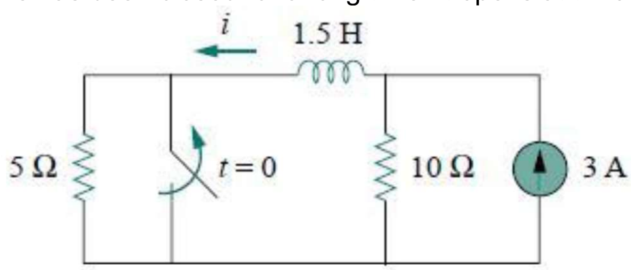
Course Outcome 2(CO2):

1. At what frequency will the output voltage $V_o(t)$ in Fig. below be equal to the input voltage $V(t)$?

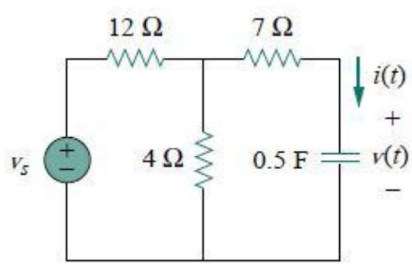


(a) 0 rad/s (b) 1 rad/s (c) 4 rad/s (d) ∞ rad/s (e) none of the above

2. The switch in figure has been closed for a long time. It opens at t = 0. Find $i(t)$ for $t > 0$.



3. Find the step responses $v(t)$ and $i(t)$ to $v_s = 5u(t)$ V in the circuit of figure



Course Outcome 3(CO3):

1. Two point charges - 4 μC and 5 μC are located at (2, - 1, 3) and (0, 4, - 2), respectively. If a third point charge of 3 μC is located at the origin. Find the potential at (-1 , 5, 2) assuming V(∞) = 0
2. Derive the Maxwell's equation for static fields.
3. Given points P(l, - 3 , 5), *Q(2,* 4, 6), and *R(0,* 3, 8), find: (a) the position vectors of *P* and *R,* (b) the distance vector r_{qr}*(c)* the distance between *Q* and *R.*

Course Outcome 4 (CO4):

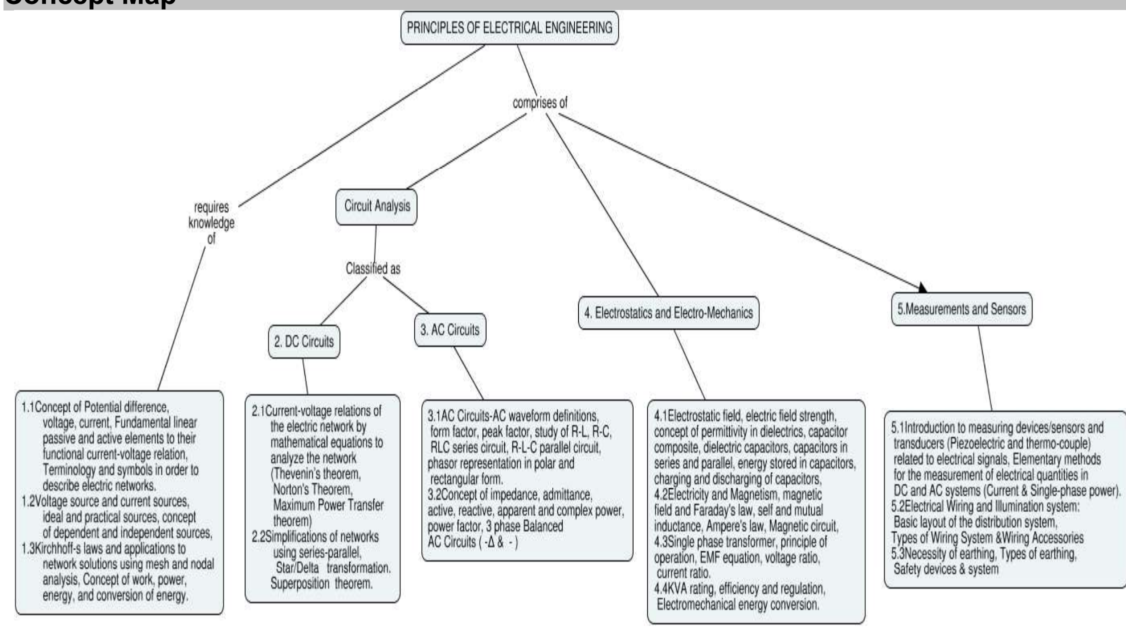
1. Derive the EMF equation of single phase transformer.
2. Define the term transformation ratio in Transformer.

3. Mention the advantages of shell type transformer over core type transformer.

Course Outcome 5 (CO5):
1. Describe the various forces/torques required in the measuring instruments.
2. Name the few static performance characteristics of a measuring instrument.
3. Discuss various methods for the measurement of electrical quantities in AC and DC system.

Course Outcome 6(CO6):
1. Design a lighting layout for a seminar hall having a dimension of 10 meter X 15 meter for an illumination level of 400 Lux. The recommended lamp is 36 watts fluorescent lamp. The depreciation factor is 1.2 and Utilization factor is 0.7. The lumens output of the 36watts fluorescent lamp is 3250 lumens. Also Calculate the number of fittings required.
2. Compare the luminous efficiency of various lamps.
3. Discuss the various earthing techniques used in a house.
4. List the electrical accessories used in a house wiring.

Concept Map



Syllabus

Introduction: Concept of Potential difference, voltage, current, Fundamental linear passive and active elements to their functional current-voltage relation, Terminology and symbols in order to describe electric networks, voltage source and current sources, ideal and practical sources, concept of dependent and independent sources, Kirchhoff-s laws and applications to network solutions using mesh and nodal analysis, Concept of work, power, energy, and conversion of energy.
DC Circuits: Current-voltage relations of the electric network by mathematical equations to analyze the network (Thevenin's theorem, Norton's Theorem, Maximum Power Transfer theorem) Simplifications of networks using series-parallel, Star/Delta transformation. Superposition theorem.
AC Circuits: AC waveform definitions, form factor, peak factor, study of R-L, R-C,RLC series circuit, R-L-C parallel circuit, phasor representation in polar and rectangular form, concept of impedance, admittance, active, reactive, apparent and complex power, power factor, 3 phase Balanced AC Circuits (⅄-Δ & ⅄-⅄).
Electrostatics and Electro-Mechanics: Electrostatic field, electric field strength, concept of permittivity in dielectrics, capacitor composite, dielectric capacitors, capacitors in series and

parallel, energy stored in capacitors, charging and discharging of capacitors, Electricity and Magnetism, magnetic field and Faraday's law, self and mutual inductance, Ampere's law, Magnetic circuit, Single phase transformer, principle of operation, EMF equation, voltage ratio, current ratio, KVA rating, efficiency and regulation, Electromechanical energy conversion.

Measurements and Sensors: Introduction to measuring devices/sensors and transducers (Piezoelectric and thermo-couple) related to electrical signals, Elementary methods for the measurement of electrical quantities in DC and AC systems (Current & Single-phase power). Electrical Wiring and Illumination system: Basic layout of the distribution system, Types of Wiring System &Wiring Accessories, Necessity of earthing, Types of earthing, Safety devices & system.

For Further Reading - Principle of batteries, types, construction and application, Magnetic material and B-H Curve, Basic concept of indicating and integrating instruments.

Learning Resources

1. Electric Machinery, (Sixth Edition) A. E. Fitzgerald, Kingsely Jr Charles, D. Umans Stephen, Tata McGraw Hill.
2. A Textbook of Electrical Technology, (vol. I), B. L. Theraja, Chand and Company Ltd., New Delhi.
3. Basic Electrical Engineering, V. K. Mehta, S. Chand and Company Ltd., New Delhi.
4. Theory and problems of Basic Electrical Engineering, (Second Edition), J. Nagrath and Kothari, Prentice Hall of India Pvt. Ltd.
5. Basic of Electrical Engineering, T. K. Nagsarkar and M. S. Sukhija, Oxford University Press.
6. Introduction to Electrodynamics, D. J. Griffiths, (Fourth Edition), Cambridge University Press.
7. Engineering Circuit Analysis, William H. Hayt & Jack E. Kemmerly, McGraw-Hill Book Company Inc.
8. Fundamentals of Electrical and Electronics Engineering, Smarjith Ghosh, Prentice Hall (India) Pvt. Ltd.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1.	**Introduction**		
1.1	Concept of Potential difference, voltage, current, Fundamental linear passive and active elements to their functional current-voltage relation, Terminology and symbols in order to describe electric networks.	1	CO1
1.2	Voltage source and current sources, ideal and practical sources, concept of dependent and independent sources,	1	CO1
1.3	Kirchhoff-s laws and applications to network solutions using mesh and nodal analysis, Concept of work, power, energy, and conversion of energy.	2	CO1
2.	**DC Circuits**		
2.1	Current-voltage relations of the electric network by mathematical equations to analyze the network (Thevenin's theorem, Norton's Theorem, Maximum Power Transfer theorem)	2	CO1
2.2	Simplifications of networks using series-parallel, Star/Delta transformation. Superposition theorem.	2	CO1
3.	**AC Circuits**		
3.1	AC Circuits-AC waveform definitions, form factor, peak factor, study of R-L, R-C, RLC series circuit, R-L-C parallel circuit, phasor representation in polar and rectangular form.	2	CO2

3.2	Concept of impedance, admittance, active, reactive, apparent and complex power, power factor, 3 phase Balanced AC Circuits (⅄-∆ & ⅄-⅄)	2	CO2
4.	**Electrostatics and Electro-Mechanics**		
4.1	Electrostatic field, electric field strength, concept of permittivity in dielectrics, capacitor composite, dielectric capacitors, capacitors in series and parallel, energy stored in capacitors, charging and discharging of capacitors,	2	CO3
4.2	Electricity and Magnetism, magnetic field and Faraday's law, self and mutual inductance, Ampere's law, Magnetic circuit,	2	CO3
4.3	Single phase transformer, principle of operation, EMF equation, voltage ratio, current ratio.	2	CO4
4.4	KVA rating, efficiency and regulation, Electromechanical energy conversion.	1	CO4
5.	**Measurements and Sensors**		
5.1	Introduction to measuring devices/sensors and transducers (Piezoelectric and thermo-couple) related to electrical signals, Elementary methods for the measurement of electrical quantities in DC and AC systems (Current & Single-phase power).	2	CO5
5.2	Electrical Wiring and Illumination system: Basic layout of the distribution system, Types of Wiring System &Wiring Accessories	2	CO6
5.3	Necessity of earthing, Types of earthing, Safety devices & system	1	CO6
	Total	24	

Course Designers:

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20CB150	BUSINESS COMMUNICATION & VALUE SCIENCE – I

Category	L	T	P	Credit
Project	2	-	-	2

Preamble

This course aims at building up the behavioral performance of the learners. It makes learners Understand what life skills are and their importance in leading a happy and well-adjusted life that motivate students to look within and create a better version of self by introducing them to key concepts of values, life skills and business communication

Prerequisite

Basic Knowledge of high school English

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Recognize the need for life skills and values	10
CO2	Recognize own strengths and opportunities	10
CO3	Apply the life skills to different situations	20
CO4	Explain the basic tenets of communication	20
CO5	Apply the basic communication practices in different types of communication	20
CO6	Design a project based on field work (Community services)	20

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Value	Perception	2.4, 2.5, 3.1
CO2	TPS2	Understand	Respond	Perception	2.4, 2.5, 3.2.6
CO3	TPS3	Apply	Value	Perception	3.1, 3.1.6
CO4	TPS2	Understand	Receive	Perception	3.1.6, 3.2
CO5	TPS3	Apply	Respond	Guided response	3.2.1, 3.2.3, 3.3.1
CO6	TPS6	Create	Characterize	Origination	4.3.4, 4.7.7, 4.7.8

Mapping with Programme Outcomes and Programme Specific Outcomes

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

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

S- Strong; M-Medium; L-Low

AssessmentPattern: Cognitive Domain

No CAT will be conducted.
Summative - Activity Based Evaluation (No External Examination)

Evaluation is done in classroom activities as given below:

Essential Grammar	CO4	APPLY	10
Business Communication	CO5	APPLY	10
Listening Comprehension	CO1	UNDERSTAND	10
Group Assignment	CO3	APPLY	10
Self Introduction	CO2	APPLY	10

Project submission (20) + interview (15) CO6		35
GD (15) CO1		15
	Total	100

Assessment Pattern: Psychomotor

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

Sample Questions for Course Outcome Assessment**

** (2 to 3 at the cognitive level of course outcome)

Course Outcome 1(CO1): (15 marks)

1. Corona virus Pandemic and its Impact
2. FDI in Retail Sector a Boon or Curse?
3. Digital Education vs Traditional Education

Course Outcome 2(CO2): (10 marks)
Project: Submission and Presentation.

Course Outcome 3 (CO3): : (10 Marks – Time Max 20 mints)
Type of Exercise: Listen to the MP3n/ or MP4 (You Tube Videos) and answer the given MCQs/ Gap -Filling / True or False Exercises

Course Outcome 4 (CO4): Do as Directed (15 Marks)

1. **Choose the correct alternative to fill in the blanks: (3 Marks)**

a. Food prices --------------------- again this month.
(i) have raised (ii) have been raising (C) have been rising (D) have arose

b. The team lead, as well as the other members , ------------- present on the occasion.
(A) were (B) was (C) has (D) have

c. Despite the new medicine's ------------ in treating diabetes, it is not ----------- widely.
(A) effectiveness – prescribed (B) availability – used
(C) prescription – available (D) acceptance – proscribed

2. **Do as directed (3 Marks**)

a. Rewrite the following sentence with standard grammatical accuracy.
Epic, the country's first browser, uses very less memory than Google chrome.

b. Which of the above underlined parts of the sentence is not appropriate?
All engineering students (I)/should learn business systems, (II)/ mathematics and (III) how to do computation. (IV).

c. Which of the following options is the closest in meaning to the sentence below?
She enjoyed herself immensely at party

(A) She had a terrible time at the party (B) She had a horrible time at the party

(C) She had a terrific time at the party (D) She had a terrifying time at the party

3. **Do as directed (3 Marks)**

a. Write down the verbs of the following words: i) standard ii) responsive
b. Frame adjectives from the following words: i) news ii) operation
c. Construct a passive using the following prompt, given in brackets.
(It/feel) There is a lack of communication in sales .

4. **Do as directed (3 Marks)**

a. Rearrange the following words to make formal business expressions.
look / meeting / forward / to/ you.

b. Complete the sentence with the correct relative pronoun.
The merger raises a number of HR issues ---------- need to be addressed soon.

c. Complete the sentence with a suitable preposition.
I am working ------- TCS ------- the domain of Business Analytics.

5. **Do as directed (3 Marks)**

a. Frame a sentence in the future perfect, using the prompt given.
network / half our suppliers by / end of this year.
b. Complete the following sentence, using the correct form of the passive.
To asses past performance, and review pay all employees -------- (assess) once a year.
c. Complete the sentence using the correct alternative given in brackets.
d. The number of training organizations ------- (has / have) increasing rapidly.

Course Outcome 5 (CO5): (15 Marks : Time: 20 Minutes)

TCS E Mail Writing: As a recent buyer of their car, write an E-mail to the Manager of XYZ automotive company, Mr Kishore, regarding the poor quality of service facility available in the city. Sign the E-mail as Anil. (Max: 50 words in two Paragraphs)
very few - service centers - complaints - pending problems - maintenance - cost - time - delivery - increase - customer satisfaction

(OR)

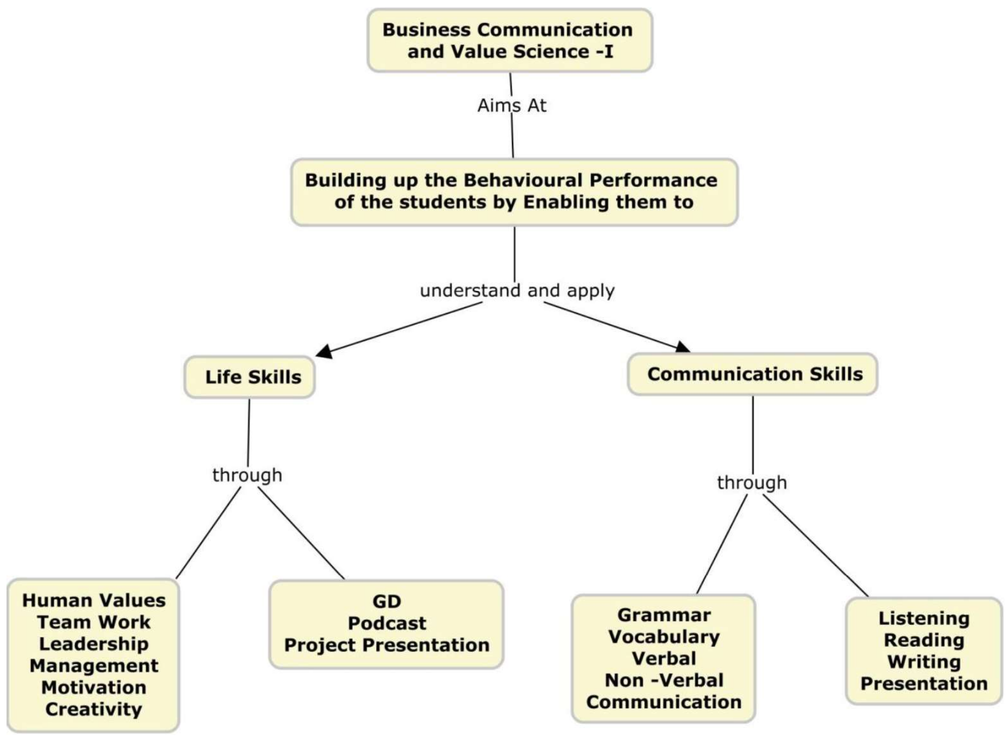
BEC Vantage- Email Writing - Task 1: Your office printer has broken down and you decide to replace it. Write an email to the Head of Purchasing including the following content points: (Words: 40- 50)

- Describing the reason for not repairing the old printer
- Explaining what you need from a new one (colour printing, paper size, etc.)
- Suggesting where to buy a new one

Course Outcome 6 (CO6): (35 Marks – 20+15)

Project Submission and interview.

Concept Map



Syllabus

Overview of LOL (include activity on introducing self), Introduction to critical life skills - Leadership, teamwork, dealing with ambiguity, managing stress, motivating people, creativity, result orientation; Understanding Life Skills: Movie based learning, Self-awareness - identity, body awareness, stress management; Importance of listening skills, Difference between listening and hearing, Types of listening

.

Essential Grammar – Parts of Speech, Applications of tenses in Functional Grammar, Sentence formation, Common errors, Voices; Overview of Business Communication Skills, Barriers of communication, Effective communication, Types of communication- verbal and non–verbal – Role-play based learning, Importance of Questioning, Written Communication: Summary writing, story writing

Business Communication : Formal and informal emails, Verbal communication: Pronunciation, Clarity of speech, Vocabulary Enrichment: Exposure to words from General Service List (GSL) by West, Academic word list (AWL) technical specific terms related to the field of technology, phrases, idioms, formal business vocabulary.

Learning Resources

Text Books:	
There are no prescribed texts for Semester 1 – there will be handouts and reference links shared.	
Reference Books:	
1	English vocabulary in use – Alan Mc'carthy and O'dell
2	APAART: Speak Well 1 (English Language and Communication)
3	APAART: Speak Well 2 (Soft Skills)
4	Business Communication – Dr.SarojHiremath
Web References:	
1	Train your mind to perform under pressure- Simon sinek https://curiosity.com/videos/simon-sinek-on-training-your-mind-to-perform-under-pressure-capture-your-flag/
2	Brilliant way one CEO rallied his team in the middle of layoffs https://www.inc.com/video/simon-sinek-explains-why-you-should-put-people-before-numbers.html
3	Will Smith's Top Ten rules for success https://www.youtube.com/watch?v=bBsT9omTeh0
Online Resources:	
1	https://www.coursera.org/learn/learning-how-to-learn
2	https://www.coursera.org/specializations/effective-business-communication

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1.1	Overview of LOL (include activity on introducing self)	1	CO1
1.2	Self-awareness – identity, body awareness, stress management	1	CO1
1.3	Discussion in classroom (Movie based learning – Pursuit of Happiness)	2 1	CO2
1.4	Verbal and non – verbal – Role-play based learning – Activity	1	CO2
1.5	Importance of listening skills - Listen to recording and answer	1 (lab)	CO3
1.6	Writing a newspaper report – Activity	2	CO5
1.7	Presentation on a favourite topic	2	CO5
2.1	Overview - Barriers of communication, Effective communication	1	CO1
2.2	Parts of Speech–Listening to an audio clip and noting down the difference	1 (lab)	CO3
2.3	Sharing words and framing sentence with various parts of speech	1	CO4
2.4	Tenses: Applications of tenses in Functional Grammar	2	CO4
2.5	Sentence formation (general & Technical),	1	CO4
2.6	Common errors, Voices	1	CO4
2.7	Summary writing, story writing	2	CO5
3.1	Overview of business communication	1	CO4
3.2	Formal and informal emails	2	CO5
3.3	Pronunciation, clarity of speech	2 (lab)	CO4
3.4	Reading Economic Times, Reader's Digest and discuss	2	CO4

	vocabulary		
3.5	Exposure to words from General Service List (GSL) by West	1	CO2
3.6	Group discussion using words learnt - Academic word list (AWL) technical specific terms related to the field of technology, phrases, idioms, significant abbreviations formal business vocabulary	2	CO1
3.7	Toastmaster style speech with evaluation	2	CO5
3.8	Creating a podcast on a topic that will interest college students	2	CO5
3.9	Project Preparation - Community Service	2	CO6

Course Designers:

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20CB160	FUNDAMENTALS OF PHYSICS

Category	L	T	P	Credit
BS	2	0	2	3

Preamble

The course work aims in imparting fundamental knowledge of oscillations, optics, quantum mechanics ,crystal structures and laws of thermodynamics which are essential in understanding and explaining engineering devices

Prerequisite

Basic course (No prerequisite)

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Analyze the behavior of a damped harmonic oscillator	15
CO2	Explain the phenomenon of interference, diffraction and polarization and utilize it for engineering applications	20
CO3	Describe and make use of the Maxwells equation of electromagnetism	10
CO4	Use the basic principles of Quantum mechanics to identify the wave function & understand different crystal structures	25
CO5	Understand the different types of laser ,fiber optic and their applications	15
CO6	Compute the entropy of a given thermodynamic process using the laws of thermodynamics.	15

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value		1.1
CO2	TPS3	Apply	Value		1.1
CO3	TPS2	Understand	Respond		1.1
CO4	TPS3	Apply	Value		1.1
CO5	TPS2	Understand	Respond		1.1
CO6	TPS3	Apply	Value		1.1

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO 1	S	M	L	L					L	L			M	L	
CO 2	M	L	L	-					L	L			L	L	

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

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Assignment			Terminal Examination Theory
	1	2	3 Practical	1	2	3	
Remember	20	20					20
Understand	30	30					30
Apply	50	50	100	100	100	100	50
Analyse							
Evaluate							
Create							

Assessment Pattern: Psychomotor

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

Sample Questions for Course Outcome Assessment**

** (2 to 3 at the cognitive level of course outcome)

Course Outcome 1(CO1):

1. Write any two necessary conditions for body to execute S.H.M
2. Construct the differential equation of a damped harmonic oscillator and deduce the conditions of heavy damping.
3. Explain the different types of damping with suitable displacement-time graph.

Course Outcome 2(CO2):

1. In Newton's ring experiment, the diameter of the fifth ring was 0.3 cm and diameter of twenty fifth ring was 0.8 cm.If the radius of curvature of plano convex lens is 1m, compute the wavelength of light used.
2 Calculate the angles at which the first dark band and next bright band are formed in

Fraunhoffer diffraction pattern of slit width 0.3mm wide if wavelength of light used is 5890 A.

3 The critical angle for a clear crystal for green light is 24.4·Identify the angle of Polarisation.

Course Outcome 3(CO3):

1. Briefly explain the Hertz experiment for production of electromagnetic waves
2. Make use of the Maxwells equation to develop the wave equation for a transverse electric field in free space.
3. Recall the maxwells equation in differential form.

Course Outcome 4 (CO4):

1. If the uncertainity in position of electron is $4x10^{-10}$ m,calculate the uncertainity in velocity of electron
2. Calculate the first two energy levels for electron confined to a one dimensional box of 10^{-10} m width.
3. Calculate the interplanar spacing for a (321) plane in a simple cubic lattice where lattice constant is $4.2x10^{-10}$ m

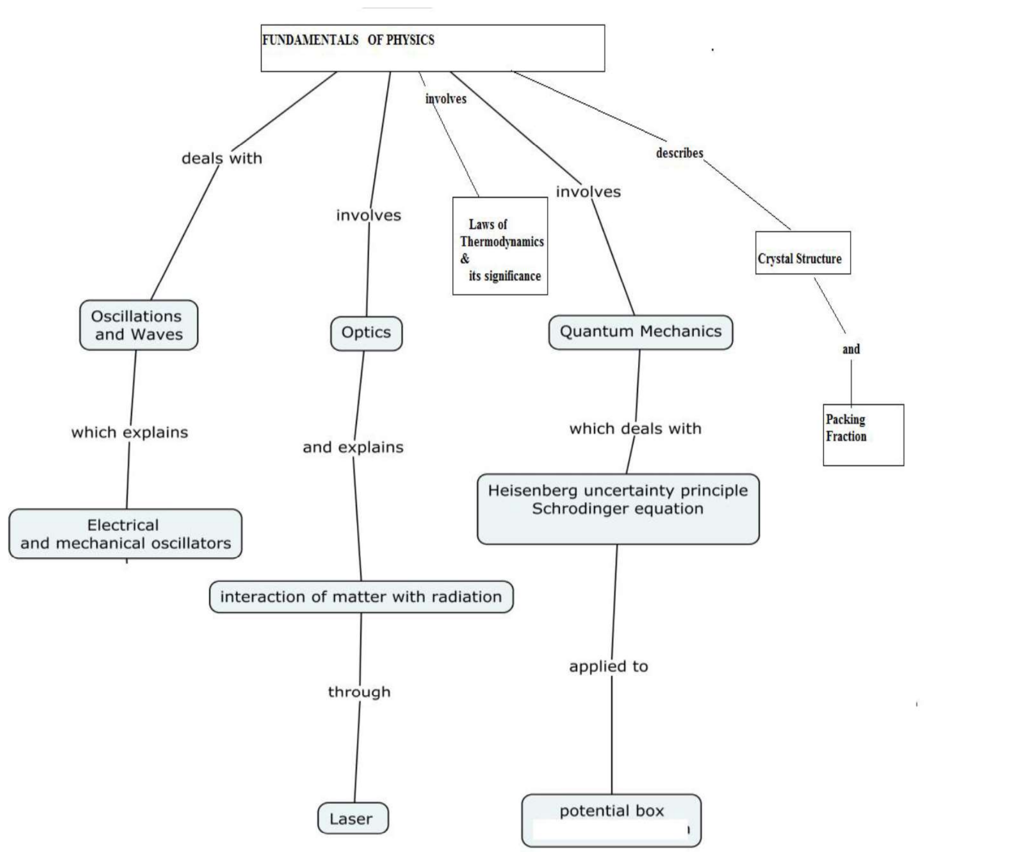
Course Outcome 5 (CO5):

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

Course Outcome 6(CO6):

1. Recall the first law of thermodynamics and its significance.
2. Calculate the change in entropy when 1 g of ice is converted into 1 g of water at 0C.Given that latent heat of fusion is 80 cal/g
3. Cite two examples for irreversible process and prove that entropy increases in irreversible process.

Concept Map



Syllabus

Oscillations

Periodic motion-simple harmonic motion-characteristics of simple harmonic motion-vibration of simple springs mass system. Resonance-definition, damped harmonic oscillator – heavy, critical and light damping, energy decay in a damped harmonic oscillator, quality factor, forced mechanical and electrical oscillators.

Interference

principle of superposition-Young's experiment,Theory of interference fringes-types of interference-Fresnel's prism-Newton's rings, Diffraction-Two kinds of diffraction-Difference between interference and diffraction- Fraunhofer diffraction at single slit-plane diffraction grating. Temporal and Spatial Coherence.

Polarisation of Light

Concept of production of polarized beam of light from two SHM acting at right angle; plane, elliptical and circularly polarized light, Brewster's law, double refraction.

Basic Idea of Electromagnetisms, Maxwell's Equations

Continuity equation for current densities, Maxwell's equation in vacuum and non-conducting medium

Quantum Mechanics

Introduction- Planck's quantum theory- Matter waves, de-Broglie wavelength, Heisenberg's Uncertainty principle, time independent and time dependent Schrödinger's wave equation, Physical significance of wave function, Particle in a one dimensional potential box

Crystallography

Basic terms-types of crystal systems, Bravais lattices, miller indices, d spacing, Atomic packing factor for SC, BCC, FCC and HCP structures, X-ray diffraction

Semiconductor Physics
Conductor, semiconductor and Insulator; Basic concept of Band theory
Laser and Fiber optics:
Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: Ruby Laser, CO_2 and Nd-YAG (Neodymium-doped Yttrium Aluminium Garnet) Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, laser speckles, applications of lasers in engineering.
Fiber optics and Applications, Types of optical fibers
Thermodynamics
Zeroth law of thermodynamics, first law of thermodynamics, brief discussion on application of 1st law, second law of thermodynamics and concept of Engine, entropy, change in entropy in reversible and irreversible processes.

Laboratory

1) Magnetic field along the axis of current carrying coil – Stewart and Gee
2) Determination of Hall coefficient of semi conductor
3) Determination of Plank constant
4) Determination of wave length of light by Laser diffraction method
5) Determination of wave length of light by Newton's Ring method
6) Determination of laser and optical fiber parameters
7) Determination of Stefan's Constant.

Learning Resources
Text Books:

1. Beiser A, "Concepts of Modern Physics", Fifth Edition, McGraw Hill International.
2. David Halliday, Robert Resnick, Jearl Walker, "Fundamentals of Physics",Seventh Edition Wiley plus

Reference Books:
1. AjoyGhatak, "Optics" Fifth Edition, Tata McGraw Hill.
2. Sears & Zemansky, "University Physics",Eleveth Edition, Addison-Wesley.
3. Jenkins and White, "Fundamentals of Optics", Third Edition, McGraw-Hill

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1.	**Oscillations**		
1.1	Periodic motion-simple harmonic motion-characteristics of simple harmonic motion- vibration of simple springs mass system. Resonance-definition.	1	CO1
1.2	Damped harmonic oscillator – heavy, critical and light damping,	1	CO1
1.3	Energy decay in a damped harmonic oscillator, quality factor, forced mechanical and electrical oscillators.	1	CO1
2.	**Interference &Polarization of Light**		
2.1	Principle of superposition-Young's double slit experiment:Theory of interference fringes-types of interference-Fresnel's prism-Newton's rings,	2	CO2
2.2	Diffraction-Two kinds of diffraction-Difference between	2	CO2

	interference and diffraction-Fresnel's half period zone and zone plate-Fraunhofer diffraction at single slit-plane diffraction grating. Temporal and Spatial Coherence.		
2.3	Concept of production of polarized beam of light from two SHM acting at right angle; plane, elliptical and circularly polarized light, Brewster's law, double refraction.	1	CO2
3.	**Basic Idea of Electromagnetisms, Maxwell's Equations**		
3.1	Continuity equation for current densities. .	1	CO3
3.2	Maxwell's equation in vacuum and non-conducting medium	1	CO3
4.	**Quantum Mechanics and Crystallography:**		
4.1	Introduction- Planck's quantum theory- Matter waves, de-Broglie wavelength, Heisenberg's Uncertainty principle,	1	CO4
4.2	Time independent and time dependent Schrödinger's wave equation, Physical significance of wave function, Particle in a one dimensional potential box,	2	CO4
4.3	Crystallography- Basic terms-types of crystal systems, Bravais lattices, miller indices, d spacing,	1	CO4
4.4	Atomic packing factor for SC, BCC, FCC and HCP structures.	1	CO4
4.5	X-ray Diffraction	1	CO4
4.6	Semiconductor Physics – conductor, semiconductor and Insulator; Basic concept of Band theory	1	CO4
5.	**Laser and Fiber optics:**		
5.1	Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion,	1	CO5
5.2	different types of lasers: Ruby Laser, CO2 and Nd-YAG Laser(Neodymium-doped Yttrium Aluminium Garnet)	1	CO5
5.3	Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, laser speckles, applications of lasers in engineering.	1	CO5
5.4	Fiber optics and Applications, Types of optical fibers	1	CO5
6.	**Thermodynamics**		
6.1	Zeroth law of thermodynamics, first law of thermodynamics, brief discussion on application of 1st	1	CO6

	law.		
6.2	Second law of thermodynamics and concept of Engine.	1	CO6
6.3	Change in entropy in reversible and irreversible processes.	1	CO6
	Theory class	**24hrs**	
7	Practicals		
7.1	Introduction to Laboratory Class –Brief Theory of Experiments	3	
7.1	Determination of Plank constant.	2	CO4
7.2	Determination of wave length of light by Laser diffraction method	2	CO5
7.3	Determination of wave length of light by Newton's Ring method	3	CO2
7.4	Determination of laser and optical fiber parameters	2	CO5
7.5	Determination of Stefan's Constant	3	CO6
7.6	Magnetic field along the axis of current carrying coil – Stewart and Gee	3	CO3
7.7	Determination of Hall coefficient of semi conductor	2	CO4
7.8	Additional Practical class (Absentees , Students Joining Late, Repeat Experiments)	2	
7.8	Practical –Continoius Assesment Test 3	2	
	Total Practical Hours	24	
	Total hours (Theory 24+Practical 24)	**48**	

Course Designers:

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20CB170	FUNDAMENTALS OF COMPUTER SCIENCE LAB

Category	L	T	P	Credit
ES	0	0	4	2

Preamble

This course aims to provide exposure to problem solving through C programming. It aims to train the student to design, implement and test the Mathematical and Engineering problems using C-programming language

Prerequisite

NIL

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Design the algorithms and draw flowcharts for the given Mathematical and Engineering problems	15
CO2	Write Computer programs for the given algorithm.	20
CO3	Implement programs with the relevant control structure and parameter passing using functions.	20
CO4	Develop C programs using derived data types.	15
CO5	Create and use header files and C pre-processor directive as utility.	15
CO6	Use Pattern searching and parsing strategies in problem solving	15

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value	-	1.2, 2.1.2 , 2.1.5, 2.4.6, 3.2.4, 3.2.5, 4.4.3
CO2	TPS3	Apply	Value	-	1.2, 2.1.2 , 2.1.5, 2.4.6, 3.2.3, 3.2.4, 4.5.3
CO3	TPS3	Apply	Value	-	1.2, 2.1.2 , 2.1.5, 2.4.6, 3.2.3, 3.2.4, 4.5.3
CO4	TPS3	Apply	Value	-	1.2, 2.1.2 , 2.1.5, 2.4.6, 3.2.3, 3.2.4, 4.5.3
CO5	TPS3	Apply	Value	-	1.2, 2.1.2 , 2.1.5 ,2.4.6, 3.2.3, 3.2.4, 4.5.3
CO6	TPS3	Apply	Value	-	1.2, 2.1.2 , 2.1.5, 2.4.6, 3.2.3, 3.2.4, 4.5.3

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO 1	S	M	L	-	-	L	-	L	-	-	L	L	M	L	L
CO 2	S	M	L	-	-	L	-	L	-	-	L	L	M	L	L
CO	S	M	L	-	-	L	-	L	-	-	L	L	M	L	L

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

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

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

Assessment Pattern: Psychomotor

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

List of Experiments/Activities with CO Mapping

Ex.No	List of Experiments	CO
1.	Algorithm and flowcharts of small problems like GCD	CO1
	Structured code writing with:	
2.	Small but tricky codes	CO2
3.	Proper parameter passing	CO3
4.	Command line Arguments	CO3
5.	Variable parameter	CO3
6.	Pointer to functions	CO4
7.	User defined header	CO5
8.	Make file utility	CO5

9.	Multi file program and user defined libraries	CO5
10.	Interesting substring matching / searching programs	CO6
11.	Parsing related assignments	CO6

Learning Resources

1. "C: The Complete Reference", Herbert Schildt, Fourth Edition, , McGraw Hill, 2017
2. "Let Us C", Yashavant Kanetkar , Sixteenth edition, BPB Publication, 2017
3. "Programming in C",B. Gottfried, Third Edition, Schaum Outline Series, 2017
4. "The C Programming Language", B. W. Kernighan and D. M. Ritchi, Second Edition, PHI,1988.
5. "How to solve it by Computer", R.G Dromey, Pearson education, Delhi, 2008.
6. "Simple Program Design", A Step-by-Step Approach, Lesley Anne Robertson, 5th Edition, Thomson, 2007

Course Designers:

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20CB180	PRINCIPLES OF ELECTRICAL ENGINEERING LAB	Category	L	T	P	Credit
		ES	0	0	2	1

Preamble

The course is designed to provide students a widespread knowledge and understanding of the basic Electrical Systems Components and theorems. The indispensable and pervasive knowledge of various types of circuits and its behavior, two types of connections in AC system and quantities associated in both DC and AC will enhance the practical knowledge about the electrical engineering system.

Prerequisite

Nil

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Practice the use of electrical Elements, sources, measuring devices and transducers related to electrical circuits experimentally.	10
CO2	Determine the resistance temperature coefficient experimentally.	10
CO3	Verify the network theorems for the electric circuit using hardware and simulation software experimentally.	30
CO4	Verify series resonance phenomena in a RLC circuit experimentally.	10
CO5	Analyze the transient behavior of the given RC circuit experimentally.	10
CO6	Verify the relationship between voltage and current in three phase balanced star and delta connected loads experimentally.	20
CO7	Practice electrical quantities measurement in DC and AC systems experimentally.	10

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value	Mechanism	1.2.1 ,2.2.3
CO2	TPS3	Apply	Value	Mechanism	1.2.1 ,2.2.3
CO3	TPS3	Apply	Value	Mechanism	1.2.1 ,2.2.3
CO4	TPS3	Apply	Value	Mechanism	1.2.1 ,2.2.3
CO5	TPS4	Analyze	Organize	Complex Overt Responses	1.2.1 ,2.2.3
CO6	TPS3	Apply	Value	Mechanism	1.2.1 ,2.2.3
CO7	TPS3	Apply	Value	Mechanism	1.2.1 ,2.2.3

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO 1	S	M	L	L	M			M	M	M			M	M	L
CO 2	S	M	L	L	M			M	M	M			M	M	L
CO 3	S	M	L	L	S			M	M	M			M	M	L
CO 4	S	M	L	L	S			M	M	M			M	M	L
CO 5	S	M	L	L	S			M	M	M			M	M	L
CO 6	S	M	L	L	S			M	M	M			M	M	L
CO 7	S	M	L	L	L			M	M	M			M	L	L

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

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

Assessment Pattern: Psychomotor

Psychomotor Skill	**Miniproject /Practical Component/Observation**
Perception	
Set	
Guided Response	
Mechanism	30
Complex Overt Responses	
Adaptation	
Origination	

List of Experiments/Activities with CO Mapping

Experiment List	**CO**
Familiarization of electrical Elements, sources, measuring devices and transducers related to electrical circuits	CO1
Determination of resistance temperature coefficient	CO2
Verification of Network Theorem (Superposition, Thevenin, Norton, Maximum Power Transfer theorem)	CO3
Simulation of R-L-C series circuits for XL> XC , XL< XC & XL= XC	CO4
Simulation of Time response of RC circuit	CO5

Verification of relation in between voltage and current in three phase balanced star and delta connected loads.	CO6
Demonstration of measurement of electrical quantities in DC and AC systems.	CO7

Learning Resources

1. Electric Machinery, (Sixth Edition) A. E. Fitzgerald, Kingsely Jr Charles, D. Umans Stephen, Tata McGraw Hill.
2. A Textbook of Electrical Technology, (vol. I), B. L. Theraja, Chand and Company Ltd., New Delhi.
3. Basic Electrical Engineering, V. K. Mehta, S. Chand and Company Ltd., New Delhi.
4. Theory and problems of Basic Electrical Engineering, (Second Edition), J. Nagrath and Kothari, Prentice Hall of India Pvt. Ltd.
5. Basic of Electrical Engineering, T. K. Nagsarkar and M. S. Sukhija, Oxford University Press.
6. Introduction to Electrodynamics, D. J. Griffiths, (Fourth Edition), Cambridge University Press.
7. Engineering Circuit Analysis, William H. Hayt & Jack E. Kemmerly, McGraw-Hill Book Company Inc.
8. Fundamentals of Electrical and Electronics Engineering, Smarjith Ghosh, Prentice Hall (India) Pvt. Ltd.

Course Designers:

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CURRICULUM AND DETAILED SYLLABI

FOR

B.Tech DEGREE (Computer Science and Business Systems) PROGRAMME

SECOND SEMESTER

FOR THE STUDENTS ADMITTED FROM THE

ACADEMIC YEAR 2020 - 2021 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.Tech (Computer Science and Business systems) Programme

COURSES OF STUDY
(For the candidates admitted from 2020 - 21 onwards)

SECOND SEMESTER

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	No.of Hours / Week			Credits
				L	T	P	
THEORY COURSES							
1	20CB210	Linear Algebra	BS	3	1	0	4
2	20CB220	Statistical Methods	BS	3	1	0	4
3	20CB230	Data Structures and Algorithms	PC	3	1	0	4
4	20CB240	Principles of Electronics	ES	2	0	0	2
5	20CB250	Fundamentals of Economics	HSS	2	0	0	2
6	20CB260	Business Communication & Value Science - II	Project	2	0	0	2
PRACTICAL COURSES							
7	20CB270	Data Structures and Algorithms Lab	PC	0	0	4	2
8	20CB280	Principles of Electronics Lab	ES	0	0	2	1
9	18ES290	Lateral Thinking	ES	0	0	2	1
10	18CHAA0	Environmental Sciences	AC	1	0	1	-
Total				**16**	**3**	**9**	**22**

BS : Basic Science
HSS : Humanities and Social Science
ES : Engineering Science
PC : Program Core
PE : Program Elective
OE : Open Elective
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.Tech (Computer Science and Business systems) Programme

SCHEME OF EXAMINATIONS
(For the candidates admitted from 2020 - 21 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	20CB210	Linear Algebra	3	50	50	100	25	50
2	20CB220	Statistical Methods	3	50	50	100	25	50
3	20CB230	Data Structures and Algorithms	3	50	50	100	25	50
4	20CB240	Principles of Electronics	3	50	50	100	25	50
5	20CB250	Fundamentals of Economics	3	50	50	100	25	50
6	20CB260	Business Communication & Value Science - II	-	100	-	100	-	50
PRACTICAL								
7	20CB270	Data Structures and Algorithms Lab	3	50	50	100	25	50
8	20CB280	Principles of Electronics Lab	3	50	50	100	25	50
9	18ES290	Lateral Thinking	-	50	50	100	25	50
10	18CHAA0	Environmental Sciences	-	50	50	100	25	50

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

20CB210	LINEAR ALGEBRA	Category	L	T	P	Credit
		BS	3	1	0	4

Preamble

A general theory of Mathematical systems involving addition and scalar multiplication of vectors has applications in all Engineering field. Mathematical systems of this form are called Vector spaces or linear spaces. Linear systems of equations are associated with many problems in Engineering and Sciences, as well as with applications of mathematics to social sciences, quantitative study of business and economic problems. The modules II and III of this subject deal with the concepts on Vector spaces and orthogonality. SVD & PCA are the two important techniques used for dimensionality reduction in unsupervised learning of machine learning.

Prerequisite

Matrices and Determinants

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Solve the system of linear equations	20
CO2	Verify whether the given set is vector space or not and determine its dimension	15
CO3	Predict an orthonormal basis and decompose a given matrix using QR decomposition	15
CO4	Compute eigen values and eigen vectors for a given matrix	20
CO5	Decompose a matrix using Singular Value Decomposition (SVD)	15
CO6	Perform dimensionality reduction on the given data using SVD and Principal Component Analysis(PCA)	15

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value	-	1.1, 2.1,2.2,2.5.1,4.1.2
CO2	TPS3	Apply	Value	-	1.1, 2.1,2.2,2.5.1,4.1.2
CO3	TPS3	Apply	Value	-	1.1, 2.1,2.2,2.5.1,4.1.2
CO4	TPS3	Apply	Value	-	1.1, 2.1,2.2,2.5.1,4.1.2
CO5	TPS3	Apply	Value	-	1.1, 2.1,2.2,2.5.1,4.1.2
CO6	TPS3	Apply	Value	-	1.1, 2.1,2.2,2.5.1,4.1.2

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO 1	S	M	L	L	-	L	-	L			L	L	M	L	L
CO 2	S	M	L	L	-	L	-	L			L	L	M	L	L

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

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

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

Sample Questions for Course Outcome Assessment**

Course Outcome 1(CO1)

1. Compute the rank of the matrix $\begin{pmatrix} 4 & 2 & 1 \\ 2 & 0 & 1 \\ 2 & 0 & -1 \\ 1 & 2 & 1 \end{pmatrix}$
2. Solve by Gauss elimination method: $x + y + z = 3$: $2x - y + 3z = 16$; $3x + y - z = -3$
3. Obtain LU decomposition: $\begin{pmatrix} 2 & 4 & 5 \\ 4 & 10 & 0 \\ 5 & 0 & 7 \end{pmatrix}$

Course Outcome 2(CO2)

1. Verify that $M_3(R)$ is a vector space and identify its dimension.
2. Given the basis $\{1, x, x^2\}$ for C[-1, 1], construct an orthonormal basis for C[-1, 1].
3. Obtain QR decomposition for the matrix $\begin{pmatrix} 2 & 2 & 0 \\ 1 & 0 & 3 \\ 2 & 0 & 1 \\ 4 & 3 & 1 \end{pmatrix}$

Course Outcome 3(CO3)

1. Show that $\left\{ \frac{(1,1,1)^T}{\sqrt{3}}, \frac{(2,1,-3)^T}{\sqrt{14}}, \frac{(4,-5,1)^T}{\sqrt{42}} \right\}$ is an orthonormal set in R^3

2. Construct a QR decomposition for the matrix $\square = \begin{pmatrix} 4 & 2 & 1 \\ 2 & 0 & 1 \\ 2 & 0 & -1 \\ 1 & 2 & 1 \end{pmatrix}$
3. Construct a QR decomposition for the matrix $\begin{bmatrix} -4 & 2 & 2 \\ 3 & -3 & 3 \\ 6 & 6 & 0 \end{bmatrix}$

Course Outcome 4 (CO4)

1. Find the eigen values and eigen vectors for the matrix adj A where A= $\begin{pmatrix} 2 & 4 & 5 \\ 4 & 10 & 0 \\ 5 & 0 & 7 \end{pmatrix}$
2. Let L:$R^3 \rightarrow R^3$ be defined by $L(x,y,z) = (x,\ x+y,\ x+y+z)$. Verify whether L is a linear transformation and if so identify its matrix representation.
3. State and prove any two properties of Hermitian and Unitary matrices.

Course Outcome 5 (CO5)

1. Obtain SVD for the matrix i) $\begin{pmatrix} 1 & 1 \\ 1 & 1 \\ 0 & 0 \end{pmatrix}$ ii) $\begin{pmatrix} 2 & 2 & -2 \\ 2 & 2 & -2 \\ -2 & -2 & 6 \end{pmatrix}$
2. Compute pseudo inverse of the matrix $\begin{pmatrix} 1 & 1 \\ 1 & 1 \\ 0 & 0 \end{pmatrix}$

Course Outcome 6(CO6)

1. Calculate PCA for the following data

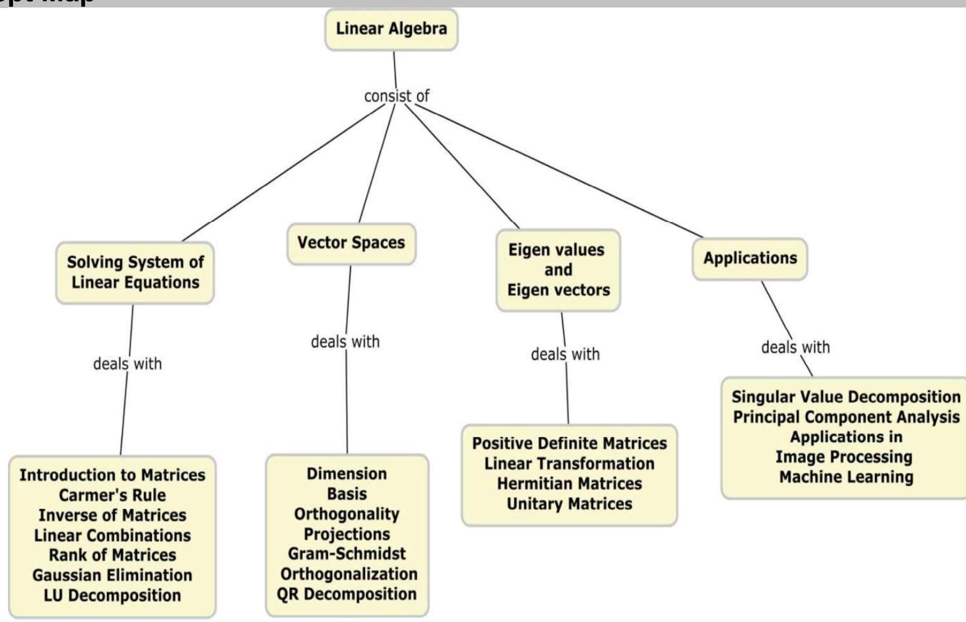
X:	2.5	0.5	2.2	1.9	3.1	2.3	2.0	1.0
Y:	2.4	0.7	2.9	2.2	3.0	2.7	1.6	1.1

2. Calculate PCA for the following trivariate data

X:	60	90	50	30	60
Y:	90	30	50	45	60
Z:	90	90	50	45	90

3. Apply PCA to i) $\begin{pmatrix} 1 & -1 \\ 0 & 1 \\ -1 & 0 \end{pmatrix}$ ii) $\begin{pmatrix} -1 & -2 & 4 \\ 1 & 3 & 0 \\ 2 & 1 & 3 \end{pmatrix}$

Concept Map



Syllabus

Introduction to Matrices and Determinants Introduction to Matrices and Determinants; Solution of Linear Equations; Cramer's rule; Inverse of a Matrix.
Vectors and linear combinations Rank of a matrix; Gaussian elimination; LU Decomposition; Solving Systems of Linear Equations using the tools of Matrices.
Vector Space Vector space; Dimension; Basis; Orthogonality; Projections; Gram-Schmidt orthogonalization and QR decomposition.
Eigen Values and Eigen Vectors Eigenvalues and Eigenvectors; Positive definite matrices; Linear transformations; Hermitian and unitary matrices;
Singular Value Decomposition and Principal component analysis Introduction to their applications in Image Processing and Machine Learning.

Learning Resources

1. Higher Engineering Mathematics, B. S. Grewal.
2. Advanced Engineering Mathematics, 7th Edition, Peter V. O'Neil.
3. Advanced Engineering Mathematics, 2nd Edition, Michael. D. Greenberg.
4. Introduction to linear algebra, 5th Edition, Gilbert Strang.
5. Applied Mathematics (Vol. I & II) , by P. N. Wartikar& J. N. Wartikar.
6. Digital Image Processing, R C Gonzalez and R E Woods
7. https://medium.com/@jonathan_hui/machine-learning-singular-value-decomposition-svd-principal-component-analysis-pca-1d45e885e491
8. https://machinelearningmastery.com/introduction-matrices-machine-learning/

Online course
https://www.coursera.org/lecture/machine-learning/principal-component-analysis-algorithm-ZYIPa

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1.	**Solving System of Linear Equations**		
1.1	Introduction to Matrices and Determinants	1	CO1
1.2	Solution of Linear Equations	1	CO1

1.3.	Cramer's Rule and Inverse of a Matrix	1	CO1
	Tutorial	1	CO1
1.4	Vectors and Linear Combinations	1	CO1
1.5	Rank of a Matrix	1	CO1
	Tutorial	1	CO1
1.6	Gaussian Elimination	1	CO1
1.7	LU Decomposition	1	CO1
	Tutorial	1	CO1
1.9	Solving systems of the linear equations using the tools of the matrices(Iterative Methods)	1	CO1
	Tutorial	1	
2.	**Vector Space**		
2.1	Vector Space	2	CO2
2.2	Basis and Dimension	2	CO2
	Tutorial	1	CO2
2.3	Orthogonality	1	CO3
2.4	Projections	1	CO3
	Tutorial	1	CO3
2.5	Gram-Schmidth Orthogonalisation	2	CO3
2.6	QR Decomposition	1	CO3
	Tutorial	1	CO3
3.	**Eigen Values and Eigen Vectors**		
3.1	Eigen values and Eigen vectors	3	CO4
3.2	Positive Definite Matrices	2	CO4
	Tutorial	1	CO4
3.3	Linear Transformation and Matrix Representation	2	CO4
	Tutorial	1	CO4
3.4	Hermitian and Unitary Matrices	2	CO4
	Tutorial	1	CO4
4.	**Applications**		
4.1	Singular Value Decomposition(SVD)	3	CO5
4.2	Pseudo inverse	1	CO5
	Tutorial	1	CO5
4.3	Principal Component Analysis(PCA)	3	CO6
4.4	Applications in Machine Learning	3	CO6
	Tutorial	1	

- Assignment : Google Page Rank Algorithm related to matrices and vector(Case Study)

Course Designers:

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20CB220	STATISTICAL METHODS

Category	L	T	P	Credit
BS	3	1	0	4

Preamble

Statistics as a subject is a science of learning from data and provides tools for making decisions when conditions of uncertainty prevail. Statistical techniques are an important tool in these activities because they provide the engineer with both descriptive and analytical methods for dealing with the variability in observed data. The main objective of this course is to provide students with the foundations of statistical and probabilistic analysis mostly used in various applications in engineering and science as well as which a basic essential mathematics for machine learning. It introduces students to cognitive learning in statistics and develops skills in writing programme language using R.

Prerequisite

- Nil.

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Use several statistical method for the given data to infer the relation among the given variables.	20
CO2	Estimate the population parameters and sufficient statistic.	15
CO3	Identify the right test statistic to test the hypothesis formulated from the given data.	15
CO4	Use the appropriate non parametric hypothesis testing procedures based on inferences	15
CO5	Develop the model for the given time series and estimate the required forecasting.	15
CO6	Explore the features of R language to implement statistical tests for the given data.	20

*** Weightage depends on Bloom's Level, number of contact hours.

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value	-	1.1.1, 2.1.4
CO2	TPS3	Apply	Value	-	1.1.1, 2.1.1
CO3	TPS3	Apply	Value	-	1.1.1, 2.1.5, 2.2.1
CO4	TPS3	Apply	Value	-	1.1.1, 2.1.5, 2.2.4
CO5	TPS3	Apply	Value	-	1.1.1, 2.1.1, 2.1.3
CO6	TPS2	Understand	Respond	-	1.1.1, 2.1.1, 4.6.2

Mapping with Programme Outcomes and Programme Specific Outcomes

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

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

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

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

Assessment Pattern: Psychomotor

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

Sample Questions for Course Outcome Assessment**

Course Outcome 1(CO1):

1. Suppose we have a linear equation through the origin. Estimate the regression line passing through the origin for the following data. Suppose it is not known whether the true regression should pass through the origin. Estimate the regression line.

x	0.5	1.5	3.2	4.2	5.1	6.5
y	1.3	3.4	6.7	8.0	10.0	13.2

2. A study was done on a diesel-powered light-duty pickup truck to see if humidity, air temperature, and barometric pressure influence emission of nitrous oxide (in ppm). Emission measurements were taken at different times, with varying experimental conditions. The data are given in Table 12.2. The model is $y_i = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \beta_3 x_{3i} + \_i$, $i = 1, 2, \ldots, 20$. Fit this multiple linear regression model to the given data and then estimate the amount of nitrous oxide emitted for the conditions where humidity is 50%, temperature is 76◦F, and barometric pressure is 29.30.

Nitrous Oxide y	Humidity x_1	Temp., x_2	Pressure x_3	Nitrous Oxide y	Humidity x_1	Temp., x_2	Pressure x_3
0.90	72.4	76.3	29.18	1.07	23.3	76.8	29.38
0.91	41.6	70.3	29.35	0.94	47.4	86.6	28.35
0.96	34.3	77.1	29.24	1.10	31.5	76.9	29.63
0.89	35.1	68.0	29.27	1.10	10.6	86.3	29.56
1.00	10.7	79.0	29.78	1.10	11.2	86.0	29.48
1.10	12.9	67.4	29.39	0.91	73.3	76.3	29.40
1.15	8.3	66.8	29.69	0.87	75.4	77.9	29.28
1.03	20.1	76.9	29.48	0.78	96.6	78.7	29.29
0.77	72.2	77.7	29.09	0.82	107.4	86.8	29.03
1.07	24.0	67.7	29.60	0.95	54.9	70.9	29.37

3. Concerns about the increasing friction between some machine parts prompted an investigation of four different types of ball bearings. Five different machines were available and each type of ball bearing was tried in each machine. Given the observations on temperature, coded by subtracting the smallest value, *Machines* 1 2 3 4 5
   Ball bearing 1 10 8 7 4 6
   Ball bearing 2 10 7 12 5 11
   Ball bearing 3 8 9 11 12 10
   Ball bearing 4 12 8 6 11 13
   (a) decompose each observation y_{ij} as
   $y_{ij} = y_{\cdot\cdot} + (y_{i\cdot} - y_{\cdot\cdot}) + (y_{\cdot j} - y_{\cdot\cdot}) + (y_{ij} - y_{i\cdot} - y_{\cdot j} + y_{\cdot\cdot})$
   (b) obtain the sum of squares and the degrees of freedom for each component;
   (c) construct the analysis of variance table and test for differences among the bearings using $\alpha = 0.01$.

Course Outcome 2(CO2):

1. Apply least square method to fit an exponential curve of the form $Y = ab^X$ to the following data

X	1	2	3	4	5	6	7	8
Y	1.0	1.2	1.8	2.5	3.6	4.7	6.6	9.1

   The two regression lines are $4x - 5y + 53 = 0$ and $20x - 9y = 107$ and variance of X is 25. Calculate the values correlation coefficient and variance of Y
2. X_1, X_2, and X3 is a random sample of size 3 from a population with mean μ and variance σ^2. T_1, T_2, T_3 are the estimators used to estimate the mean value μ, where $T_1 = X_1 + X_2 - X_3$; $T_2 = 2X_1 + 3X_3 - 4X_2$ and $T_3 = 1/3(\lambda X_1 + X_2 + X_3)$ (i) Are T_1 and T_2 unbiased estimators? Find λ such that T_3 is an unbiased estimator for μ
3. Calculate the maximum likelihood estimator for λ when f (x; λ) is the Poisson distribution

Course Outcome 3(CO3):

1. A shoe manufacturer wants potential customers to compare two types of shoes, one made of the current PVC material *X* and one made of a new PVC material *Y*. Shoes made of both are available. Each person, in a sample of 52, is asked to wear one pair of each type for a whole day. After a walk of 2 km, they are asked to score that day's pair on a scale of 1 to 10, with higher scores being better. The differences in scores (New PVC *Y)* − (Current PVC *X*) have mean 2.6 and variance 3.9. Construct a 90% confidence interval for the mean difference.
2. Two different computer processors are compared by measuring the processing speed for different operations performed by computers using the two processors. If

12 measurements with the first processor had a standard deviation of 0.1 GHz and 16 measurements with the second processor had a standard deviation of 0.15 GHz, can it be concluded that the processing speed of the second processor is less uniform? Use a 0.05 level of significance. What assumptions must be made as to how the two samples are obtained?

3. Transceivers provide wireless communication among electronic components of consumer products. Responding to a need for a fast, low-cost test of Bluetooth-capable transceivers, engineers2 developed a product test at the wafer level. In one set of trials with 60 devices selected from different wafer lots, 48 devices passed. Test the null hypothesis $p = 0.70$ against the alternative hypothesis $p > 0.70$ at the 0.05 level of significance.

Course Outcome 4 (CO4):

1. The following are 42 consecutive pizza breads baked by a newly improved oven model during 6 weeks: 25, 28, 32, 31, 30, 29, 16, 18, 31, 24, 72, 55, 61, 33, 30, 44, 46, 59, 62, 75, 75, 80, 70, 64, 48, 52, 39, 38, 61, 64, 38, 48, 35, 34, 49, 58, 63, 36, 75, 80, 32, and 48. Use the method of runs above and below the median and the 0.01 level of significance to test the null hypothesis of randomness against the alternative that there is a trend.
2. In a vibration study, certain airplane components were subjected to severe vibrations until they showed structural failures. Given the following failure times (in minutes), test whether they can be looked upon as a sample from an exponential population with the mean $\mu = 10$:
   1.5 10.3 3.6 13.4 18.4 7.7 24.3 10.7 8.4
   15.4 4.9 2.8 7.9 11.9 12.0 16.2 6.8 14.7
   Use the Kolmogorov-Smirnov test with a 0.05 level of significance.
3. The following are the self-reported times (hours for month), spent on homework, by random samples of juniors in two different majors.
   Major 1: 63 72 29 58 81 65 79 57 40 76 47 55 60
   Major 2: 41 32 26 43 78 49 39 56 15 54 8 66 64
   Use the *U* test at the 0.05 level of significance to test whether or not students from the 2 groups devote the same amounts of time to homework.

Course Outcome 5 (CO5):

1. For the model $(1 - B)(1 - 0.2B)X_t = (1 - 0.5B)Z_t$
   (a) Classify the model as an ARIMA (p, *d, q)* process (i.e. find *p, d. q).*
   (b) Determine whether the process is stationary.
2. Suppose that the correlogram of a time series consisting of 100 observations has r1=0.31, r2 = 0.37, r3≈ -0.05, r4=0.06, *r5* = -0.21, r6 = 0.1 li r7 = 0.08, r8 ~0.05, r9=0.12, r10= —0.01
3. For the SARIMA(0, 0, 1)(1, 1, 0)12 model, find forecasts at time # for up to 12 steps ahead in terms of observations and estimated residuals up to time *N.*

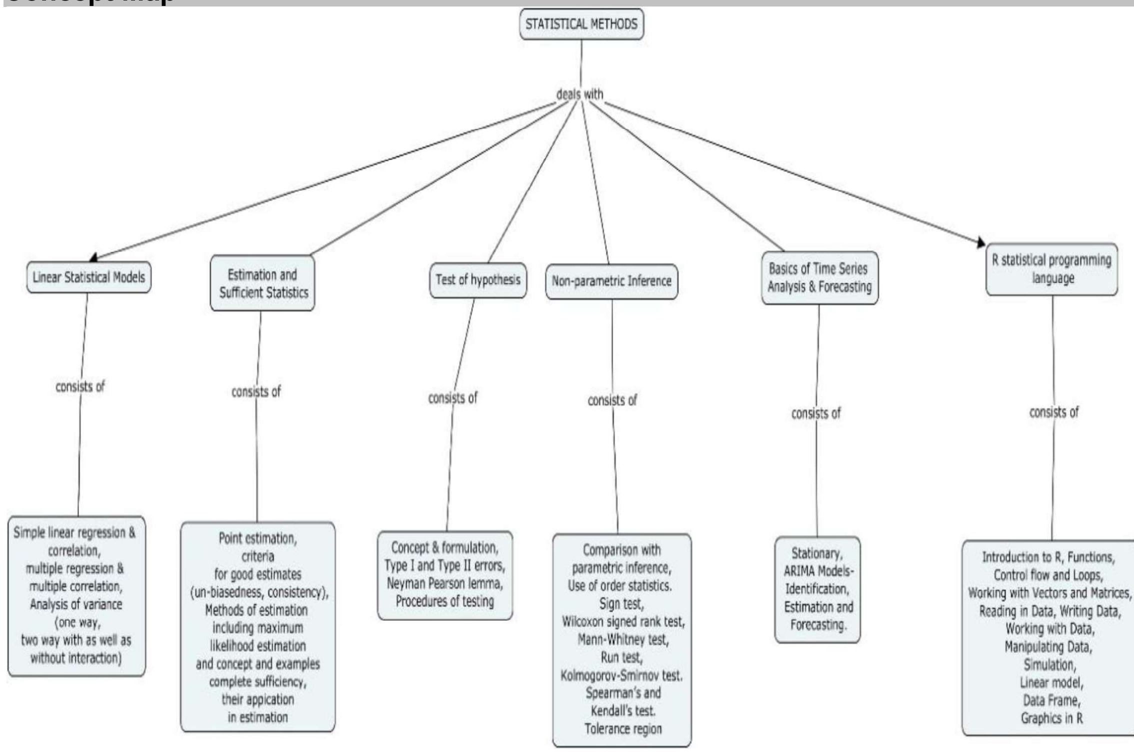
Course Outcome 6(CO6):

1. Can you spot the difference between a character string and a number? Which of these are character strings and which are numbers? 1, "1", "one".
2. Create an atomic vector that stores just the face names of the cards in a royal flush, for example, the ace of spades, king of spades, queen of spades, jack of spades, and ten of spades. The face name of the ace of spades would be "ace," and "spades" is the suit. Which type of vector will you use to save the names?
3. Create the following matrix, which stores the name and suit of every card in a royal flush.

```
## [,1] [,2]
## [1,] "ace" "spades"
```

```
## [2,] "king" "spades"
## [3,] "queen" "spades"
## [4,] "jack" "spades"
## [5,] "ten" "spades"
```

Concept Map



Syllabus

Linear Statistical Models: Simple linear regression & correlation, multiple regression & multiple correlation, Analysis of variance (one way, two way with as well as without interaction)
Estimation and Sufficient Statistic: Estimation: Point estimation, criteria for good estimates (un-biasedness, consistency), Methods of estimation including maximum likelihood estimation. Sufficient Statistic: Concept & examples, complete sufficiency, their application in estimation
Test of hypothesis: Concept & formulation, Type I and Type II errors, Neyman Pearson lemma, Procedures of testing.
Non-parametric Inference: Comparison with parametric inference, Use of order statistics. Sign test, Wilcoxon signed rank test, Mann-Whitney test, Run test, Kolmogorov-Smirnov test. Spearman's and Kendall's test. Tolerance region
Basics of Time Series Analysis & Forecasting: Stationary, ARIMA Models: Identification, Estimation and Forecasting.
R statistical programming language: Introduction to R, Functions, Control flow and Loops, Working with Vectors and Matrices, Reading in Data, Writing Data, Working with Data, Manipulating Data, Simulation, Linear model, Data Frame, Graphics in R

Learning Resources

1. I.R. Miller, J.E. Freund and R. Johnson, *"Probability and Statistics for Engineers"* 9th Edition, Pearson.

2. A. Goon, M. Gupta and B. Dasgupta, "Fundamentals of Statistics", vol. I & II, World Press.
3. Chris Chatfield, *"The Analysis of Time Series: An Introduction*", 6th edition, Chapman and Hall/CRC.
4. D.C. Montgomery & E.Peck, *"Introduction to Linear Regression Analysis"*, 5th edition, Wiley.
5. A.M. Mood, F.A. Graybill & D.C. Boes, "*Introduction to the Theory of Statistics*", 3rd edition, McGraw Hill.
6. N. Draper & H. Smith, *"Applied Regression Analysis*", 3rd edition, Wiley.
7. Garrett Grolemund, *"Hands-on Programming with R", 1st* edition, O′Reilly.
8. Jared P. Lander, *"R for Everyone: Advanced Analytics and Graphics"*, 2nd edition, Addison-Wesley Professional.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1.	**Linear Statistical Models**		
1.1	Simple linear regression & correlation	2	CO1
1.2	Multiple regression & Multiple correlation	2	CO1
1.3	Tutorial	1	
1.4	Analysis of variance (one way, two way with as well as without interaction)	2	CO1
1.5	Tutorial	1	
2.	**Estimation and Sufficient Statistic**		
2.1	Estimation: Point estimation, criteria for good estimates (un-biasedness, consistency)	1	CO2
2.2	Methods of estimation including maximum likelihood estimation	2	CO2
2.3	Tutorial	1	
2.4	Sufficient Statistic: Concept & examples	1	CO2
2.5	Sufficient Statistic: complete sufficiency	1	CO2
2.6	Sufficient Statistic: their application in estimation	1	CO2
2.7	Tutorial	1	
	Case study problems in correlation analysis and estimation-Assignment-I		
3.	**Test of hypothesis**		
3.1	Concept & formulation, Type I and Type II errors	2	CO3
3.2	Neyman Pearson lemma	1	CO3
3.3	Tutorial	1	
3.4	Procedures of testing	3	CO3
3.5	Tutorial	1	
4.	**Non-parametric Inference**		
4.1	Comparison with parametric inference, Use of order statistics	1	CO4
4.2	Sign test, Wilcoxon signed rank test	1	CO4
4.3	Mann-Whitney test, V	1	CO4
4.4	Tutorial	1	
4.5	Kolmogorov-Smirnov test	1	CO4
4.6	Spearman's and Kendall's test	1	CO4
4.7	Tolerance region	1	CO4
4.8	Tutorial	1	
	Case study problems in parametric and non-parametric tests- Assignment II		
5.	**Basics of Time Series Analysis & Forecasting:**		

5.1	Stationary, ARIMA Models: Identification, Estimation and Forecasting	3	CO5
5.2	Tutorial	1	
6.	**R statistical programming language**		
6.1	Introduction to R	1	CO6
6.2	Functions, Control flow and Loops	1	CO6
6.3	Working with Vectors and Matrices	1	CO6
6.4	Tutorial	1	
6.5	Reading in Data, Writing Data, Working with Data, Manipulating Data	2	CO6
6.6	Simulation	1	CO6
6.7	Tutorial	1	
6.8	Linear model	1	CO6
6.9	Data Frame, Graphics in R	2	CO6
6.10	Tutorial	1	
	Case study problems in R-tool - Assignment III		
	Total	48	

Course Designers:

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20CB230	DATA STRUCTURES AND ALGORITHMS

Category	L	T	P	Credit
PC	3	1	0	4

Preamble

This course provides an introduction to the basic concepts and techniques of Linear and nonlinear data Structures and analyzes the various algorithms. It also discusses the use of data structures and the algorithm design techniques to provide efficient software solutions.

Prerequisite

- 20CB130-Fundamentals of Computer Science

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Construct algorithms for performing operations on a data structure, with an understanding of the trade-off between the time and space complexity.	20
CO2	Demonstrate how linear data structures like array, stack, queue and linked list are represented in the main memory and manipulated or used by different operations.	20
CO3	Apply non-linear data structures like Binary Tree, Threaded Binary Tree, Binary Search Tree, B & B+ Tree, AVL Tree, Splay Tree and Graphs in different operations.	20
CO4	Identify the computational efficiency of searching algorithms.	10
CO5	Determine the computational efficiency of sorting and hashing algorithms.	15
CO6	Illustrate the organization of files and its accessing schemes	15

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS 3	Apply	Value	Mechanism	1.2, 2.1.5,2.2.3,2.5.1,3.2.3, 4.5.3
CO2	TPS 3	Apply	Value	Mechanism	1.2, 2.1.5,2.2.3,2.5.1,3.2.3, 4.5.3
CO3	TPS 3	Apply	Value	Mechanism	1.2, 2.1.5,2.2.3,2.5.1,3.2.3, 4.5.3
CO4	TPS 3	Apply	Value	Mechanism	1.2, 2.1.5,2.2.3,2.5.1,3.2.3, 4.5.3
CO5	TPS 3	Apply	Value	Mechanism	1.2, 2.1.5,2.2.3,2.5.1,3.2.3, 4.5.3
CO6	TPS 3	Apply	Value	Mechanism	1.2, 2.1.5,2.2.3,2.5.1,3.2.3, 4.5.3

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO 1	S	M	L	L	-	L	-	L			L	L	M	L	L

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

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

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

Assessment Pattern: Psychomotor

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

Sample Questions for Course Outcome Assessment**

** (2 to 3 at the cognitive level of course outcome)

Course Outcome 1(CO1):

1. There are three towers and sixty four disks of different diameters placed on the first tower. The disks are in order of decreasing diameter as one scans up the tower. Monks were reputedly supposed to move the disks from tower 1 to tower 3 obeying the rules: (i) only one disk can be moved at any time; (ii) no disk can be placed on top of a disk with smaller diameter. Write a recursive procedure which prints the sequence of moves which accomplish this task.
2. Is $f(n) = \Theta(n^2)$, where f(n) is defined to be the running time of the program A(n):

```
def A(n): a tuple = tuple(range(0, n))    # a tuple is an immutable version of a
                                          # list, so we can hash it
S = set()
   for i in range(0, n):
```

```
        for j in range(i+1, n):
            S.add(atuple[i:j])              # add tuple (i,...,j-1) to set S.
```

Justify your answer.

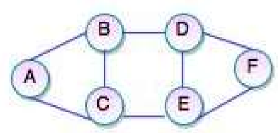
3. Given an array A which stores 0 and 1, such that each entry containing 0 appears before all those entries containing 1. In other words, it is like {0, 0, 0,..., 0, 0, 1, 1,..., 111}. Design an algorithm to find out the small index i in the array A such that A[i] = 1 using c log n instructions in the worst case for some positive constant c.

Course Outcome 2(CO2):

1. Two stacks are to be represented in an array V(1:m) .Write algorithms ADD(i.X) and DELETE(i) to add X and delete an element from stack i, $1 \leq i \leq 2.$. Your algorithms should be able to add elements to the stacks so long as there are fewer than m elements in both stacks together.
2. Explain how to implement doubly linked lists using only one pointer value x:np per item instead of the usual two (next and prev). Assume that all pointer values can be interpreted as k-bit integers, and define x:np to be x:np D x:next XOR x:prev, the k-bit "exclusive-or" of x:next and x:prev. (The value NIL is represented by 0.) Be sure to describe what information you need to access the head of the list. Show how to implement the SEARCH, INSERT, and DELETE operations on such a list. Also show how to reverse such a list in O(1) time.
3. Write an algorithm to transform from prefix to postfix. Carefully state any assumptions you make regarding the input. How much time and space does your algorithm take?

Course Outcome 3(CO3):

1. Write an algorithm which inserts a new node T as the left child of node S in a threaded binary tree. The left pointer of S becomes the left pointer of T.
2. Show how the graph below would look if represented by its adjacency matrix, adjacency lists,adjacency multilist.



3. Write algorithm to insert key values into AVL trees, B-trees of order 3, B*-trees of order 3 and B'-trees of order 3. Evaluate the relative performance of these four representations of internal tables.

Course Outcome 4 (CO4):

1. Consider linear search - How many elements of the input sequence need to be checked on the average, assuming that the element being searched for is equally likely to be any element in the array? How about in the worst case? What are the average-case and worst-case running times of linear search ? Justify your answers
2. Consider the searching problem: given an array A[1…n] and a value v output an Index i such that v = A[i] or the special value ф if v does not appear in A. If the array J is sorted, we can perform a binary search: compare P with the midpoint of the array and repeat the search on one half of array, eliminating the other half from further consideration.
   (a) Construct a pseudocode for binary search as a recursive procedure.
   (b) Rewrite your binary search procedure in an iterative style.
3. Show that in an undirected graph, classifying an edge (u, v) as a tree edge or a back edge according to whether (u, v)or (v, u) is encountered first during the depth-first search is equivalent to classifying it according to the ordering of the four types in the classification scheme.

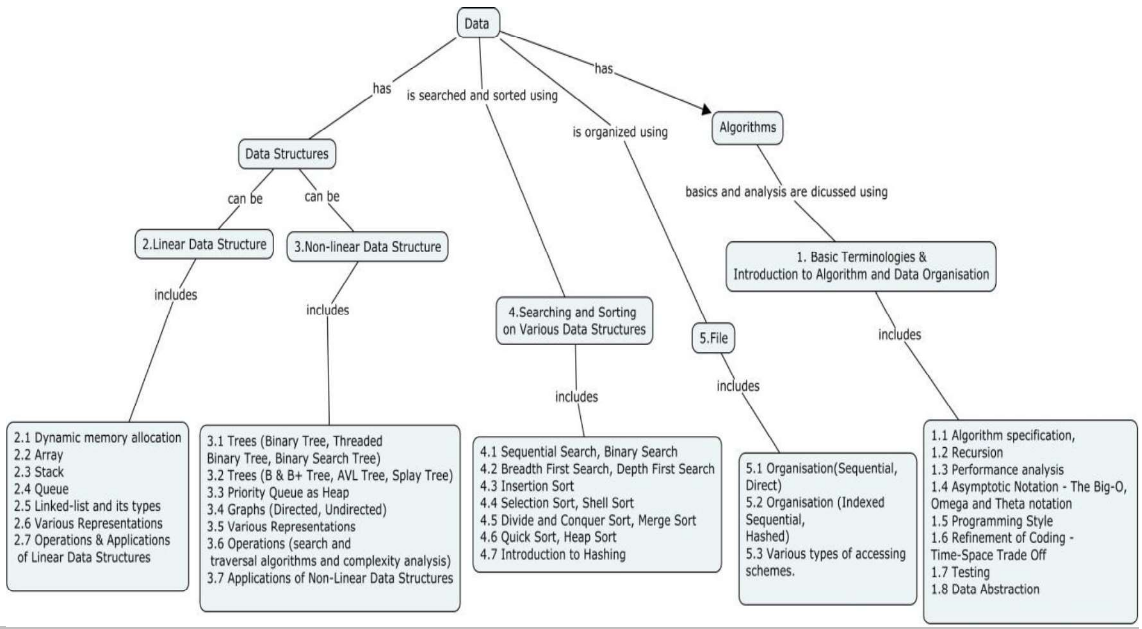
Course Outcome 5 (CO5):

1. Consider sorting n numbers stored in array A by first finding the smallest element of A and exchanging it with the element in AOE1_. Then find the second smallest element of A, and exchange it with AOE2_. Continue in this manner for the first n_1 elements of A. Write pseudocode for this algorithm, which is known as selection sort. What loop invariant does this algorithm maintain? Why does it need to run for only the first n _ 1 elements, rather than for all n elements? Give the best-case and worst-case running times of selection sort in ,-notation
2. Show that the running time of QUICKSORT is θ (n2) when the array A contains distinct elements and is sorted in decreasing order.
3. Consider implementing a hash table for an application in which we will build an initial hash table by inserting a substantial collection of records. After this, we expect that the number of insertions and the number of deletions performed to be roughly the same, although there may be long runs of consecutive insertions or consecutive deletions. Furthermore, the table will use a probe strategy to resolve any collisions that occur during insertion, and therefore we will "tombstone" cells from which a record has been deleted. If we implement the hash table described above, then when we search for a record, we cannot conclude the record is not in the table until we have found an empty cell in the table, not just a tombstone. (We will ensurethat the table never reaches the state that there are no empty cells.) Explain carefully why the search cannot stopwhen a tombstone is encountered

Course Outcome 6(CO6):

1. Write an algorithm to process a tape file in the batched mode. Assume the master file is ordered by increasing primary key value and that all such values are distinct. The transaction file contains transactions labeled: update, delete and insert. Each such transaction also contains the primary key value of the record to be updated, deleted or inserted. A new updated master file is to be created. What is the complexity of your algorithm?
2. Describe briefly how to do the following:
   (i) In a multilist organization: (a) output all records with KEY1 = PROG and KEY2 = NY. How many accesses are needed to carry this out? (b) Output all records with KEY1 = PROG or KEY2 = NY. How many accesses are needed for this. Assume that each access retrieves only one record.
   (ii) If a ring organization is used instead, what complications are introduced into (a) and (b) above?
3. A 105 record file is maintained as an inverted file on a disk with track capacity 5000 characters. This disk has 200 tracks on each of its 10 surfaces. Each record in the file is 50 characters long and has five key fields. Each key is binary (i.e., has only two distinct values) and so the index for each key can be maintained as a binary bit string of length 105 bits. If 1 character is 6 bits long, then each index takes about 4 tracks. How should the 5 indexes be stored on disk so as to minimize total seek time while processing the indexes in order to determine which records satisfy a given boolean query Q? This processing involves reading in 1 track of each index and testing the query against records represented by this track. Then the next set of index tracks is input and so on. How much time does it take to process all the indexes in order to determine which records are to be retrieved? Assume a seek time of 1/10 sec and a latency time of 1/40 sec. Also assume that only the input time is significant. If k records satisfy this query, how much more time is needed to retrieve these k records? Using other file structures it may be necessary to read in the whole file. What is the minimum time needed to read in the entire file of 105 records? How does this compare with the time needed to retrieve k records using an inverted file structure?

Concept Map



Syllabus

Basic Terminologies &Introduction to Algorithm and Data Organisation: Algorithm specification, Recursion, Performance analysis, Asymptotic Notation - The Big-O, Omega and Theta notation, Programming Style, Refinement of Coding - Time-Space Trade Off, Testing, Data Abstraction

Linear Data Structure: Dynamic memory allocation**,**Array, Stack, Queue, Linked-list and its types, Various Representations, Operations & Applications of Linear Data Structures

Non-linear Data Structure: Trees (Binary Tree, Threaded Binary Tree, Binary Search Tree, B & B+ Tree, AVL Tree, Splay Tree) , Priority queue as heap, Graphs (Directed, Undirected), Various Representations, Operations (search and traversal algorithms and complexity analysis) & Applications of Non-Linear Data Structures

Searching and Sorting on Various Data Structures: Sequential Search, Binary Search, Breadth First Search, Depth First Search, Insertion Sort, Selection Sort, Shell Sort, Divide and Conquer Sort, Merge Sort, Quick Sort, Heap Sort, Introduction to Hashing

File: Organisation (Sequential, Direct, Indexed Sequential, Hashed) and various types of accessing schemes.

Learning Resources

1. E. Horowitz and S. Sahni , Fundamentals of Data Structures , Computer Science Press, 1977.
2. AlfredV.Aho, John E.Hopperoft, Jeffrey D.UIlman, Data Structures and Algorithms,Pearson Education,2002.
3. Donald E. Knuth ,The Art of Computer Programming: Volume 1: Fundamental Algorithms, Donald E. Knuth,3rd edition,Pearson Education.
4. Charles E. Leiserson, Thomas H. Cormen, Ronald L. Rivest, Clifford Stein, Introduction to Algorithms, Third edition, PHI, 2010.
5. Pat Morin,Open Data Structures: An Introduction (Open Paths to Enriched Learning), 31st ed. Edition , AU Press,2013

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1.	**Basic Terminologies &Introduction to Algorithm and Data Organisation**		
1.1	Algorithm specification,	1	CO1
1.2	Recursion	1	CO1
1.3	Performance analysis	1	CO1
1.4	Asymptotic Notation - The Big-O, Omega and Theta notation	1	CO1
1.5	Programming Style	1	CO1
1.6	Refinement of Coding - Time-Space Trade Off	1	CO1
1.7	Testing	1	CO1
1.8	Data Abstraction	1	CO1
	Tutorial	3	
2	**Linear Data Structure**		
2.1	Dynamic Memory allocation	1	CO2
2.2	Array	1	CO2
2.3	Stack	1	CO2
2.4	Queue	1	CO2
2.5	Linked-list and its types	1	CO2
2.6	Various Representations	1	CO2
2.7	Operations & Applications of Linear Data Structures	1	CO2
	Tutorial	3	
3	**Non-linear Data Structure**		
3.1	Trees (Binary Tree, Threaded Binary Tree, Binary Search Tree)	2	CO3
3.2	Trees (B & B+ Tree, AVL Tree, Splay Tree)	2	CO3
3.3	Priority Queue as Heap	1	CO3
3.4	Graphs (Directed, Undirected)	1	CO3
3.4	Various Representations	1	CO3
3.6	Operations (search and traversal algorithms and complexity analysis)	1	CO3
3.7	Applications of Non-Linear Data Structures	1	CO3
	Tutorial	3	
4	**Searching and Sorting on Various Data Structures**		
4.1	Sequential Search, Binary Search	1	CO4
4.2	Breadth First Search, Depth First Search	1	CO4
4.3	Insertion Sort	1	CO4
4.4	Selection Sort, Shell Sort	1	CO5
4.5	Divide and Conquer Sort, Merge Sort	1	CO5
4.6	Quick Sort, Heap Sort	1	CO5
4.7	Introduction to Hashing	1	CO5
	Tutorial	3	
5	**File**		
5.1	Organisation(Sequential,Direct)	1	CO6
5.2	Organisation (Indexed Sequential, Hashed)	2	CO6
5.3	Various types of accessing schemes.	2	CO6
	Total Hours	48	

Course Designers:

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20CB240	PRINCIPLES OF ELECTRONICS	Category	L	T	P	Credit
		ES	2	0	0	2

Preamble

This course seeks to cover the basics of semiconductor devices including the physics of energy bands, doping and carrier statistics and transport leading up to the understanding of common semiconductor devices including p-n junctions and their applications, BJTs , FETs and MOSFETs. Having learnt the fundamental operating principals of active devices, feedback concept is also introduced to understand the working of amplifiers. The course will also give a flavour of the basics of integrated circuits and to digital electronic fundamentals. The course will ensure that undergraduates, with no background in semiconductors are able to grasp the content. The aim of the course is to develop physics and engineering strategies of semiconductor devices and to discuss their functionalities in modern electronic devices.

Prerequisite

High school physics & math, 10+2 physics

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Summarize the important concepts related to semiconductor Technology	10
CO2	Design and characterization of Diode, BJT and FET devices using specifications from the datasheet.	25
CO3	Categorize the feedback mechanisms	10
CO4	Design op-amp based circuits	20
CO5	Summarize the significance of Digital Systems, how they differ from analog systems and their applications.	10
CO6	Apply the principles of Boolean algebra to manipulate and minimize logic expressions to design simple combinational logic circuits using basic gates.	25

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	-	1.2.3, 2.4.6
CO2	TPS3	Apply	Value	-	1.2.2, 2.1.1, 2.1.2, 2.1.3, 2.5.1
CO3	TPS2	Understand	Respond	-	1.2.3, 2.4.6
CO4	TPS3	Apply	Value	-	1.2.2, 2.1.1, 2.1.2, 2.5.1
CO5	TPS2	Understand	Respond	-	1.2.3, 2.4.6
CO6	TPS3	Apply	Value	-	1.2.2, 2.1.1, 2.1.2, 2.5.1

Mapping with Programme Outcomes and Programme Specific Outcomes

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

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

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Assignment			Terminal Examination
	1	**2**	**3**	1	2	3	
Remember	-	-	-	-	-	-	-
Understand	40	40	40	50	-	-	20
Apply	60	60	60	50	100	100	80
Analyse	-	0	0	0	0	0	-
Evaluate	0	0	0	0	0	0	0
Create	0	0	0	0	0	0	0

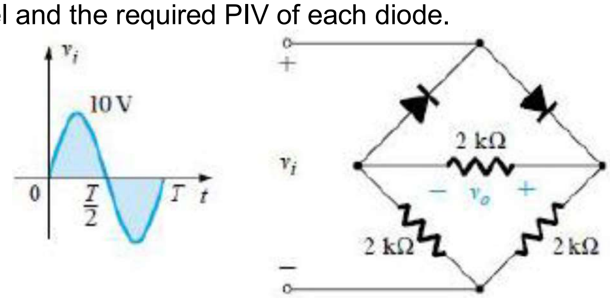
Sample Questions for Course Outcome Assessment**

Course Outcome 1(CO1):

1. Differentiate between intrinsic and extrinsic semiconductors with examples.
2. Calculate the drift velocity of the free electrons in a conductor of area 10-4m2,given the electron density to be 8x1028/m3when a current of 5A flows through it.

Course Outcome 2(CO2):

1. Explain the input and output characteristics of BJT in CE configuration
2. Determine the output waveform for the network of Figure and calculate the output dc level and the required PIV of each diode.



Course Outcome 3 (CO3):

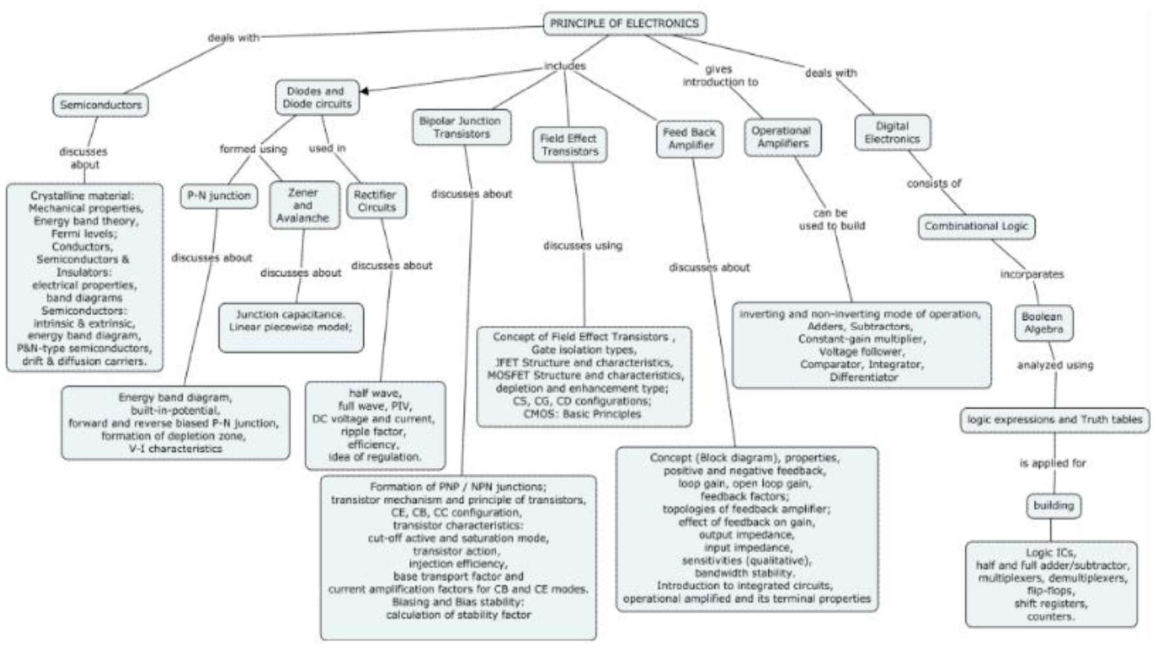
1. Draw the block diagram of feedback amplifier.
2. Determine the voltage gain, input, and output impedance with feedback for voltage series feedback having *A*=-100, *Ri* = 10 kΩ, *Ro* = 20 kΩ for feedback of (a) β=-0.1 and (b) β=-0.5

Course Outcome 4 (CO4):
1. Calculate the maximum frequency for an op-amp with sine wave output voltage of 10 V peak and slew rate is 2 V/μs.
2. Construct an inverting amplifier with gain of 10 and a non-inverting amplifier with gain of 100 using op-amp

Course Outcome 5(CO5):
1. Discuss the advantages of processing information in digital form.
2. Describe the software aspects of Digital design.

Course Outcome 6(CO6):
1. Simplify the given logic expression using Demorgan's theorem=(A+B+(AB)'+CD)'
2. Prove the commutative and distributive laws in Boolean algebra.

Concept Map



Syllabus

Semiconductors: Crystalline material: Mechanical properties, Energy band theory, Fermi levels; Conductors, Semiconductors & Insulators: electrical properties, band diagrams. Semiconductors: intrinsic & extrinsic, energy band diagram, P&N-type semiconductors, drift & diffusion carriers.
Diodes and Diode Circuits: Formation of P-N junction, energy band diagram, built-in-potential, forward and reverse biased P-N junction, formation of depletion zone, V-I characteristics, Zener breakdown, Avalanche breakdown and its reverse characteristics; Junction capacitance. Linear piecewise model; Rectifier circuits: half wave, full wave, PIV, DC voltage and current, ripple factor, efficiency, idea of regulation.
Bipolar Junction Transistors: Formation of PNP / NPN junctions; transistor mechanism and principle of transistors, CE, CB, CC configuration, transistor characteristics: cut-off active and saturation mode, transistor action, injection efficiency, base transport factor and

current amplification factors for CB and CE modes. Biasing and Bias stability: calculation of stability factor

Field Effect Transistors: Concept of Field Effect Transistors (channel width modulation), Gate isolation types, JFET Structure and characteristics, MOSFET Structure and characteristics, depletion and enhancement type; CS, CG, CD configurations; CMOS: Basic Principles

Feed Back Amplifier, and Operational Amplifiers: Concept (Block diagram), properties, positive and negative feedback, loop gain, open loop gain, feedback factors; topologies of feedback amplifier; effect of feedback on gain, output impedance, input impedance, sensitivities (qualitative), bandwidth stability. Introduction to integrated circuits, operational amplified and its terminal properties; Application of operational amplifier; inverting and non-inverting mode of operation, Adders, Subtractors, Constant-gain multiplier, Voltage follower, Comparator, Integrator, Differentiator

Digital Electronics Fundamentals: Difference between analog and digital signals, Boolean algebra, Basic and Universal Gates, Symbols, Truth tables, logic expressions, Logic simplification using K- map, Logic ICs, half and full adder/subtractor, multiplexers, demultiplexers, flip-flops, shift registers, counters.

Learning Resources

1. Adel S. Sedra and Kenneth C. Smith, "Microelectronic Circuits: Theory and Application", 7th Edition, Oxford University Press, 2017.
2. Jacob millman, christos halkias chetan parikh,"Millman's Integrated Electronics "McGraw Hill education (India) private limited,2009
3. M. Morris Mano," *Digital Logic & Computer Design"* Pearson India Educational Services PvT. Limited, 2016
4. Robert L. Boylestad, Louis Nashelsky, *"Electronic Devices and Circuit Theory"*, Pearson India Educational Services PvT. Limited,2015
5. Ben Streetman, Sanjay Banerjee," *Solid State Electronic Devices"*,6th Edition, Prentice Hall of India 2005
6. NPTEL online Course on "Fundamentals of Semiconductor devices", Course Link: https://onlinecourses.nptel.ac.in/noc19_ee04/
7. https://www.electronics-tutorials.ws/
8. https://circuitverse.org/

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1.	**Semiconductors:** Crystalline material: Mechanical properties, Energy band theory	1	CO1
1.1	Fermi levels; Conductors, Semiconductors & Insulators: electrical properties, band diagrams	1	CO1
1.2	Intrinsic & extrinsic, P&N-type semiconductors	1	CO1
1.3	Drift & diffusion carriers	1	CO1
2	**Diodes and Diode Circuits:** Formation of P-N junction, built-in-potential, forward and reverse biased P-N junction, formation of depletion zone, V-I characteristics	1	CO2
2.1	Zener breakdown, Avalanche breakdown and its reverse characteristics; Junction capacitance. Linear piecewise model;	1	CO2
2.2	Rectifier circuits: half wave, full wave, PIV, DC voltage and current, ripple factor, efficiency, idea of regulation.	2	CO2
3	**Bipolar Junction Transistors:** Formation of PNP / NPN junctions; transistor mechanism and principle of	1	CO2

	transistors,		
3.1	CE, CB, CC configuration, transistor characteristics: cut-off active and saturation mode, transistor action	1	CO2
3.2	Injection efficiency, base transport factor and current amplification factors for CB and CE modes.	1	CO2
3.3	Need for Biasing	1	CO2
4	**Field Effect Transistors:** Concept of Field Effect Transistors (channel width modulation), Gate isolation; CS, CG, CD configurations;	1	CO2
4.1	Types, JFET Structure and characteristics,	1	CO2
4.2	MOSFET Structure and characteristics, depletion and enhancement type	1	CO2
4.3	CMOS: Basic Principles	1	CO2
5	**Feed Back Amplifier, and Operational Amplifiers:** Concept (Block diagram), properties, positive and negative feedback, loop gain, open loop gain, feedback factors	1	CO3
5.1	Topologies of feedback amplifier; effect of feedback on gain, output impedance, input impedance, sensitivities (qualitative), bandwidth stability.	2	CO3
5.2	Introduction to integrated circuits, operational amplified and its terminal properties; Application of operational amplifier; inverting and non-inverting mode of operation, Adders, Subtractors, Constant-gain multiplier	1	CO4
5.3	Voltage follower, Comparator, Integrator, Differentiator	1	CO4
6	**Digital Electronics Fundamentals:** Difference between analog and digital signals, Boolean algebra, Basic and Universal Gates, Symbols	1	CO5
6.1	Truth tables, logic expressions, Logic simplification using K- map	2	CO6
6.2	Logic ICs, half and full adder/ subtractor	1	CO6
6.3	Concept of Multiplexers, flip-flops, shift registers, counters.	2	CO6

Course Designers:

1. Dr.S.Kanthamani skmece@tce.edu

20CB250	FUNDAMENTALS OF ECONOMICS	Category	L	T	P	Credit
		HSS	2	0	0	2

Preamble

The objective of this course is to provide the basic knowledge on micro and macroeconomics to analyse the market structure and demand-supply in real time economy. Further it imparts the knowledge of economic decision making by exploring the performance and behaviour of an economy.

Prerequisite

Nil

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Explain the basic principles and concepts of microeconomics for economic decision making.	8
CO2	Select the appropriate microeconomic demand-supply concepts to solve the business problems.	8
CO3	Develop a strategy that measure, critique and interpret consumer's behavior in decision making.	21
CO4	Make use of the different production and cost functions to derive product decision.	17
CO5	Analyze with the macroeconomics components and Keynesian Multiplier to solve the real time economy problems.	21
CO6	Examine the banking and central bank's monetary policy concepts in economic development of a nation.	25

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	-	1.1.1,2.1.3
CO2	TPS3	Apply	Value	-	1.1.1,2.1.3,2.1.4
CO3	TPS3	Apply	Value	-	2.1.3,2.1.4,2.1.5
CO4	TPS3	Apply	Value	-	2.2.4
CO5	TPS4	Analyse	Organise	-	2.5.4,4.3.4
CO6	TPS3	Apply	Value	-	2.5.4,3.1.5,3.2.5

Mapping with Programme Outcomes and Programme Specific Outcomes

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

CO 5	S	S	M	L	L			M	M	M	L	L	M	M	L
CO 6	S	M	L					M	L			L	M	L	L

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Assignment			Terminal Examination
	1	**2**	**3**	1	2	3	
Remember	20	20	20	-	-	-	20
Understand	30	20	20	-	-	-	20
Apply	50	60	60	100	60	60	60
Analyse	0	0	0	0	40	40	0
Evaluate	0	0	0	0	0	0	0
Create	0	0	0	0	0	0	0

Assessment Pattern: Psychomotor

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

Sample Questions for Course Outcome Assessment**

Course Outcome 1(CO1):

1. State the uses of the study of microeconomics.
2. Differentiate between a firm and industry.
3. Explain various types of price elasticity of demand with the help of diagrams.

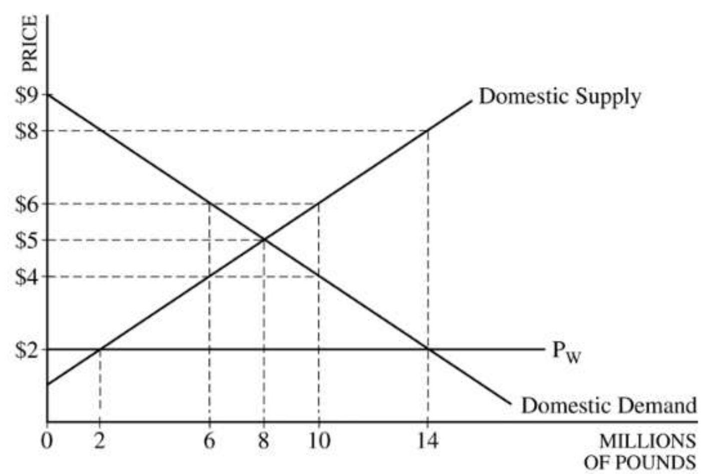
Course Outcome 2(CO2):

1. Suppose research shows that the more college education individuals receive, the more responsible citizens they become and the less likely they are to commit crimes.
   (a) Draw a correctly labeled graph for the college education market and show each of the following.
   (i) Private market equilibrium quantity and price of college education, labeled Qm and Pm, respectively
   (ii) Socially optimal quantity of education, labeled Qs
   (iii) Deadweight loss at the market equilibrium, completely shaded
   (b) Assume that the government imposes an effective (binding) price ceiling on the price of college education.
   (i) Show the price ceiling on your graph in part (a), labelling the price ceiling Pc.
   (ii) Does this price ceiling increase, decrease, or have no impact on the deadweight loss in this industry?
2. Assume that the market for avocados is perfectly competitive. The typical firm is earning positive economic profit in the short-run equilibrium. (a) Draw a correctly labeled graph for the typical firm, illustrating the short-run equilibrium and labeling the equilibrium market price and output PE and QE, respectively. (b) Assume there is an increase in the market

wage rate for labor, a variable input. Show on your graph in part (a) the effect of the wage increase on the marginal cost curve in the short run. (c) Assume that avocado producers hire workers from a perfectly competitive labor market. Draw a graph of labor supply and demand for the typical firm and label the supply curve MFC and the demand curve MRP. Assume the market wage rate increases from w1 to w2. Show the effect of the wage increase on the graph, labeling the initial quantity of labor hired QL1 and the new quantity of labor hired QL2.

Course Outcome 3(CO3):

1. Assume that the market for good X is perfectly competitive and that the production of good X creates a negative externality. (a) Draw a correctly labelled graph of the market for good X and show each of the following. (i) The marginal private cost and marginal social cost of good X, labeled MPC and MSC, respectively (ii) The market quantity, labeled Qm (iii) The allocatively efficient quantity, labeled Qs (iv) The area of deadweight loss, shaded completely (b) Assume that a lump-sum tax is imposed on the producers of good X. What happens to the deadweight loss? Explain.
2. Sugar is freely traded in the world market. Assume that a country, Loriland, is a price taker in the world market for sugar. Some of the sugar consumed in Loriland is produced domestically while the rest is imported. The world price of sugar is $2 per pound. The graph below shows Loriland's sugar market, and PW represents the world price



(a) At the world price of $2 per pound, how much sugar is Loriland importing?
(b) Suppose that Loriland imposes a per-unit tariff on sugar imports and the new domestic price including the tariff is $4. (i) Identify the new level of domestic production. (ii) Calculate the domestic consumer surplus for Loriland. (iii) Calculate the total tariff revenue collected by the government. (c) Given the world price of $2, what per-unit tariff maximizes the sum of Loriland's domestic consumer surplus and producer surplus?

Course Outcome 4 (CO4):

1. The table below shows the output a firm produces using different amounts of capital (K) and labor (L). The markets for capital and labor are perfectly competitive. The rental rate of capital is $75 per unit, and the wage rate is $200 per unit. In the short run, capital is fixed and labor is variable.

Labor	Output with K=1	Output with K=2
0	0	0
1	10	20
2	25	50
3	38	75

(a) If the firm uses one unit of capital and one unit of labor, will it be operating with constant, increasing, or decreasing returns to scale? Explain using numbers from the table.
(b) Assume, the firm currently has two units of capital and is using three units of labor.

(i) Calculate the marginal product for the third unit of labor.
(ii) Did the firm experience diminishing marginal returns with the addition of the third unit of labor? Explain using numbers from the table.
(iii) Calculate the firm's average total cost for its current level of production.
(iv) If the firm's output is sold in a competitive market, what is the lowest output price at which the third unit of labor would be hired?

2. Camden's Cakery is one of many dessert cafés serving a local community. Each café produces a slightly differentiated product, there are no barriers to entry or exit, and the firm is in long-run equilibrium.
(a) Draw a correctly labeled graph showing Camden's demand curve, marginal revenue curve, marginal cost curve, and long-run average total cost curve. Label Camden's profit-maximizing output Qm and its price Pm.
(b) On your graph in part (a), label the output at which total revenue is maximized QR.
(c) Do firms in this market experience economies of scale, diseconomies of scale, or neither in long-run equilibrium? Explain.

Course Outcome 5 (CO5):

1. Assume a simplified economy where the quantity theory of money holds, with a constant velocity of money circulation *V*, and where all inflation is fully anticipated. Also, this economy does not trade with the rest of the world, and experiences the annual production function $Y=K^{\alpha}L^{1-\alpha}$, where *L* is the total number of worker-hours and *K* is the accumulated capital stock. Assume that all product markets are perfectly competitive and clear instantaneously, that the population is fixed at size *N*, that all individuals work an equal number of hours per year *H*, and that all workers are equally productive. Assume also that the capital stock is fixed for each year, and that there is no depreciation. Finally, assume there is no indirect taxation.
(a) What will the relationship be between gross domestic product (GDP), gross national product (GNP) and national income (NI) for this economy?
(b) By dividing national income *Y* into private consumption spending *C*, government consumption spending *G* and private investment spending *I*, explain how the following macroeconomic variables will be determined in this model. (Assume a constant private savings rate, *s*, and tax burden, *T,* and let the nominal money supply be *M*):
(i) Real GDP (annual)
(ii) Real GDP per capita (annual)
(iii) Real hourly and annual wages.
(iv) Nominal GDP (annual)
(v) Nominal GDP per capita (annual)
(vi) Nominal hourly and annual wages
(vii) Private saving (annual in real terms)
(viii) Private consumption (annual in real terms)

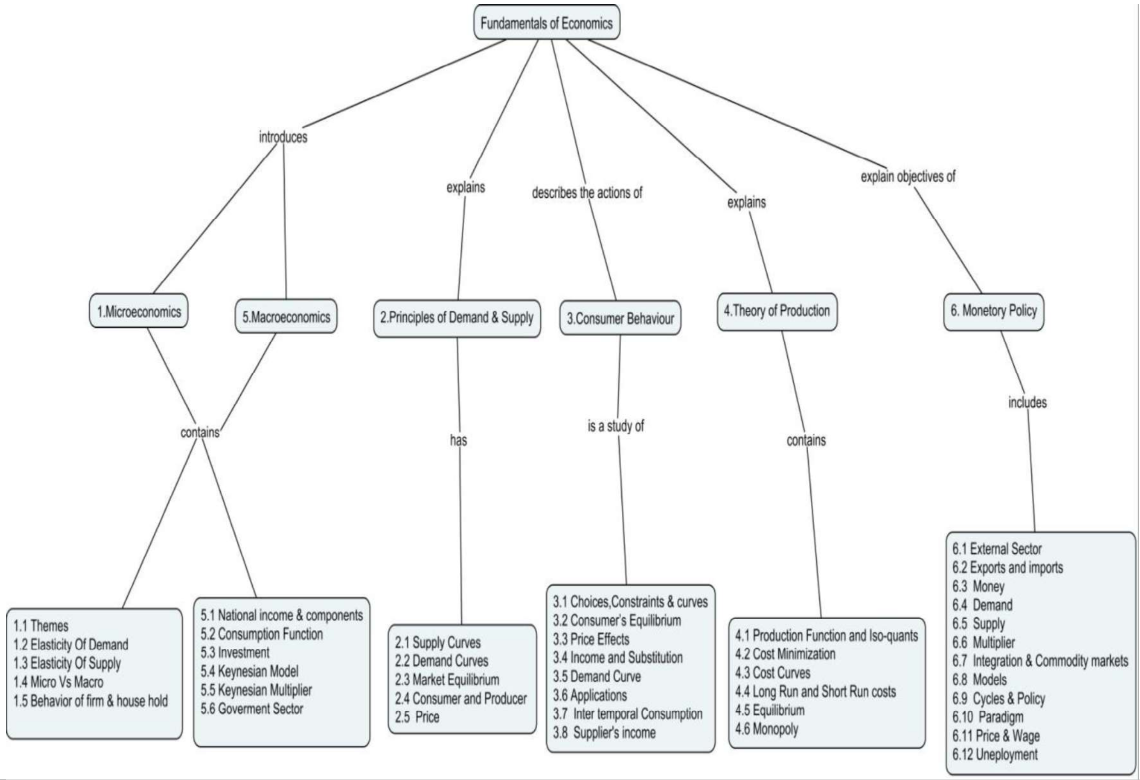
(ix) Private investment (annual in real terms)
(x) The real interest rate.

2. Analyse a Keynesian multiplier model for the short run level of aggregate demand in the closed economy which includes a proportional income tax rate *t*, a private saving rate *s*, exogenous government spending *G0*, autonomous consumption *C0* and autonomous investment *I0*. With reference to the role of the Keynesian multiplier and the circular flow model, explain the effect on (i) the equilibrium level of demand, (ii) equilibrium consumption, (iii) the equilibrium government budget deficit and (iv) equilibrium net private savings of the following:
   (a) An increase in *G0*.
   (b) An increase in *C0*.
   (c) An increase in *I0*.
   (d) An increase in *s*.
   (e) An increase in *t*.
   (f) An increase in government spending, where tax intake is raised simultaneously, so as to maintain a balanced budget.

Course Outcome 6(CO6):

1. Use the closed economy IS-LM framework to analyse the impact of each of the following policies on (i) Income/output, (ii) The real interest rate, (iii) Investment, (iv) The government budget deficit.
   Pay particular attention to the role of the slope of the IS and LM curves:
   (a) An increase in government expenditure.
   (b) An increase in the proportional income tax rate.
   (c) An increase in the saving rate.
   (d) An increase in the nominal money supply.
2. Apply the Baumol-Tobin theory of money management to derive the impact of the following on an individual's demand for nominal money balances:
   (a) An increase in the nominal interest rate offered on corporate and government bonds.
   (b) An increase in the riskiness of bonds.
   (c) An increase in real income.
   (d) An increase in the price level.
   (e) A rise in the expected rate of inflation.
   (f) Introduction of charges for withdrawals at cash machines.

Concept Map



Syllabus

Introduction to Microeconomics: The themes of microeconomics, Elasticity of Supply, Elasticity of Demand, Microeconomics versus Macroeconomics, Behavior of firm and House hold.

Principles of Demand and Supply: Supply Curves of Firms — Demand Curves of Households; Equilibrium and Comparative Statics (Shift of a Curve and Movement along the Curve); Welfare Analysis — Consumers' and Producers' Surplus — Price Ceilings and Price Floors.

Consumer Behaviour: Axioms of Choice — Budget Constraints and Indifference Curves; Consumer's Equilibrium — Effects of a Price Change, Income and Substitution Effects — Derivation of a Demand Curve; Applications — Tax and Subsidies — Intertemporal Consumption — Suppliers' Income Effect.

Theory of Production: Production Function and Iso-quants — Cost Minimization; Cost Curves — Total, Average and Marginal Costs — Long Run and Short Run Costs; Equilibrium of a Firm Under Perfect Competition; Monopoly and Monopolistic Competition.

Introduction to Macroeconomics: National Income and its Components — GNP, NNP, GDP, NDP; Consumption Function; Investment; Simple Keynesian Model of Income Determination and the Keynesian Multiplier; Government Sector — Taxes and Subsidies.

Monetary Policy: External Sector — Exports and Imports; Money — Definitions; Demand for Money —Transactionary and Speculative Demand; Supply of Money — Bank's Credit Creation Multiplier; Integrating Money and Commodity Markets — IS, LM Model; Business Cycles and Stabilization — Monetary and Fiscal Policy — Central Bank and the

Government; The Classical Paradigm — Price and Wage Rigidities — Voluntary and Involuntary Unemployment.

Learning Resources

1. Pindyck, Robert S., and Daniel L. Rubinfeld, "Microeconomics", 8th Edition, The Pearson Education, Inc., 2013.
2. Dornbusch, Fischer and Startz, "Macroeconomics", 13th Edition, McGraw Hill, 2018.
3. Paul Anthony Samuelson, William D. Nordhaus, "Economics", 19th Edition, McGraw Hill International Edition, 2009.
4. https://data.oecd.org/economy.htm
5. https://www.focus-economics.com
6. https://www.rbi.org.in

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1.	**Introduction to Microeconomics**		
1.1	The themes of microeconomics		CO1
1.2	Elasticity of Supply		CO1
1.3	Elasticity of Demand	1	CO1
1.4	Microeconomics versus Macroeconomics		CO1
1.5	Behaviour of firm and House hold	1	CO1
2.	**Principles of Demand and Supply**		
2.1	Supply Curves of Firms		CO2
2.2	Demand Curves of Households	1	CO2
2.3	Market Equilibrium & Comparative Statics		CO2
2.4	Consumers' and Producers' Surplus	1	CO2
2.5	Price Ceilings and Price Floors		CO2
3.	**Consumer Behaviour**		
3.1	Axioms of Choice, Budget Constraints and Indifference Curves	1	CO3
3.2	Consumer's Equilibrium	1	CO3
3.3	Effects of a Price Change		CO3
3.4	Income and Substitution Effects	1	CO3
3.5	Derivation of a Demand Curve		CO3
3.6	Applications: Tax and Subsidies		CO3
3.7	Inter temporal Consumption	1	CO3
3.8	Suppliers' Income Effect	1	CO3
4.	**Theory of Production**		
4.1	Production Function and Iso-quants	1	CO4
4.2	Cost Minimization		CO4
4.3	Cost Curves: Total, Average and Marginal Costs	1	CO4
4.4	Long Run and Short Run Costs	1	CO4
4.5	Equilibrium of a Firm Under Perfect Competition	1	CO4
4.6	Monopoly and Monopolistic Competition		CO4
5.	**Introduction to Macroeconomics**		
5.1	National Income and its Components	1	CO5
5.1.1	GNP, NNP, GDP, NDP		CO5
5.2	Consumption Function	1	CO5
5.3	Investment		CO5
5.4	Simple Keynesian Model of Income	1	CO5

	Determination		
5.5	Keynesian Multiplier	1	CO5
5.6	Government Sector	1	CO5
5.6.1	Taxes and Subsidies		CO5
6.	**Monetary Policy**		
6.1	External Sector	1	CO6
6.2	Exports and Imports		CO6
6.3	Money — Definitions, Demand for Money	1	CO6
6.4	Transactionary and Speculative Demand	1	CO6
6.5	Supply of Money		CO6
6.6	Bank's Credit Creation Multiplier		CO6
6.7	Integrating Money and Commodity Markets	1	CO6
6.8	IS, LM Model		CO6
6.9	Business Cycles and Stabilization, Monetary and Fiscal Policy	1	CO6
6.10	Central Bank and the Government; The Classical Paradigm		CO6
6.11	Price and Wage Rigidities	1	CO6
6.12	Voluntary and Involuntary Unemployment		CO6
	Total Hours	**24**	

Course Designers:

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2. M. Manikandakumar mmrit@tce.edu

20CB260	BUSINESS COMMUNICATION & VALUE SCIENCE – II

Category	L	T	P	Credit
Project	2	-	-	2

Preamble

This course aims at developing effective reading, writing, presentation and group discussion skills and helps students identify personality traits and evolve as a better team player besides introducing them to key concepts of morality, behaviour and beliefs, and diversity and inclusion.

Prerequisite

Basic Knowledge of English and completion of 20CB150

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Understand the basic tools of Reading, Writing and Presentation skills	15
CO2	Use the skills of reading, writing and presentation skills effectively	25
CO3	Comprehend and review the concepts of morality, diversity and inclusion	15
CO4	Identify the personality traits and team work	15
CO5	Organize and document the concepts and theory dedicated to a social cause.	20
CO6	Create an E-Magazine (Morality, diversity and inclusion)	10

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	Guided Response	1.2, 2.5, 3.1,3.2,3.3.1 3.2.1, 3.2.3,3.2.6,4.2
CO2	TPS3	Apply	Value	Guided Response	1.2, 2.5, 3.1,3.2,3.3.1 3.2.1, 3.2.3,3.2.6,4.2
CO3	TPS2	Understand	Respond	Perception	1.2, 2.5, 3.1,3.2,3.3.1 3.2.1, 3.2.3,3.2.6,4.2
CO4	TPS2	Understand	Respond	Perception	1.2, 2.5, 3.1,3.2,3.3.1 3.2.1, 3.2.3,3.2.6,4.2
CO5	TPS3	Apply	Value	Guided Response	1.2, 2.5, 3.1,3.2,3.3.1 3.2.1, 3.2.3,3.2.6,4.2
CO6	TPS6	Create	Characterize	Origination	4.4.1, 4.4.3, 4.4.6, 4.5

Mapping with Programme Outcomes and Programme Specific Outcomes

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

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

INTERNALS

No CAT will be conducted.

SUMMATIVE- Activity Based Evaluation (No External Examination)

Evaluation is done in classroom activities as given below

Reading and Writing	CO1	UNDERSTAND	20
Presentation	CO2	APPLY	10
E-magazine	CO6	CREATE	10
Review on movie	CO3	UNDERSTAND	5
Group Discussion/enacting a play	CO4	APPLY	5

Resume Submission CO1		10
Interview – Immersion CO5		20
Presentation CO2		20
	Total	100

Assessment Pattern: Psychomotor

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

Sample Questions for Course Outcome Assessment**

** (2 to 3 at the cognitive level of course outcome)

Course Outcome 1(CO1): (20 marks + 10 marks)

1. Read the following passage and comprehend it. (10 marks)

2. Resume Writing / Blog Writing / Story writing. (5 marks)
3. **A**) **Spot the error**. **(2 marks)**
   If you lend him book (A) he will lend it to someone else (B) and never you get it back (C) No error (D)
   B) **Punctuate the following. (3 marks)**
   i remember the maps of the holy land coloured they were very pretty the dead sea was pale and blue the very look of it made me thirsty

Course Outcome 2(CO2): (10 marks + 20 marks)

Individual presentation on any one of the topics given:

1. Social media in the classroom
2. Lack of practical knowledge in the education system
3. The history behind the currency

Course Outcome 3(CO3): (5 marks)

Write a review on an English movie that you watched recently (Or) Write a review on your favourite story book.

Course Outcome 4 (CO4): (5 marks)

Group Discussion

1. Digital India: Whom does it Benefit?
2. Future of Crypto currencies.
3. Which is more important creativity or efficiency?

(Or)

Skit

Select any one the topic and enact a play

1. Child right to Education
2. Unemployment
3. Women Empowerment

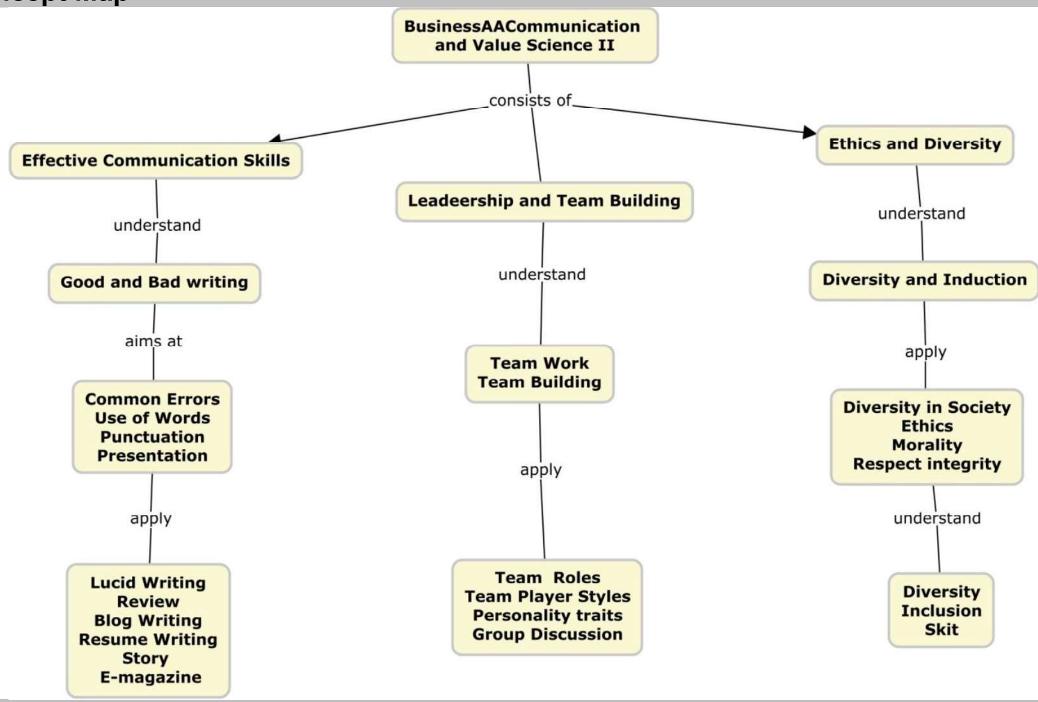
Course Outcome 5 (CO5): (20 Marks)

Interview and Immersion

Course Outcome 6 (CO6): (10 marks)

Create an **E-Magazine** based on the concepts of morality, diversity and inclusion

Concept Map



Syllabus

Effective Communication Skills: Good and Bad Writing – Common Errors, Punctuation rules, Use of Words, Lucid Writing, Speed Reading, Skimming, Scanning, Presentation Techniques, Book/Film/Incident Review, Blog Writing, Resume Writing, Story Writing, E Magazine

Leadership and Team Building: Team Work, Team Building, Introduction to Dr. Meredith Belbin and his 8 Team Roles and Team Player Styles, Lindgren's Big 5 Personality Traits, Myer Brigg's Questionnaire, Team Falcon Practical to identify individual personality traits, Group Discussion.

Ethics and Diversity: Diversity and Inclusion, Different types of Diversity in Society, Ethics, Morality and respect for individuals, Case study discussion be used to learn Values, Respect for individual and integrity, understanding Diversity inclusion, Skit,

Learning Resources

Text Books: There are no prescribed texts for Semester 2 – there will be handouts and reference links shared	
Reference Books:	
1	Guiding Souls : Dialogues on the purpose of life; Dr. A.P.J Abdul Kalam ;Publishing Year-2005; Co-author—ArunTiwari
2	The Family and the Nation; Dr. A.P.J Abdul Kalam; Publishing year: 2015; Co-author: AcharyaMahapragya
3	The Scientific India: A twenty First Century Guide to the World around Us; Dr. A.P.J Abdul Kalam; Publishing year: 2011; Co-author- Y.S.Rajan
4	Forge Your Future: Candid, Forthright, Inspiring ; Dr. A.P.J Abdul Kalam; Publishing year: 2014

5	Abundance: The Future is Better Than You Think; Peter H. Diamandis and Steven Kotler; Published: 21 Feb, 2012; Publisher: Free Press
6	Start With Why: How Great Leaders Inspire Everyone to Take Action; Simon Sinek; Published: 6 October 2011; Publisher: Penguin
7	Advertising & IMC: Principles and Practice; Sandra Moriarty, Nancy D. Mitchell, William D. Wells; Published: 15 June 2016; Publisher: Pearson Education India
Web References:	
1	ETHICS FUNDAMENTALS AND APPROACHES TO ETHICS https://www.eolss.net/Sample-Chapters/C14/E1-37-01-00.pdf
2	A Framework for Making Ethical Decisions https://www.brown.edu/academics/science-and-technology-studies/framework-making-ethical-decisions
3	Five Basic Approaches to Ethical Decision- http://faculty.winthrop.edu/meelerd/docs/rolos/5_Ethical_Approaches.pdf
Online Resources:	
1	https://youtu.be/CsaTslhSDI
2	https://m.youtube.com/watch?feature=youtu.be&v=IIKvV8_T95M
3	https://m.youtube.com/watch?feature=youtu.be&v=e80BbX05D7Y How To Begin Your Presentation with Simon Sinek
4	https://m.youtube.com/watch?v=dT_D68RJ5T8&feature=youtu.be POWER Writing - Write ANYTHING in English Easily
5	https://m.youtube.com/watch?v=7sLLEdBgYYY&feature=youtu.be

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1.1	Introduction, Identification of a social issue for presentation	1	CO2
1.2	Presentation of the social issue in groups	2	CO2
1.3	Good and Bad writing - common errors and punctuation rules	1	CO1
1.4	Elevator pitch	1	CO1
1.5	Discussion on Writing techniques by Catherine Morris & Joanie Mcmahon	2	CO1
1.6	Planning and designing of E magazine with objective & guidelines	1	CO5
1.7	Creating and the launching of E-magazine	2	CO6
2.1	Introduction to basic presentation skills & practice using ORAI app	2 (lab)	CO1
2.2	Introduction and practice to skimming and scanning	2	CO1
2.3	Introducing Dr. Meredith Belbin's research on teamwork	1	CO4
2.4	Watching Belbin's 8 Team roles, 8 team player styles and Lindgren's Big 5 personality traits	1 (lab)	CO4
2.5	Myer Brigg's AVK Method questionnaire	1(lab)	CO4
2.6	Creating a story in groups based on the social issue - feedback	2 1	CO5
2.7	Researching on a book, or film akin to the topic of your social issue and writing about it	2 1	CO3
3.1	Watching a short film on Diversity and discussing in groups	1 (lab)	CO4
3.2	Watching the film "The Fish and I" and debriefing in classroom	2 1 (lab)	CO3
3.3	Introduction to Diversity and Inclusion with reference to our society	1	CO3
3.4	Debating on the topic of diversity with an angle of ethics, morality and respect for individual	2	CO3

3.5	Narrating the challenges faced by a member of a diverse group in 4 minutes	2	CO3
3.6	(Case study discussion be used to learn Values, respect for individual and integrity) Discussing on Values, Respect for individual and integrity using appropriate case study.	2	CO1
3.7	Preparing a CV with the activities done so far	2	CO1

Course Designers:

1. Dr. A. Tamilselvi tamilselvi@tce.edu
2. Dr. S. Rajaram sorajaram@gmail.com
3. Mr. R. Vinoth vino@tce.edu
4. Dr. G. Jeya Jeevakani gjjeng@tce.edu
5. Ms. R. Manibala rmaeng@tce.edu

20CB270	DATA STRUCTURES AND ALGORITHMS LAB

Category	L	T	P	Credit
PC	0	0	4	2

Preamble

The laboratory course is designed to enable the students to solve simple mathematical, numerical and engineering problems and provide solutions using suitable data structures. The list of experiments includes the implementation of various linear and non-linear data structures and traversal through graphs. These experiments will strengthen the concepts learnt in the corresponding theory course.

Prerequisite

20CB130: Fundamentals of Computer Science

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Construct and Implement the stack and queue functionality for suitable applications.	20
CO2	Implement the operations in linked list data structure for suitable applications	20
CO3	Implement appropriate data structure for string manipulations and text editors	10
CO4	Implement appropriate searching and sorting techniques, with an understanding of the trade-off between the time and space complexity.	20
CO5	Implement graph traversals and manipulate with disjoint sets.	20
CO6	Manipulate files to store and retrieve non-linear data structure.	10

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value	Mechanism	1.2, 2.1.5,2.2.3,2.5.1,3.2.3, 4.5.3
CO2	TPS3	Apply	Value	Mechanism	1.2, 2.1.5,2.2.3,2.5.1,3.2.3, 4.5.3
CO3	TPS3	Apply	Value	Mechanism	1.2, 2.1.5,2.2.3,2.5.1,3.2.3, 4.5.3
CO4	TPS3	Apply	Value	Mechanism	1.2, 2.1.5,2.2.3,2.5.1,3.2.3, 4.5.3
CO5	TPS3	Apply	Value	Mechanism	1.2, 2.1.5,2.2.3,2.5.1,3.2.3, 4.5.3
CO6	TPS3	Apply	Value	Mechanism	1.2, 2.1.5,2.2.3,2.5.1,3.2.3, 4.5.3

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO 1	S	M	L	L	L	L	-	L	M	L	L	L	M	L	L
CO 2	S	M	L	L	L	L	-	L	M	L	L	L	M	L	L
CO 3	S	M	L	L	L	L	-	L	M	L	L	L	M	L	L
CO 4	S	M	L	L	L	L	-	L	M	L	L	L	M	L	L
CO 5	S	M	L	L	L	L	-	L	M	L	L	L	M	L	L
CO 6	S	M	L	L	L	L	-	L	M	L	L	L	M	L	L

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

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

Assessment Pattern: Psychomotor

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

List of Experiments/Activities with CO Mapping

Module No.	Topic	Course Outcome
1	Implementation of Stack using arrays and linked list.	CO1
2	Implementation of Queue using arrays and linked list.	CO1
3	Implementation of Towers of Hanoi using user defined stacks.	CO1
4	Implementation of Singly Linked List.	CO2
5	Implementation of Doubly Linked List.	CO2
6	Implementation of reading, writing, and addition of polynomials.	CO2
7	Implementation of Line editor.	CO3
8	Implementation of Binary Search Tree operations and traversals	CO4

9	Implementation of AVL Tree.	CO4
10	Implementation of B Tree.	CO4
11	Implementation of Merge sort and Quick sort	CO4
11	Implementation of Disjoint Set.	CO5
12	Implementation of Breadth First Traversal and Depth First Traversal	CO5
13	Saving / retrieving non-linear data structure in/from a file	CO6
	Total sessions	

Learning Resources

1. E. Horowitz and S. Sahni , Fundamentals of Data Structures , Computer Science Press, 1977.
2. AlfredV.Aho, John E.Hopperoft, Jeffrey D.UIlman, Data Structures and Algorithms,Pearson Education,2002.
3. Donald E. Knuth ,The Art of Computer Programming: Volume 1: Fundamental Algorithms, Donald E. Knuth,3rd edition,Pearson Education.
4. Charles E. Leiserson, Thomas H. Cormen, Ronald L. Rivest, Clifford Stein, Introduction to Algorithms, Third edition, PHI, 2010.
5. Pat Morin,Open Data Structures: An Introduction (Open Paths to Enriched Learning), 31st ed. Edition , AU Press,2013

Course Designers:

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2. Raja Lavanya rlit@tce.edu

20CB280	PRINCIPLES OF ELECTRONICS LAB	Category	L	T	P	Credit
		ES	0	0	2	1

Preamble

The goal of this course is to supplement the theory course '20CB280 Principles of Electronics' by giving a practical exposure to the students to learn the characteristics of various electronic devices such as diodes, BJT,FET that are used nowadays in most of the electronic circuits. The students also learn the design and the construction of different electronic circuits based on the above electronic devices.

Prerequisite

NIL

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Study the characteristics of Diodes experimentally	20
CO2	Find the equivalent circuit parameters of the given BJT,FET experimentally	20
CO3	Analyze the characteristics of the designed zener regulator for the given specifications experimentally	10
CO4	Analyze the performance of the diode rectifier circuit for the given specifications experimentally	10
CO5	Analyze the performance of the designed amplifiers to meet the given specifications experimentally	20
CO6	Demonstrate minimization of the given Boolean function using K-Map and realize it using logic gates	20

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value	Mechanism	1.2.3, 2.2.3,4.3.2,4.5.4,4.6.1
CO2	TPS3	Apply	Value	Mechanism	1.2.3, 2.2.3,4.3.2,4.5.4,4.6.1
CO3	TPS4	Analyze	Organize	Complex Overt Responses	1.2.3, 2.2.3,4.3.2,4.5.4,4.6.1
CO4	TPS4	Analyze	Organize	Complex Overt Responses	1.2.3, 2.2.3,4.3.2,4.5.4,4.6.1
CO5	TPS4	Analyze	Organize	Complex Overt Responses	1.2.3, 2.2.3,4.3.2,4.5.4,4.6.1
CO6	TPS3	Apply	Value	Mechanism	1.2.3, 2.2.3,4.3.2,4.5.4,4.6.1

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO 1	S	M	L	L	S			M	M	M	L	L	M	M	L
CO 2	S	M	L	L	S			M	M	M	L	L	M	M	L
CO 3	S	S	S	M	S			M	M	M	L	L	S	M	L
CO 4	S	S	S	M	S			M	M	M	L	L	S	M	L
CO 5	S	S	S	M	S			M	M	M	L	L	S	M	L
CO 6	S	M	L	L	S			M	M	M	L	L	M	M	L

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

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

Assessment Pattern: Psychomotor

Psychomotor Skill	Practical Component
Perception	
Set	
Guided Response	
Mechanism	30
Complex Overt Responses	
Adaptation	
Origination	

List of Experiments/Activities with CO Mapping

Sl.No.	Name of the Experiment	Course Outcome
1.	Familiarization of CRO,DSO,AFO, Bread board ,Devices, Data sheet	CO1 - CO6
2.	Characteristics of PN junction diode and Zener diode	CO1
3.	Design of DC voltage regulator using zener diode	CO3

4.	Design of Rectifier with and without filter	CO1
5.	Characteristics of BJT, FET	CO2
6.	Design of CE amplifier	CO5
7.	Simplification and Realization of digital circuits using logic gates	CO6

Learning Resources

1. Adel S. Sedra and Kenneth C. Smith, "Microelectronic Circuits: Theory and Application", 7th Edition, Oxford University Press, 2017.
2. Jacob millman, christos halkias chetan parikh,"Millman's Integrated Electronics "Macgraw Hill education (india) private limited,2009
3. M. Morris Mano," *Digital Logic & Computer Design"* Pearson India Educational Services PvT. Limited, 2016
4. Robert L. Boylestad, Louis Nashelsky,*"Electronic Devices and Circuit Theory"*, Pearson India Educational Services PvT. Limited,2015
5. Ben Streetman, Sanjay Banerjee," *Solid State Electronic Devices"*,6th Edition, Prentice Hall of India 2005
6. NPTEL Video Lecture on "Basic Electronics and Lab" , weblink: https://nptel.ac.in/courses/122106025
7. MIT Video Lecture on "Circuits and Electronics" , weblink: https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-002-circuits-and-electronics-spring-2007/index.htm

Course Designers:

1. Dr.S.Kanthamani skmece@tce.edu

CURRICULUM AND DETAILED SYLLABI

FOR

B.Tech DEGREE (Computer Science and Business Systems) PROGRAMME

THIRD SEMESTER

FOR THE STUDENTS ADMITTED FROM THE

ACADEMIC YEAR 2020 - 2021 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
(A Govt. Aided, ISO 9001:2008 certified Autonomous Institution affiliated to Anna University)
B.Tech Degree (Computer Science and Business systems) Programme
COURSES OF STUDY
(For the candidates admitted from 2020 – 2021onwards)

THIRD SEMESTER

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT HOURS	No.of Hours / Week			Credits
					L	T	P	
THERORY COURSES								
1	20CB310	Computer Organization and Architecture	PC	3	3	0	0	3
2	20CB320	Object Oriented Programming	PC	2	2	0	0	2
3	20CB330	Computational Statistics	ES	3	3	0	0	3
4	20CB340	Software Engineering	PC	3	3	0	0	3
5	20CB350	Formal Language and Automata Theory	PC	3	3	0	0	3
PRACTICAL COURSES								
6	20CB360	Computer Organization and Architecture Lab	PC	4	0	0	4	2
7	20CB370	Object Oriented Programming Lab	PC	4	0	0	4	2
8	20CB380	Computational Statistics Lab	ES	2	0	0	2	1
9	20CB390	Software Engineering Lab	PC	2	0	0	2	1
AUDIT COURSES								
10	18CHAB0	Constitution of India	AC	2	2	0	0	-
			TOTAL	**28**	**16**	**0**	**12**	**20**

AC : Audit Course
ES : Engineering Science
PC : Program Core
L : Lecture
T : Tutorial
P : Practical

Note:

1 Hour Lecture is equivalent to 1 credit

1 Hour Tutorial is equivalent to 1 credit

2 Hours Practical is equivalent to 1 credit

THIAGARAJAR COLLEGE OF ENGINEERING, MADURAI- 625 015
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B.Tech Degree (Computer Science and Business systems) Programme
SCHEME OF EXAMINATIONS
(For the candidates admitted from 2020 – 2021onwards)

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	20CB310	Computer Organization and Architecture	3	50	50	100	25	50
2	20CB320	Object Oriented Programming	3	50	50	100	25	50
3	20CB330	Computational Statistics	3	50	50	100	25	50
4	20CB340	Software Engineering	3	50	50	100	25	50
5	20CB350	Formal Language and Automata Theory	3	50	50	100	25	50
PRACTICAL								
5	20CB360	Computer Organization and Architecture Lab	3	50	50	100	25	50
6	20CB370	Object Oriented Programming Lab	3	50	50	100	25	50
7	20CB380	Computational Statistics Lab	3	50	50	100	25	50
8	20CB390	Software Engineering Lab	3	50	50	100	25	50

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

20CB310	COMPUTER ORGANIZATION AND ARCHITECTURE

Category	L	T	P	Credit
PC	3	0	0	3

Preamble

The syllabus is designed for the students to learn and understand the basic organization of computers and the working of its functional components. It gives a brief overview of the organization of a computer, instruction set and basic arithmetic operations. Then memory hierarchy, types of memories, organization of main memory, types of IO buses, and their operation are presented. Then the elements of cache memory design, it's mapping functions and replacement algorithms are emphasized.

Prerequisite

NIL

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Explain the basic principle of digital circuits and components of computers	15
CO2	Explain the various addressing modes, instruction set and data representation of CPU	15
CO3	Perform integer and floating point arithmetic operations on binary numbers and design CPU control unit	20
CO4	Design memory system and perform IO operations, for the given specifications	15
CO5	Estimate the performance improvement through pipelining and Identify the impact of cache coherency in parallel processors	15
CO6	Design the cache memory organization, its mapping functions and replacement algorithms and estimate the performance improvement	20

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	Guided Response	1.3
CO2	TPS2	Understand	Respond	Guided Response	1.3
CO3	TPS3	Apply	Value	Mechanism	1.3,2.1.1
CO4	TPS3	Apply	Value	Mechanism	1.3,2.1.1
CO5	TPS3	Apply	Value	Mechanism	1.3,2.1.1
CO6	TPS3	Apply	Value	Mechanism	1.3,2.1.1

Mapping with Programme Outcomes and Programme Specific Outcomes

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

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	**Continuous Assessment Tests**			**Assignment**			**Terminal Examination**
	1	**2**	**3**	1	2	3	
Remember	40	20	20		-	-	20
Understand	40	40	40				40
Apply	20	40	40	100	100	100	40
Analyse							
Evaluate							
Create							

AssessmentPattern: Psychomotor

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

Sample Questions for Course Outcome Assessment**

Course Outcome 1(CO1):

1. Differentiate combinational and sequential circuit
2. Distinguish between computer structure and computer function?
3. List the components of computer system.

Course Outcome 2 (CO2):

1. List the different addressing modes.
2. Give an example for direct addressing mode.
3. Discuss the different ways of representing signed numbers.

Course Outcome 3 (CO3):

1. Use the Booth algorithm to multiply 23 (multiplicand) by 29 (multiplier), where each number is represented using 6 bits.

2. Illustrate the steps required for Floating point addition and show the steps for performing addition of 0.8125_{ten} and -0.0625_{ten}

Course Outcome 4 (CO4):

1. State the difference between DRAM and SRAM.
2. Why does DMA have priority over CPU when both when both request a memory transfer?

Course Outcome 5 (CO5):

1. Explain why the MEM and the IF stage of a pipeline can potentially have a structural hazard. What can be done to avoid that hazard?
2. What problem can exceptions cause when having a pipelined execution of instruction, and how is the problem typically solved?
3. Define cache coherence.

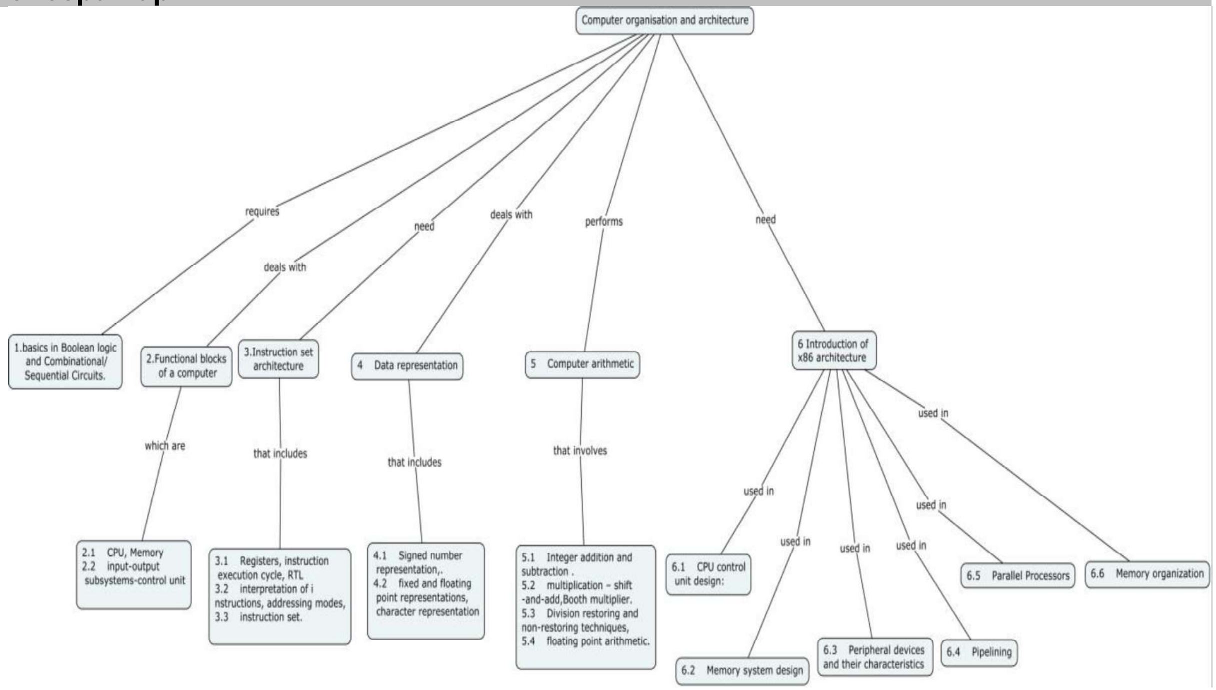
Course Outcome 6 (CO6):

1. For a direct-mapped cache, a main memory address is viewed as consisting of three fields. List and define the three fields.

2. A set-associative cache consists of 64 lines, or slots, divided into four-line sets. Main Memory contains 4K blocks of 128 words each. Show the format of main memory addresses.

3. Given the following specifications for an external cache memory: four-way set associative; line size of two 16-bit words; able to accommodate a total of 4K 32-bit words from main memory; used with a 16-bit processor that issues 24-bit addresses. Design the cache structure with all pertinent information and show how it interprets the processor's addresses.

Concept Map



Syllabus

Functional blocks of a computer: CPU, memory, input-output subsystems, control unit. Instruction set architecture of a CPU: Registers, instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set. Outlining instruction sets of some common CPUs.
Data representation: Signed number representation, fixed and floating point representations, character representation.
Computer arithmetic: Integer addition and subtraction, ripple carry adder, carry look-ahead adder, etc. multiplication – shift-and-add,Booth multiplier, carry save multiplier, etc. Division restoring and non-restoring techniques, floating point arithmetic, IEEE 754 format.
Introduction to x86 architecture.
CPU control unit design: Hardwired and micro-programmed design approaches, design of a simple hypothetical CPU.
Memory system design: Semiconductor memory technologies, memory organization. **Peripheral devices and their characteristics**: Input-output subsystems, I/O deviceinterface, I/O transfers – program controlled, interrupt driven and DMA, privilegedand non-privileged instructions, software interrupts and exceptions. Programs andprocesses – role of interrupts in process state transitions, I/O device interfaces – SCII, USB
Pipelining: Basic concepts of pipelining, throughput and speedup, pipeline hazards.
Parallel Processors: Introduction to parallel processors, Concurrent access to memory and cache coherency.
Memory organization: Memory interleaving, concept of hierarchical memory organization, cache memory, cache size vs. block size, mapping functions, replacement algorithms, write policies.

Learning Resources

1. Computer System Architecture M. M. Mano:, 3rd ed., Pearson Education, 2007.
2. Computer Organization and Design: The Hardware/Software Interface, David A. Patterson and John L. Hennessy., Morgan Kaufmann publishers,2014

3. Computer Organization and Embedded Systems, Carl Hamacher.Mcgeaw Hill, 2002.
4. Computer Architecture and Organization, John P. Hayes,3rddeition, Tata Mcgraw hill , 1998.
5. Computer Organization and Architecture: Designing for Performance, William Stallings, Nineth edition, Prentice Hall, 2013.
6. Computer System Design and Architecture, Vincent P. Heuring and Harry F. Jordan, 3rd ed., Pearson Education, 2004.
7. https://circuitverse.org/

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1	Revision of basics in Boolean logic and Combinational/Sequential Circuits.	1	CO1
2	**Functional blocks of a computer**		
2.1	CPU, Memory	2	CO1
2.2	input-output subsystems-control unit	2	CO1
3	**Instruction set architecture of a CPU**		
3.1	Registers, instruction execution cycle, RTL	1	CO2
3.2	interpretation of instructions, addressing modes,	1	CO2
3.3	instruction set. Outlining instruction sets of some common CPUs.	1	CO2
4	**Data representation**		
4.1	Signed number representation,.	1	CO2
4.2	fixed and floating point representations, character representation	1	CO2
5	**Computer arithmetic**		
5.1	Integer addition and subtraction - ripple carry adder, carry look-ahead adder, etc.	1	CO3
5.2	multiplication – shift-and-add,Booth multiplier, carry save multiplier, etc.	1	CO3
5.3	Division restoring and non-restoring techniques,	1	CO3
5.4	floating point arithmetic, IEEE 754 format.	1	CO3
6	**Introduction to x86 architecture.**		
6.1	**CPU control unit design:**		
6.1.1	Hardwired and micro-programmed design approaches,	1	CO3
6.1.2	design of a simple hypothetical CPU.	1	CO3
6.2	**Memory system design**		
6.2.1	Semiconductor memory technologies	1	CO4
6.2.2	memory organization	1	CO4
6.3	**Peripheral devices and their characteristics**		
6.3.1	Input-output subsystems, I/O device interface, I/O transfers – program controlled, interrupt driven and DMA.,	1	CO4
6.3.2	Privileged and non-privileged instructions, software interrupts and exceptions	1	CO4
6.3.3	Programs and processes – role of interrupts in process state transitions	1	CO4
6.3.4	I/O device interfaces – SCII, USB	1	CO4

6.4	**Pipelining**		
6.4.1	Basic concepts of pipelining, Throughput and speedup,	1	CO5
6.4.2	pipeline hazards	2	CO5
6.5	**Parallel Processors**		
6.5.1	Introduction to parallel processors	1	CO5
6.5.2	Concurrent access to memory and cache coherency	2	CO5
6.6	**Memory organization**		
6.6.1	Memory interleaving, concept of hierarchical memory organization	2	CO6
6.6.2	cache memory, cache size vs. block size	2	CO6
6.6.3	mapping functions,	2	CO6
6.6.4	replacement algorithms, write policies	2	CO6
	Total	36	

Course Designers:

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20CB320	OBJECT ORIENTED PROGRAMMING

Category	L	T	P	Credit
PC	2	0	0	2

Preamble

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

Prerequisite

Programming fundamentals

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Construct object-oriented programs for a given scenario using the concepts of abstraction, encapsulation, message-passing and modularity.	20
CO2	Illustrate the relationships between objects using inheritance.	15
CO3	Develop object-oriented programs for a given application using the concepts of compile-time and run-time polymorphism.	15
CO4	Construct object oriented programs for a given application using Generics and handle exceptions.	15
CO5	Construct object-oriented applications for a given scenario to persist data using files.	15
CO6	Develop object oriented design for the given scenario using UML diagram and evolve object oriented program from the design.	20

CO Mapping with CDIO Curriculum Framework

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

Mapping with Programme Outcomes and Programme Specific Outcomes

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

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

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

Assessment Pattern: Psychomotor

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

Sample Questions for Course Outcome Assessment**

Course Outcome 1(CO1)

1. Assume a class in C++ named Car that keeps track of price of cars. It has member variables carName, price and taxRate. Write a member function that computes the total price(including tax) of the Car object with the values passed as arguments, but which also

includes 12.5% as a reasonable default value for taxRate. Create 2 Car objects and display their total price.
2. Write about the benefits of Object oriented Programming.
3. List the difference between inline and non-inline functions.

Course Outcome 2(CO2):
1. Discuss about public and protected derivations with an example program.
2. Consider the scenario in which a class named EBCustomerthat inherits into Domestic and Commercial. Define an interface named calculateTariff that is used both by the Domestic EB customer and the Commercial EB customer in calculating the Nett current consumption charges. Create a Domestic EB customer object and a Commercial EB customer object and print the Nett current consumption charges of the customers

Course Outcome 3 (CO3):
1. Consider a class called **Dealer** and a class called **PartSupplier**. Multiply inherit them into **DealerPartSupplier**. Now define **LocaldealerPartSuppler** and **OutStationdealerPartSupplier** inheriting from DealerPartSupplier. Use virtual functions in C++ to show the number of parts supplied by LocaldealerPartSupplier and OutStationdealerPartSupplier.
2. Write a C++ program to create 2 overloaded functions named findAtto find the digit / character at the position specified. One function takes a number and position as arguments. Another function takes a string and position as arguments.

Course Outcome 4 (CO4):
1. Write a program to create a class named BirthDay that has date, month and year as members. Write a program to create BirthDay objects of 5 students. Write object oriented exception handling code to validate the month, day and year of thecreatedBirthDay objects.
2. Create a class named Account having Account number, Customer Name and balance as member variables and deposit and withdraw as member functions. Write the exception handling code when the balance of an account drops below Rs.1000.
3. Write a Generic class to sort integers and string.

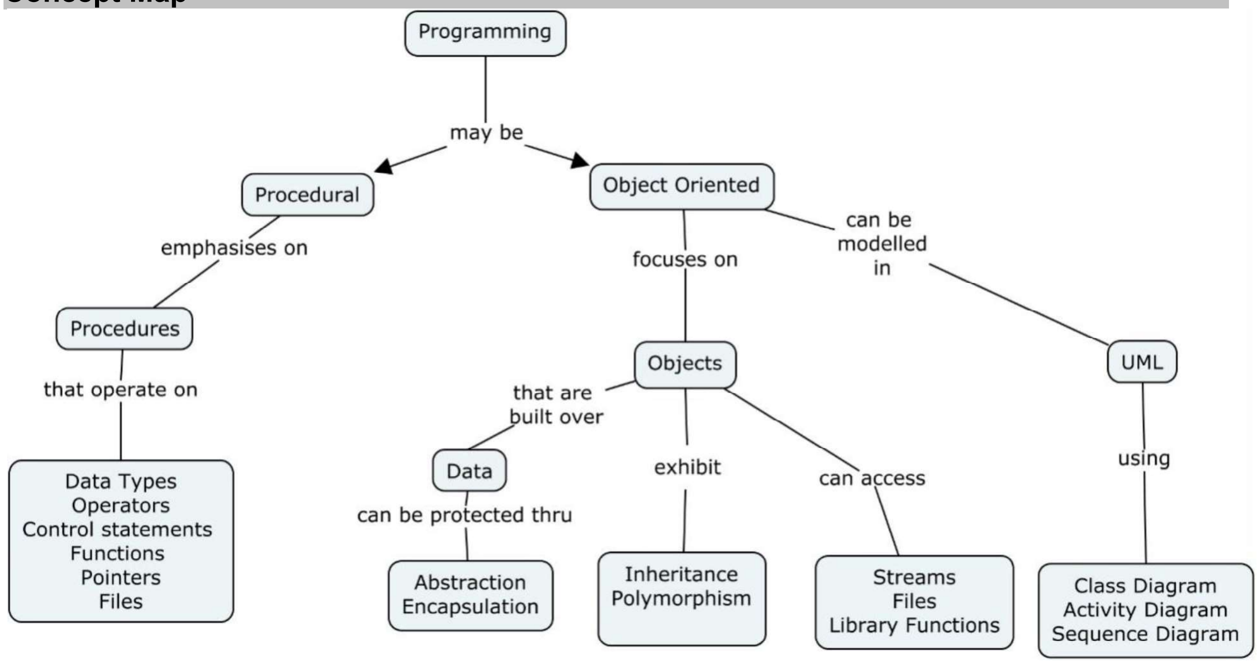
Course Outcome 5(CO5):

1. Consider a class called **UsedCar** which uses an interface called secsalesItem. The UsedCar class has the following fields: vehicleNumber, model, year, kmTravelled, price and the following methods: getVehicleNumber, getModel and getRetailPrice. The interface secsalesItem has only one method called getRetailPrice which calculates price based on the year of manufacture and kilometers travelled. Create 5 usedCar objects and serialize them into a file
2. Write a student database maintenance application using c++
3. Write a program to copy the content of one file to another file.

CourseOutcome6(CO6):
1. PATIENTBASE is a patient management system. The users of this system schedules patient appointment, manages patient admission and can delete any patient record through this system. There are two types of patients in this system. Patients who visit the doctor in the outdoor with an appointment are called Out-Patient. Patients who get admitted in the hospital are called In-Patient. Give the sequence diagram for the given scenario.

2. Determine the user requirements for a web phone-mail product. The primary purpose of this product is to give phone-mail users (e.g., faculty and staff) the ability to access the functionality of the phone-mail system from a web page. In general, the product should enable users of the phone-mail system to do their usual phone-mail activities via a web page. Determine what are those activities, in the form of product requirements and give a Use case diagram for the same.
3. A bank system contains data on customers (identified by name and address) and their accounts. Each account has a balance and there are 2 type of accounts: one for savings which offers an interest rate, the other for investments, used to buy stocks. Stocks are bought at a certain quantity for a certain price (ticker) and the bank applies commission on stock orders. Draw the class diagram and write the corresponding C++ classes.

Concept Map



Syllabus

Procedural programming, An Overview of C: Types Operator and Expressions, Scope and Lifetime, Constants, Pointers, Arrays, and References, Control Flow, Functions and Program Structure, Namespaces, error handling, Input and Output (*C*-way), Library Functions (*string*, *math*, *stdlib*), Command line arguments, Pre-processor directive. Some difference between C and C++:Single line comments, Local variable declaration within function scope, function declaration, function overloading, stronger type checking, Reference variable, parameter passing – value vs reference, passing pointer by value or reference, Operator new and delete, the typecasting operator, Inline Functions in contrast to macro, default arguments. **Fundamentals of Object Oriented Programming:** Necessity for OOP, Data Hiding, Data Abstraction, Encapsulation, Procedural Abstraction, Class and Object. **More extensions to C in C++ to provide OOP Facilities:** Scope of Class and Scope Resolution Operator, Member Function of a Class, private, protected and public Access Specifier, this Keyword, Constructors and Destructors, friend class, error handling (exception). **Essentials of Object Oriented Programming:** Operator overloading, Inheritance – Single and Multiple, Class Hierarchy, Pointers to Objects, Assignment of an Object to another Object, Polymorphism through dynamic binding, Virtual Functions, Overloading, overriding and hiding, Error Handling. Generic Programming: Template concept, class template, function template, template specialization. **Input and Output:** Streams, Files, Library functions, formatted output. **Object Oriented Design and Modelling:** UML concept, Use case for requirement capturing, Class diagram, Activity diagram and Sequence Diagram for design, Corresponding C++&Java code from design

Learning Resources

1. A Tour of C++ (Second edition) ,BjarneStroustrup Addison-Wesley. ISBN 978-0-13-499783-4. July 2018.
2. The C++ Programming Language, BjarneStroustrup, Addison-Wesley Professional ISBN: 9780133522884,2013.
3. C++ and Object-Oriented Programming Paradigm, Debasish Jana, PHI Learning Pvt. Ltd, 2014
4. Programming – Principles and Practice Using C++, BjarneStroustrup, Addison Wesley, 2014.
5. The Design and Evolution of C++, BjarneStroustrup, Addison Wesley,1994

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1	**Procedural programming, An Overview of C and Fundamentals of Object Oriented Programming (5)**		
1.1	Types Operator and Expressions, Scope and Lifetime, Constants, Pointers, Arrays, and References, Control Flow, Functions, Program Structure, Namespaces, error handling, Input and Output (*C*-way), Library Functions (*string*, *math*, *stdlib*), Command line arguments, Pre-processor directive.	1	CO1
1.2	Some difference between C and C++:Single line comments, Local variable declaration within function scope, function declaration, function overloading, stronger type checking, Reference variable, parameter passing – value vs reference, passing pointer by value or reference, Operator new and delete, the typecasting operator, Inline Functions in contrast to macro, default arguments.	1	CO1
1.3	Necessity for OOP, Data Hiding	1	CO1
1.4	Data Abstraction	1	CO1
1.5	Encapsulation, Procedural Abstraction, Class and Object.	1	CO1
2	**Inheritance(3)**		
2.1	Scope of Class and Scope Resolution Operator, Member Function of a Class, private, protected and public Access Specifier,	1	CO2
2.2	this Keyword, Constructors and Destructors, friend classes	1	CO2
2.3	Inheritance – Single and Multiple, Class Hierarchy	1	CO2
3	**Polymorphism(4)**		
3.1	Operator overloading,	1	CO3

3.2	Pointers to Objects, Assignment of an Object to another Object, Polymorphism through dynamic binding	1	CO3
3.3	Virtual Functions, Overloading, overriding and hiding, Inner Classes and Annonymous Classes	1	CO3
3.4	Aggregation and Composition	1	CO3
4.	**Generic Programming and Exception Handling (4)**		
4.1	Generic Programming: Template concept	1	CO4
4.2	class template, function template	1	CO4
4.3	template specialization	1	CO4
4.4	error handling (exception)	1	CO4
5	**Input and Output(3)**		
5.1	Streams	1	CO5
5.2	Files	1	CO5
5.3	Library functions, formatted output	1	CO5
6	**Object Oriented Design and Modelling(5)**		
6.1	UML concept, Use case for requirement capturing	1	CO6
6.2	Class diagram	1	CO6
6.3	Activity diagram	1	CO6
6.4	Sequence Diagram	1	CO6
6.5	Corresponding C++ code from Design	1	CO6
	Total	24	

Course Designers:

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20CB330	COMPUTATIONAL STATISTICS	CATEGORY	L	T	P	CREDIT
		ES	3	0	0	3

Preamble

Computational statistics, or statistical computing, is the interface between statistics and computer science. It is the area of computational science specific to the mathematical science of statistics. The goal of this course is to present essential statistical concepts and introduces students to cognitive learning in computational statistics and develops skills on analyzing the data by using different analysis like discriminant analysis, principal component analysis, factor analysis

Prerequisite

Basic probability concepts

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Understand multivariate Normal Distribution Functions and stochastic processes compute marginal and conditional distributions as well as the parameters in a bivariate distribution	15
CO2	Identify discriminant functions that are the linear combination of independent variables that will discriminate between the categories of the dependent variable	15
CO3	Apply principal component analysis which will help in dimensionality reduction and to Convert set of correlated variables to non-correlated variables.	15
CO4	Understand summarization of data and data reduction and to determine number of factors involved in the analysis	15
CO5	Discover the purpose of clustering, its types and measurements	20
CO6	Solve the problems with the appropriate clustering algorithm	20

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond		1.2.7,1.3.6, 2.1.1
CO2	TPS3	Apply	Value	Mechanism	1.2.7,1.3.6, 2.1.1
CO3	TPS3	Apply	Value	Mechanism	1.2.7,1.3.6, 2.1.1
CO4	TPS2	Understand	Respond		1.2.7,1.3.6, 2.1.1
CO5	TPS3	Apply	Value	Mechanism	1.2.7,1.3.6, 2.1.1, 2.4.6, 4.5.3
CO6	TPS3	Apply	Value	Mechanism	1.2.7,1.3.6, 2.1.1, 2.4.6, 4.5.3

Mapping with Programme Outcomes and Programme Specific Outcomes

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

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

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

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

Sample Questions for Course Outcome Assessment

Course Outcome 1(CO1)

1.The joint probability mass function of (X, Y) is given byp(x, y) = k(2x + 3y), x =0, 1, 2; y = 1,2,3. Compute all the marginal and conditional probability distributions. Also find the probability distribution of (X+Y)

2. If the joint probability density function of a two-dimensional random variable (x, Y) is given by f(x, y) = $x^2 + \frac{xy}{3}; fpr\ 0 < x < 1, 0 < y < 2\ and\ 0\ elsewhere$

Find (i) P [X >$\frac{1}{2}$]

(ii) P (Y < X)

(iii) P (Y<$\frac{1}{2}$ / X<$\frac{1}{2}$)

3. Discuss the properties of estimators and maximum likelihood estimator

Course Outcome 2(CO2).

1. How to Perform Discriminant Analysis?
2. Calculate the discriminant function for the following data
   Sample means based on 50 observations each for two species

Character	Iris versicolor	Iris Setosa	Difference
Sepal length	5.936	5.006	0.930
Sepal width	2.7700	3.428	-0.658
Petal length	4.260	1.462	2.789
Petal width	1.326	0.246	1.080

3. Discuss the properties of discriminant analysis

Course Outcome 3(CO3)

1. The feeding pattern of 20 lactating buffaloes adopted in the rural area of Gurgaon district of Haryana is given below. The measured quantity (in kgs.) of feed fed to them are green(X_1), dry fodder(X_2) and concentrate (X_3) as per their lactation number (X_4) Find out the principal components which may account for most of the variation in the data

X_1	X_2	X_3	X_4
30	8	2.0	4
20	11	1.7	4
30	12	2.0	4
22	11	2.0	4
22	12	1.4	4
22	6	0.5	4
20	12	3.5	4
25	12	1.5	5
10	10	.05	5
25	2	0.5	5
15	8	3.0	2
22	8	2.0	2
22	12	2.0	2
8	7	3.2	1
10	12	1.0	1
20	10	1.0	1
3	12	2.0	6
2	12	2.0	6
10	10	0.7	6
23	4	4.5	5

2.Identify the principal components through covariance matrix of the variables
The variables X = (X_1, X_2, X_3) have the covariance matrix as

$$\sum = \begin{bmatrix} 67.629 & -5.871 & 0.318 \\ & 8.787 & -0.287 \\ & & 1.138 \end{bmatrix}$$

3. Define x as 100 linearly spaced values between -2π and 2π. Define y_1 and y_2 as sine and cosine values of x. Create a line plot of both sets of data.

Course Outcome 4 (CO4)

1. What is factor analysis?
2. Show that the maximum likelihood estimators of Λ and Ψ given $\Phi = I$ are

$$\hat{\Lambda} = C^*_{xf} C^{*-1}_{ff},$$

$$\hat{\Psi} = C^*_{xx} - C^*_{xf} C^{*-1}_{ff} C^{*\prime}_{xf}.$$

3.Discuss about various rotations in factor analysis
4.Distinguish between factor analysis and principal component analysis

Course Outcome 5(CO5)

1. Given Six observations of 2 variables,

Obs.	X_1	X_2
a	3	2
b	4	1
c	2	5
d	5	2
e	1	6
f	4	2

   Using the nearest neighbor method and the squared Euclidean distance as a measure the dissimilarity between the data.
2. Describe two methods for validating the results of cluster analysis.
3. Interpret the different types of clustering algorithms with a real time dataset.

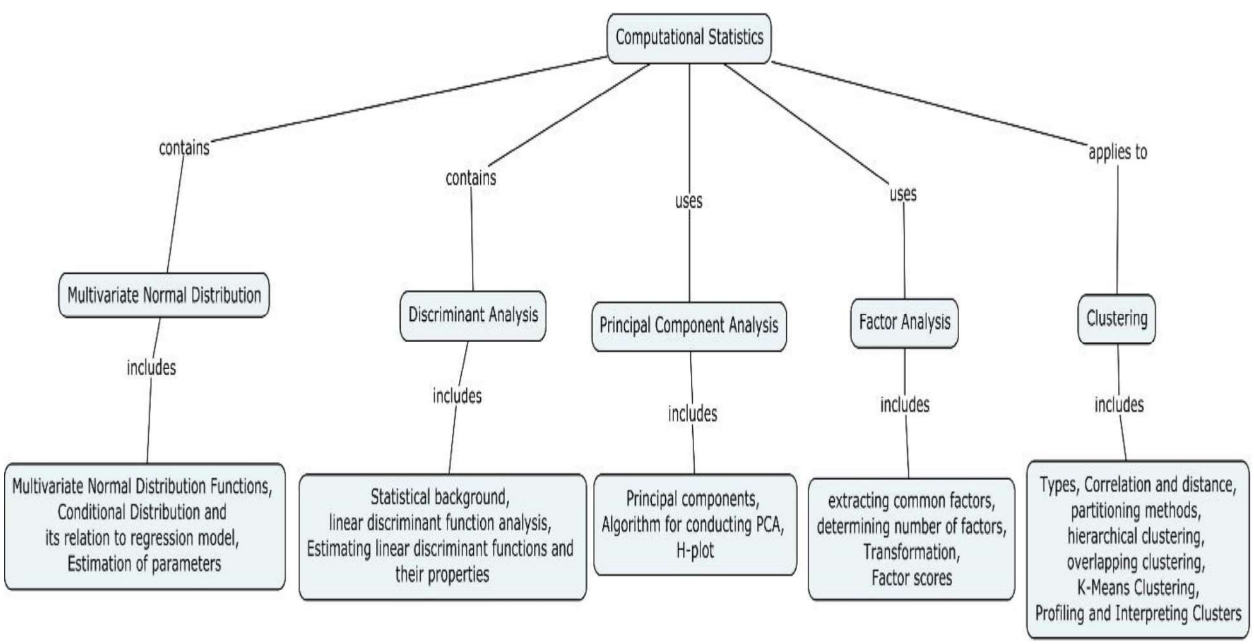
Course Outcome 6(CO6)

1. Based on the given Six observations apply the k-means algorithm and observe the assumptions in both the group that contains a and e.

Obs.	X_1	X_2
a	-1	-2
b	0	0
c	2	2
d	-2	-2
e	1	-1
f	1	2

2. Partial clustering algorithm automatically determines the number of clusters formed. Mention any two situations where this statement fails.
3. Based on the data perform cluster analysis to confirm the results concerning the nearest neighbor, average linkage and k-means method.

Concept Map



Syllabus

Multivariate Normal Distribution: Multivariate Normal Distribution Functions, Conditional Distribution and its relation to regression model, Estimation of parameters, stochastic process-Markov process, Poisson process

Discriminant Analysis: Statistical background, linear discriminant function analysis, Estimating linear discriminant functions and their properties.

Principal Component Analysis: Principal components, Algorithm for conducting principal component analysis, deciding on how many principal components to retain, H-plot.

Factor Analysis: Factor analysis model, extracting common factors, determining number of factors, Transformation of factor analysis solutions, Factor scores.

Clustering: Introduction, Types of clustering, Correlations and distances, clustering by partitioning methods, hierarchical clustering, overlapping clustering, K-Means Clustering-Profiling and Interpreting Clusters

Learning Resources

1. T.W. Anderson, “An Introduction to Multivariate Statistical Analysis”, Third Edition, A JOHN WILEY & SONS, INC., PUBLICATION, 2003.
2. J.D. Jobson, “Applied Multivariate Data Analysis, Vol I & II”, First Edition, Springer-Verlag New York, 1992.
3. Kres, Heinz, “Statistical Tests for Multivariate Analysis”, First Edition, Springer-Verlag New York, 1983.
4. Mark Lutz, “Programming Python”, 4th Edition, O'Reilly Media, 2010.
5. Tim Hall and J-P Stacey, “Python 3 for Absolute Beginners”, Apress, 1st ed. Edition, 2009
6. Magnus Lie Hetland, Beginning Python: From Novice to Professional, APress Edition, 2005
7. J. Neter, W. Wasserman and M.H. Kutner, “Applied Linear Regression Models”, Fifth Edition, e McGraw-Hill Companies, Inc., 2005
8. A.S. Mulaik, The Foundations of Factor Analysis, Second Edition, Chapman and Hall/CRC, 2009.
9. D.C. Montgomery and E.A. Peck., “Introduction to Linear Regression Analysis”, 5th edition, Wiley, 2012
10. M.R. Anderberg, “Cluster Analysis for Applications”, 1st edition, Academic Press, 1973.
11. D .F. Morrison, “Multivariate Statistical Analysis”, Brooks/Cole; New edition 2004.
12. Wes Mc Kinney, Python for Data Analysis, O'Reilly Media; 2nd edition, 2017.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1.	**Multivariate Normal Distribution**		
1.1	Multivariate Normal Distribution Functions	1	CO1
1.2	Conditional and marginal Distribution	2	CO1
1.3	Relation to regression model	2	CO1
1.4	Estimation of parameters	1	CO1
1.5	Stochastic process-Markov process	1	CO1
1.6	Poisson process	1	CO1
2.	**Discriminant Analysis**		
2.1	Statistical background	1	CO2
2.2	linear discriminant function analysis	2	CO2
2.3	Estimating linear discriminant functions	2	CO2

2.4	Properties of Discriminant Analysis	1	CO2
3.	**Principal Component Analysis**		
3.1	Principal components	1	CO3
3.2	Algorithm for conducting principal component analysis	2	CO3
3.3	deciding on how many principal components to retain	1	CO3
3.4	H-plot.	2	CO3
4.	**Factor Analysis**		
4.1	Factor analysis model	1	CO4
4.2	extracting common factors	1	CO4
4.3	determining number of factors	1	CO4
4.4	Transformation of factor analysis	1	CO4
4.5	Factor scores	1	CO4
5.	**Clustering**		
5.1	Introduction	1	CO5
5.2	Types of clustering	1	CO5
5.3	Correlations and distances	1	CO5
5.4	clustering by partitioning methods	2	CO5
5.5	hierarchical clustering	1	CO6
5.6	overlapping clustering	2	CO6
5.7	K-Means Clustering-Profiling	2	CO6
5.8	Interpreting Clusters	1	CO6
	Total	36	

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20CB340	SOFTWARE ENGINEERING

Category	L	T	P	Credit
PC	3	0	0	3

Preamble

This subject is to promote the practice of software engineering concepts at a higher level of abstraction, in a more engineering-like fashion. This course is to impart knowledge on various software development models and processes that are used by professionals for designing and developing the software.

Prerequisite

NIL

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Explain software engineering methods, practices, and their appropriate application	25
CO2	Compute cost and effort required to complete a given software using the estimation techniques	15
CO3	Explain the metrics and models of Software Quality and Reliability	15
CO4	Analyze the techniques for requirements gathering and modeling	20
CO5	Design the model for the given software requirements using Object Oriented Analysis	10
CO6	Apply various testing methods for real time applications	15

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	-	1.2, 2.1.1,2.1.2, 4.1.1, 4.1.2
CO2	TPS3	Apply	Value	-	1.2, .1.1,2.1.2, 2.1.3
CO3	TPS2	Understand	Respond	-	1.2, 2.1.1, 2.1.3, 4.1.1, 4.1.2
CO4	TPS3	Apply	Value	-	1.2, 2.1.1, 2.1.2, 2.1.3, 2.1.5,3.2.3, 4.3.1, 4.3.2
CO5	TPS3	Apply	Value	-	1.2, 2.1.1, 2.1.2, 2.1.3, 2.1.5,3.2.3, 4.3.1, 4.3.2, 4.5.1, 4.5.3
CO6	TPS3	Apply	Value	-	1.2, 2.1.1, 2.1.2, 2.1.3, 2.1.5,3.2.3, 4.3.1,4.5.5

Mapping with Programme Outcomes and Programme Specific Outcomes

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

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Assignment			Terminal Examination
	1	**2**	**3**	1	2	3	
Remember	20	20	20	-	-	-	-
Understand	20	20	20	-	-	-	40
Apply	60	60	60	100	100	100	60
Analyse	-	-	-	-	-	-	-
Evaluate	-	-	-	-	-	-	-
Create	-	-	-	-	-	-	-

Assessment Pattern: Psychomotor

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

Sample Questions for Course Outcome Assessment**

Course Outcome 1 (CO1):

1. What is the need for engineering software? (Remember)
2. Explain Evolutionary process models in detail. (Understand)

3. Explain how electronic connectivity between various development teams can support software engineering activities. (Understand)

Course Outcome 2 (CO2):

1. What are the causes for variations in project estimates? (Remember)
2. Describe the difference between process and project metrics. (Understand)
3. Use the COCOMO II model to estimate the effort required to build software for simple ATM that produces 15 screens, 12 reports and will require approximately 60 software components .Assume all weighting factor is 5 and developer/environment maturity is 25. (Apply)

Course Outcome 3 (CO3):

1. List various software Quality metrics. (Remember)
2. Discuss about Capability Maturity Models (Understand)
3. Discuss about risk management in detail. (Understand)

Course Outcome 4 (CO4):

1. Give the structure of SRS and define each one (Remember)
2. Suggest how an engineer responsible for drawing up a system requirements specification might keep track of the relationships between functional and non-functional requirements. (Apply)
3. Develop a SRS for weather monitoring system (Apply)

Course Outcome 5 (CO5):

1. What is meant by refactoring? (Remember)
2. Discuss about encapsulation and its advantages (Understand)
3. Develop CRC model for the inventory control management system with the following requirements, (Apply)
    - Placing and Tracking orders
    - Deliver the orders and Bill the customer
    - Keep track of the stocks in the stores

Course Outcome 6 (CO6):

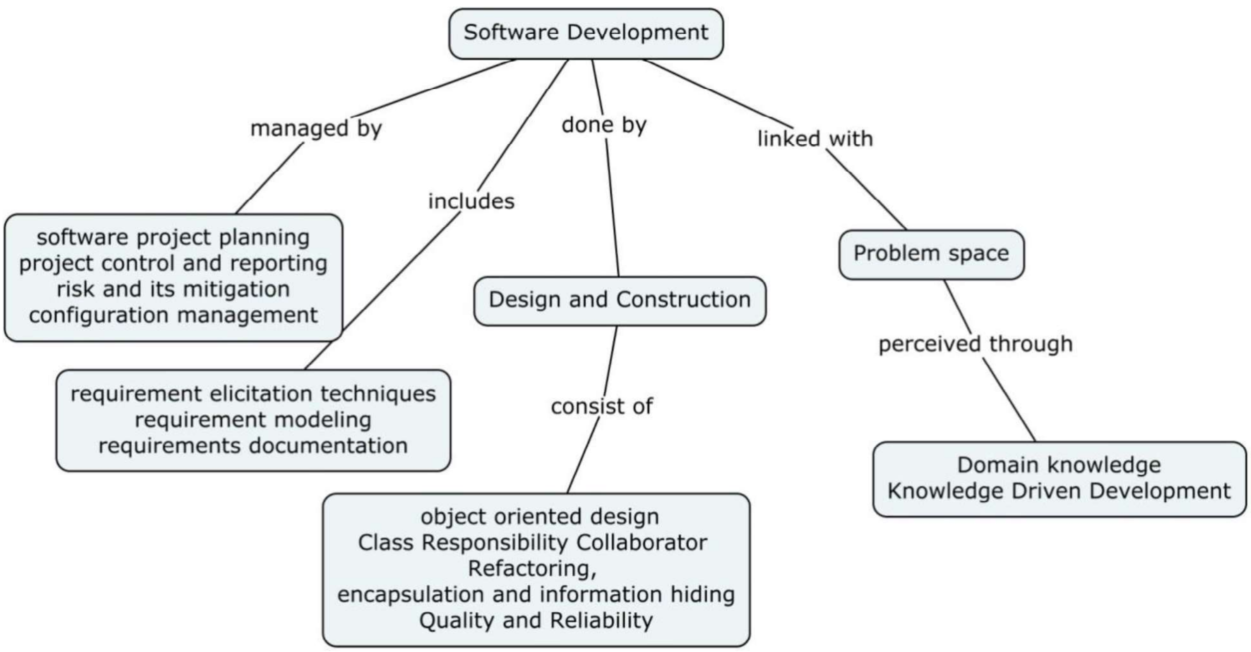
1. Explain the various Black Box Testing Techniques. (Understand)
2. Design a set of test cases for the following program that selects largest of three numbers. (Apply)

```
main()
{
floata,b,c;
scanf ( "%f%f%f,&a,&b,&c);
If (a>b)
{  If (a>c)
printf("%f\n",a);
else
printf("%f\n",c);
} else
If (c>b)
printf("%f\n",c);
else
printf("%f\n",b);
```

}}

3. Using Boundary value analysis, design the black-box test suite for a software that computes the square root of an input integer which can assume values in the range of 0 to 5000. (Apply)

Concept Map



Syllabus

Introduction: Programming in the small vs. programming in the large; software project failures and importance of software quality and timely availability; engineering approach to software development; role of software engineering towards successful execution of large software projects; emergence of software engineering as a discipline.

Software Project Management: Basic concepts of life cycle models – different models and milestones; software project planning –identification of activities and resources; concepts of feasibility study; techniques for estimation of schedule and effort; software cost estimation models and concepts of software engineering economics; techniques of software project control and reporting; introduction to measurement of software size; introduction to the concepts of risk and its mitigation; configuration management.

Software Quality and Reliability: Internal and external qualities; process and product quality; principles to achieve software quality; introduction to different software quality models like McCall, Boehm, FURPS / FURPS+, Dromey, ISO – 9126; introduction to Capability Maturity Models (CMM and CMMI); introduction to software reliability, reliability models and estimation.

Software Requirements Analysis, Design and Construction: Introduction to Software Requirements Specifications (SRS) and requirement elicitation techniques;techniques for requirement modeling – decision tables, event tables, state transition tables, Petri nets; requirements documentation through use cases; introduction to UML, introduction to software metrics and metrics based control methods; measures of code and design quality.

Object Oriented Analysis, Design and Construction: Concepts -- the principles of abstraction, modularity, specification, encapsulation and information hiding; concepts of abstract data type; Class Responsibility Collaborator (CRC) model; quality of design; design measurements; concepts of design patterns; Refactoring; object oriented construction principles; object oriented metrics.
Software Testing: Introduction to faults and failures; basic testing concepts; concepts of verification and validation; black box and white box tests; white box test coverage – code coverage, condition coverage, branch coverage; basic concepts of black-box tests – equivalence classes, boundary value tests, usage of state tables; testing use cases; transaction based testing; testing for non-functional requirements – volume, performance and efficiency; concepts of inspection.
Problem Space Understanding: How an industry works, how an IT company works, How IT supports business, Problem Space Understanding, Knowledge Driven Development (KDD), Domain knowledge framework of KDD, usage of domain knowledge framework in Insurance, Banking and Automobile, KDD as a project delivery methodology, Linking domain knowledge to software development, A case study to produce a KDD artifact using Agile.

Learning Resources

1. Ian Sommerville , "Software Engineering" , 10th Edition, John Wiley and sons,2015.
2. Roger S. Pressman, “Software Engineering: A Practitioner's Approach”, 7th Edition, McGraw Hill Education, 2017
3. PankajJalote, “Software Engineering: A Precise Approach “,Wiley, 2010
4. Carlo Ghezzi, Jazayeri Mehdi, Mandrioli Dino, “Fundamentals of Software Engineering”, 2nd edition,2002
5. Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides, “Design Patterns: Elements of Object-Oriented Reusable Software”, 2015
6. Shari Lawrence Pfleeger and Joanne, “M. Atlee Software Engineering: Theory and Practice”, 2006
7. Bertrand Meyer, “Touch of Class: Learning to Program Well with Objects and Contracts”, 2009
8. Martin Fowler, “UML Distilled: A Brief Guide to the Standard Object Modeling Language”, 2018

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1	**Introduction**		
1.1	Programming in the small vs. programming in the large; software project failures and importance of software quality and timely availability	1	CO1
1.2	Engineering approach to software development; role of software engineering towards successful execution of large software projects; emergence of software engineering as a discipline.	1	CO1
2	**Software Project Management**		
2.1	Basic concepts of life cycle models – different models and milestones	2	CO1

2.2	Software project planning –identification of activities and resources; concepts of feasibility study	1	CO2
2.3	Techniques for estimation of schedule and effort; software cost estimation models and concepts of software engineering economics	2	CO2
2.4	Techniques of software project control and reporting; Introduction to measurement of software size	1	CO2
2.5	Introduction to the concepts of risk and its mitigation; configuration management.	2	CO2
3	**Software Quality and Reliability**		
3.1	Internal and external qualities; process and product quality; principles to achieve software quality	1	CO3
3.2	Introduction to different software quality models like McCall, Boehm, FURPS / FURPS+, Dromey, ISO – 9126	2	CO3
3.3	Introduction to Capability Maturity Models (CMM and CMMI)	1	CO3
3.4	Introduction to software reliability, reliability models and estimation.	2	CO3
4	**Software Requirements Analysis, Design and Construction**		
4.1	Introduction to Software Requirements Specifications (SRS) and requirement elicitation techniques	2	CO4
4.2	Techniques for requirement modeling – decision tables, event tables, state transition tables, Petri nets;	2	CO4
4.3	Requirements documentation through use cases; Introduction to UML	1	CO4
4.4	Introduction to software metrics and metrics based control methods; measures of code and design quality.	2	CO4
5	**Object Oriented Analysis, Design and Construction**		
5.1	Concepts - the principles of abstraction, modularity, specification, encapsulation and information hiding; concepts of abstract data type;	1	CO5
5.2	Class Responsibility Collaborator (CRC) model; quality of design; design measurements; concepts of design patterns;	2	CO5
5.3	Refactoring; object oriented construction principles; object oriented metrics.	1	CO5
6	**Software Testing**		
6.1	Introduction to faults and failures; basic testing concepts; concepts of verification and validation; black box and white box tests;	1	CO6
6.2	white box test coverage – code coverage, condition coverage, branch coverage;	1	CO6
6.3	Basic concepts of black-box tests – equivalence classes, boundary value tests, usage of state tables; testing use cases; transaction based testing;	2	CO6
6.4	Testing for non-functional requirements – volume,	1	CO6

	performance and efficiency; concepts of inspection.		
7	**Problem Space Understanding**		
7.1	How an industry works, how an IT company works, How IT supports business, Problem Space Understanding	1	CO1
7.2	Knowledge Driven Development (KDD), Domain knowledge framework of KDD,	1	CO1
7.3	Usage of domain knowledge framework in Insurance, Banking and Automobile, KDD as a project delivery methodology, Linking domain knowledge to software development	1	CO1
7.4	A case study to produce a KDD artifact using Agile.	1	CO1
	Total Hours	**36**	

Course Designers:

1. Dr. A. Malini amcse@tce.edu

20CB350	FORMAL LANGUAGE AND AUTOMATA THEORY

Category	L	T	P	Credit
PC	3	0	0	3

Preamble

This course is to introduce students to the core area of computer science. The course will aid the students to focus on the study of abstract models of computation. These abstract models are needed to assess and solve the computing problems in computer science and engineering via formal reasoning. The students will be exposed to the computability as well as complexity theory. The goal is to aid the students in answering fundamental questions about problems, such as whether they can or not be computed. If the problem can be computed, then what will be its efficiency. The course introduces basic computation models and their properties, and the necessary mathematical techniques to prove the advanced attributes of these models. On successful completion of the course, the students will be able to express computer science problems as mathematical statements and formulate the proof to show the efficiency.

Prerequisite

Nil

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Construct finite state machines and the equivalent regular expressions (Apply)	20
CO2	Construct pushdown automata and the equivalent context free grammars. (Apply)	20
CO3	Construct a linear bound automata for the given context-sensitive language (Apply)	15
CO4	Sketch a turing machine for the given computational problem (Apply)	20
CO5	Demonstrate undecidability for various problems (Apply)	15
CO6	Interpret the characteristics of P, NP and NP Complete problems in the context of Turing machines (Understand)	10

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value	Mechanism	1.2,2.3.2,3.2.3,4.4.3
CO2	TPS3	Apply	Value	Mechanism	1.2,2.3.2, 3.2.3,4.4.3
CO3	TPS3	Apply	Value	Mechanism	1.2,2.3.2, 3.2.3,4.4.3
CO4	TPS3	Apply	Value	Mechanism	1.2,2.3.2, 3.2.3,4.4.3
CO5	TPS3	Apply	Value	Mechanism	1.2,2.3.2, 3.2.3,4.4.3
CO6	TPS2	Understand	Respond	Guided Response	1.2,2.3.2, 3.2.3,4.4.3

Mapping with Programme Outcomes and Programme Specific Outcomes

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

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

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

Assessment Pattern: Psychomotor

Psychomotor Skill	Miniproject /Assignment/Practical Component
Perception	
Set	
Guided Response	30
Mechanism	70
Complex Overt Responses	
Adaptation	
Origination	

Sample Questions for Course Outcome Assessment**

Course Outcome 1(CO1):

1. Construct a right-linear grammar for the language L ((aab*ab)*).
2. Show that for every regular language not containing λ there exists a right-linear grammar whose productions are restricted to the forms

$A \rightarrow aB$, or $A \rightarrow a$, where $A, B \in V$, and $a \in T$

3. Let G1 = (V2 ,Σ,S2 ,P2) be right-linear and G2= (V2 , Σ,,S2 ,P2) be a left-linear grammar, and assume that V1 and V2 are disjoint. Consider the linear grammar G =({S}∪ V1 ∪ V2 , Σ,S, P), where S is not in V1 ∪ V2 and P = {S → S1 |S2}∪ P1 ∪ P2 . Show that L(G) is regular.

Course Outcome 2(CO2):
1. Construct an LL grammar for the language L (a*ba) ∪ L (abbb*).
2. Show that if G is an LL (k) grammar, then L (G) is a deterministic context-free language.
3. Show that $L = \{a^n b^{2n} : n \geq 0\}$ is a deterministic context-free language

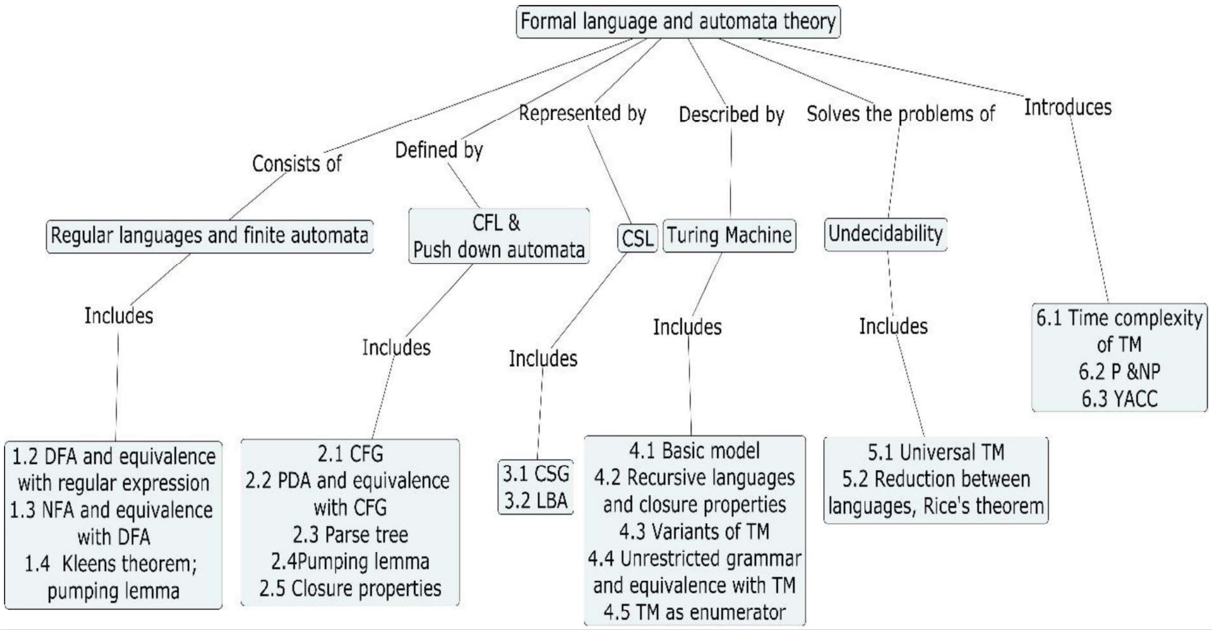
Course Outcome 3(CO3):
1. Find linear bounded automata for the following language, $L = \{a^n : n = m^2, m \geq 1\}$.
2. Find linear bounded automata for the following language, $L = \{a^n : n \text{ is a prime number}\}$.
3. Find linear bounded automata for the following language, $L = \{a^n : n \text{ is not a prime number}\}$.

Course Outcome 4 (CO4):
1. Consider the set of machine language instructions for a computer of your choice. Sketch how the various instructions in this set could be carried out by a Turing machine.
2. At one point the Turing machines appear to be more powerful than pushdown automata. Since the tape of a Turing machine can always be made to behave like a stack, it would seem that we can actually claim that a Turing machine is more powerful. What important factor is not taken into account in this argument?
3. Consider a Turing machine with a different decision process in which transitions are made if the current tape symbol is not one of a specified set. For example, $\delta (q_i , \{a, b\}) = (q_j , c, R)$ will allow the indicated move if the current tape symbol is neither a nor b. Formalize this concept and show that this modification is equivalent to a standard Turing machine.

Course Outcome 5 (CO5):
1. Show that the problem of determining whether or not $L(G_i) \subseteq L(G_2)$ is undecidable for context-free grammars G_1, G_2 .
2. Show that for arbitrary context-free grammars G1 and G2 , the problem "L(G1) ∩ L (G2) is context-free" is undecidable.
3. Let G1 and G2 be grammars with G1 regular. Is the problem L (G1) = L (G2) decidable when (a) G2 is unrestricted, (b) when G2 is context-free, (c) when G2 is regular?

Course Outcome 6(CO6):
1. Show that TSP is NP-complete.
2. Let G be an undirected graph. An Euler circuit of the graph is a simple cycle that includes all edges. The Euler Circuit Problem (EULER) is to decide if G has an Euler circuit. Show that EULER is not NP-complete
3. Is it possible that P = NP is undecidable?

Concept Map



Syllabus

Introduction: Alphabet, languages and grammars, productions and derivation, Chomsky hierarchy of languages.

Regular languages and finite automata: Regular expressions and languages, deterministic finite automata (DFA) and equivalence with regular expressions, nondeterministic finite automata (NFA) and equivalence with DFA, regular grammars and equivalence with finite automata, properties of regular languages, *Kleene's theorem,* pumping lemma for regular languages, *Myhill-Nerode theorem and its uses,* minimization of finite automata.

Context-free languages and pushdown automata: Context-free grammars (CFG) and languages (CFL), Chomsky and Greibach normal forms, nondeterministic pushdown automata (PDA) and equivalence with CFG, parse trees, ambiguity in CFG, pumping lemma for context-free languages, deterministic pushdown automata, closure properties of CFLs.

Context-sensitive languages: Context-sensitive grammars (CSG) and languages, linear bounded automata and equivalence with CSG.

Turing machines: The basic model for Turing machines (TM), Turing recognizable(recursively enumerable) and Turing-decidable (recursive) languages and their closure properties, variants of Turing machines, nondeterministic TMs and equivalence with deterministic TMs, unrestricted grammars and equivalence with Turing machines, TMs as enumerators.

Undecidability: Church-Turing thesis, universal Turing machine, the universal and diagonalization languages, reduction between languages and Rice's theorem, undecidable problems about languages.

Basic Introduction to Complexity: Introductory ideas on Time complexity of deterministic and nondeterministic Turing machines, P and NP, NP- completeness, Cook's Theorem, other NP - Complete problems.

Laboratory: YACC, the parser-generating tool

Learning Resources

1. "Introduction to Automata Theory, Languages, and Computation", John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman, third Edition, Pearson Education, 2008.
2. "An Introduction to Formal Language and Automata", Peter Linz, sixth edition, Jones & Bartlett, 2016.
3. "Elements of the Theory of Computation", Harry R. Lewis and Christos H. Papadimitriou, Second Edition, Pearson Education, 2003.
4. "Automata and Computability", Dexter C. Kozen, Springer, 2012.
5. "Introduction to the Theory of Computation", Michael Sipser, third edition, Cengage, 2014.
6. "Introduction to Languages and the Theory of Computation", John Martin, Third Edition, Tata McGraw Hill, 2007
7. "Computers and Intractability: A Guide to the Theory of NP Completeness", M. R. Garey and D. S. Johnson, W. H. Freeman, 1979.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1.	**Introduction &Regular languages and finite automata**		
1.1	Alphabet, languages and grammars, productions and derivation, Chomsky hierarchy of languages.	1	CO1
1.2	Regular expressions and languages, deterministic finite automata (DFA) and equivalence with regular expressions	1	CO1
1.3	Nondeterministic finite automata (NFA) and equivalence with DFA, regular grammars and equivalence with finite automata, properties of regular languages	2	CO1
1.4	*Kleene's theorem,* pumping lemma for regular languages, *Myhill-Nerode theorem and its uses,* minimization of finite automata.	2	CO1
2.	**Context-free languages and pushdown automata**		
2.1	Context-free grammars (CFG) and languages (CFL), Chomsky and Greibach normal forms	2	CO2
2.2	Nondeterministic pushdown automata (PDA) and equivalence with CFG	1	CO2
2.3	Parse trees, ambiguity in CFG	1	CO2
2.4	Pumping lemma for context-free languages, deterministic pushdown automata	1	CO2
2.5	Closure properties of CFLs	1	CO2
3.	**Context-sensitive languages**		
3.1	Context-sensitive grammars (CSG) and languages	2	CO3
3.2	linear bounded automata and equivalence with CSG	2	CO3
4.	**Turing machines**		
4.1	The basic model for Turing machines (TM)	1	CO4
4.2	Turing recognizable(recursively enumerable) and Turing-decidable (recursive) languages and their closure properties	2	CO4
4.3	Variants of Turing machines, nondeterministic TMs and	2	CO4

	equivalence with deterministic TMs		
4.4	Unrestricted grammars and equivalence with Turing machines	2	CO4
4.5	TMs as enumerators	1	CO4
5.	**Undecidability**		
5.1	Church-Turing thesis, universal Turing machine, the universal and diagonalization languages,	3	CO5
5.2	Reduction between languages and Rice's theorem, undecidable problems about languages	3	CO5
6.	**Basic Introduction to Complexity and Laboratory**		
6.1	Introductory ideas on Time complexity of deterministic and nondeterministic Turing machines	2	CO6
6.2	P and NP, NP- completeness, Cook's Theorem, other NP -Complete problems.	2	CO6
6.3	YACC, the parser-generating tool	2	CO6
	TOTAL HOURS	**36**	

Course Designers:

1. Dr. M. K. Kavitha Devi mkkdit@tce.edu
2. Ms. R. Nagarathna nacse@tce.edu

20CB360	COMPUTER ORGANIZATION AND ARCHITECTURE LAB

Category	L	T	P	Credit
PC	0	0	4	2

Preamble

This course provides insight into the working principles of Computer organization and architecture.

Prerequisite

NIL

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Implement the given combinational /sequential circuit	30
CO2	Develop C/C++ programming to understand different data formats	10
CO3	Perform Arithmetic operations using Assembly language programming (ALP)	25
CO4	Perform Accessing of some specific memory locations/port using ALP	10
CO5	Perform Counting odd and even integers from a series of memory locations using ALP	10
CO6	Perform Interrupt handling and displaying register content using ALP	15

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value	Mechanism	1.2,3.2.3,4.5.1
CO2	TPS3	Apply	Value	Mechanism	1.2,3.2.3,4.5.1
CO3	TPS3	Apply	Value	Mechanism	1.2,3.2.3,4.5.1,4.5.3
CO4	TPS3	Apply	Value	Mechanism	1.2,3.2.3,4.5.1,4.5.3
CO5	TPS3	Apply	Value	Mechanism	1.2,3.2.3,4.5.1,4.5.3
C06	TPS3	Apply	Value	Mechanism	1.2,3.2.3,4.5.1,4.5.3

Mapping with ProgrammeOutcomesandProgramme Specific Outcomes

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

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

S- Strong; M-Medium; L-Low

AssessmentPattern: Cognitive Domain

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

AssessmentPattern: Psychomotor

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

List of Experiments/Activities with CO Mapping

Module No.	Topic	No. of Hours	Course Outcome
1	Implementation of Combinational Digital/Boolean Circuits: Adder, Subtractor, Multiplication Module, Division Module, Multiplexer, Demultiplexer, Encoder, Decoder on breadboard or simulators	12	CO1
2	Implementation of Sequential Circuits: Counters, Linear Feedback Shift Registers (LFSR) on breadboard or simulators	4	CO1
3	Develop C/C++ programming to understand the formats of char, int, float, double, long etc	4	CO2
4	Develop an ALP to Perform Add/subtract/ multiplication/ division/GCD/ LCM on simulator	12	CO3

Module No.	Topic	No. of Hours	Course Outcome
5	Develop an ALP to Perform Accessing of some specific memory locations/port on simulator	4	CO4
6	Develop an ALP to Perform Counting odd and even integers from a series of memory locations on simulator	4	CO5
7	Develop an ALP to Printing values of selected registers on simulator	4	CO6
8	Develop an ALP to Perform interrupt handling on simulator	4	CO6
Total		48	

Learning Resources

1. Computer System Architecture M. M. Mano:, 3rd ed., Pearson Education, 2007.
2. Computer Organization and Design: The Hardware/Software Interface, David A. Patterson and John L. Hennessy., Morgan Kaufmann publishers,2014
3. Computer Organization and Embedded Systems, Carl Hamacher.Mcgeaw Hill, 2002.
4. Computer Architecture and Organization, John P. Hayes,3rddeition, Tata Mcgraw hill , 1998.
5. Computer Organization and Architecture: Designing for Performance, William Stallings, Nineth edition, Prentice Hall, 2013.
6. Computer System Design and Architecture, Vincent P. Heuring and Harry F. Jordan, 3rd ed., Pearson Education, 2004.
7. https://circuitverse.org/

Course Designers:

1. Dr.C.Senthilkumar cskcse@tce.edu
2. Dr.K.Narasimma Mallikarjunan arjunkambaraj@tce.edu

20CB370	OBJECT ORIENTED PROGRAMMING LAB

Category	L	T	P	Credit
PC	0	0	4	2

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 Number	Course Outcome Statement	Weightage*** in %
CO1	Construct Object oriented programs using methods and passing arrays, objects, and array of objects to them	30
CO2	Demonstrate Compile-time and Run-time polymorphism using object oriented programs	15
CO3	Illustrate the relationships between objects using inheritance hierarchies	10
CO4	Develop Object Oriented programs to demonstrate template functions and Collections	15
CO5	Develop Object Oriented programs to handle data using Files and Object Serialization	10
CO6	Develop object oriented design for the given scenario using UML diagram and evolve object oriented program from the design.	20

CO Mapping with CDIO Curriculum Framework

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

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO 1	S	M	L		L	L	L	L	L	L	L	M	M	L	L
CO	S	M	L		L	L	L	L	L	L	L	M	M	L	L

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

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

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

Assessment Pattern: Psychomotor

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

List of Experiments/Activities with CO Mapping

S.No.	Experiment	No. of Hours	CO
1.	Parameter passing: passing parameter by value vs by reference, passing array as constant pointer	2	CO1
2.	Function overloading: writing string operations like strcat and strncat, strcpy and strncpy as overloaded functions.	2	CO1
3.	Dynamically allocating space for a pointer depending on input and doing this repeatedly, depending on different inputs and finally de-	2	CO1

	allocating the pointer.		
4.	Define class complex with all possible operations: constructor, destructor, copy constructor, assignment operator with the data members stored as pointer to integers.	2	CO1
5.	Define class vector of integers with all possible operations like constructor, destructor, copy constructor and assignment operators	2	CO1
6.	Define class matrix of integers with all possible operations like constructor, destructor, copy constructor and assignment operators	2	CO1
7.	Define class matrix of integers using vector, with all possible operations like constructor, destructor, copy constructor and assignment operators	2	CO1
8.	Define class stack, queue, linked-list, array, set using some data-type (int) with data members kept as private and functions kept in both protected and public sections.	2	CO1
9.	Define class complex with all possible operators: constructor, destructor, copy constructor, assignment operator and operators >, <, >=, <=, ==, ++ (pre and post), +, +=, ( ), with the data members stored as pointer to integers. Operator Overloading to be used.	2	CO2
10.	Define class vector of integers/float with all possible operations like constructor, destructor, copy constructor and assignment operators>, <, >=, <=, ==, ++ (pre and post), +, +=, ( ) Operator Overloading to be used.	2	CO2
11.	Define class matrix of integers/float with all possible operations like constructor, destructor, copy constructor and assignment operators>, <, >=, <=, ==, ++ (pre and post), +, +=, ( ). Operator Overloading to be used.	1	CO2
12.	Define class matrix of integers/float using vector, with all possible operations like constructor, destructor, copy constructor and assignment operators>, <, >=, <=, ==, ++ (pre and post), +, +=, ( ). Operator Overloading to be used.	2	CO2
13.	Define stack and queue inherited from array class, with standard functions and operators. Demonstrate the use of inner classes and anonymous classes in the application.	3	CO3
14.	Overriding operators <<, >>	2	CO3
15.	Define a class called ‘array’ with data type passed as template type with constructor, destructor, copy constructor and assignment operators and index operator.	2	CO4

16.	Write a C++ Program and Java Program using Collection Class	3	CO4
17.	Define template functions for compare and use it in the algorithms like bubble sort, insertion sort, merge sort.	2	CO4
18.	Demonstrate Formatted input-output and exceptions using C++ Program and Java Program.	2	CO5
19.	Input manipulators and Thread Safe Classes	2	CO5
20.	Define class model for complex number, student class, book class and show it using UML diagram as well as concrete class. Write the corresponding C++ Program and Java Program	4	CO6
21.	Show behaviouralmodelling through sequence diagram and activity diagram for workflow in a typical log-in, log-out situation. Write the corresponding C++ Program and Java Program	5	CO6
	Total Hours	48	

Learning Resources

1. A Tour of C++ (Second edition) ,BjarneStroustrup Addison-Wesley. ISBN 978-0-13-499783-4. July 2018.
2. The C++ Programming Language, BjarneStroustrup, Addison-Wesley Professional ISBN: 9780133522884,2013.
3. C++ and Object-Oriented Programming Paradigm, Debasish Jana, PHI Learning Pvt. Ltd, 2014
4. Programming – Principles and Practice Using C++, BjarneStroustrup, Addison Wesley, 2014.
5. The Design and Evolution of C++, BjarneStroustrup, Addison Wesley,1994
6. Tony Gaddis, “Starting Out with Java: From Control Structures through Objects”, Sixth edition, Pearson Education Limited, 2016.
7. Grady Booch, Robert Maksimchuk, Michael Engel, Bobbi Young, Jim Conallen, Kelli Houston“Object Oriented Analysis and Design with Applications”, Third Edition, 2012

Course Designers:

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20CB380	COMPUTATIONAL STATISTICS LAB

Category	L	T	P	Credit
ES	0	0	2	1

Preamble

The course focuses on to provide the basic skill in python that helps to explore the data and apply the statistical measures to analyse the data by interpreting them through visualization techniques.

Prerequisite

NIL

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Write a python program using the fundamentals programming concepts such as Flow Controls, Functions, sequences and Class	10
CO2	Write a python program to perform reading / writing data into various file formats	10
CO3	Implement the python program for performing data wrangling concepts and statistical measures	25
CO4	Write a python program to perform Data Aggregation and Grouping operations for dimensionality reduction	20
CO5	Write python program for performing pivot tables and time series operations for probabilistic programming using Bayesian methods	20
CO6	Use the various visualization tools and interpret the results	15

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value	Mechanism	1.2, 2.1, 3.2, 4.5.3
CO2	TPS3	Apply	Value	Mechanism	1.2, 2.1, 3.2, 4.5.3
CO3	TPS3	Apply	Value	Mechanism	1.2, 2.1, 3.2, 4.5.3
CO4	TPS3	Apply	Value	Mechanism	1.2, 2.1, 3.2, 4.5.3
CO5	TPS3	Apply	Value	Mechanism	1.2, 2.1, 3.2, 4.5.3
CO6	TPS3	Apply	Value	Mechanism	1.2, 2.1, 3.2, 4.5.3

Mapping with Programme Outcomes and Programme Specific Outcome

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

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

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

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

Assessment Pattern: Psychomotor

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

List of Experiments/Activities with CO Mapping

Ex. No.	LIST OF EXPERIMENTS	No. of Hours	CO
1.	Basic python program execution with different interpreters and statement expressions a. Various data types b. Type casting c. Control flows	2	CO1
2.	Python program on functions and sequences using Lists, Tuples, Dictionaries, Strings and class	2	CO2
3.	Python program in handling different file formats to perform data acquisition, data cleaning - handling of missing data and descriptive statistical analytics.	2	CO3
4.	Python program to perform inferential statistics – Probability, Central Limit Theorem, Confidence Interval and Hypothesis Testing	2	CO3
5.	Implement a python program to perform data transformation,	2	CO3

	string manipulations and regular expressions		
6.	Write a python program to perform GroupBy operations and transformations	2	CO4
7.	Write a python program to implement the Data Aggregation in dataframe and dimensionality reduction	3	CO4
8.	Develop a python program to perform the pivot operations and cross tabulation in the dataset	1	CO5
9.	Develop a python program to perform Bayesian methods for computational statistics	1	CO5
10.	Develop a python program to forecast the data interpretation using time series operations	1	CO5
11.	Develop a python program to perform sampling and re-sampling using monte-carlo simulation	2	CO5
12.	Use the visualization libraries in python to view and interpret the dataset	4	CO6
	TOTAL HOURS	**24**	

Learning Resources

1. T.W. Anderson, "An Introduction to Multivariate Statistical Analysis", Third Edition, A JOHN WILEY & SONS, INC., PUBLICATION, 2003.
2. J.D. Jobson, "Applied Multivariate Data Analysis, Vol I & II", First Edition, Springer-Verlag New York, 1992.
3. **Kres**, Heinz, "Statistical Tests for Multivariate Analysis", First Edition, Springer-Verlag New York, 1983.
4. Mark Lutz, "Programming Python", 4th Edition, O'Reilly Media, 2010.
5. Tim Hall and J-P Stacey, "Python 3 for Absolute Beginners", Apress, 1st ed. Edition, 2009
6. Magnus Lie Hetland, Beginning Python: From Novice to Professional, APress Edition, 2005
7. J. Neter, W. Wasserman and M.H. Kutner, "Applied Linear Regression Models", Fifth Edition, e McGraw-Hill Companies, Inc., 2005
8. A.S. Mulaik, The Foundations of Factor Analysis, Second Edition, Chapman and Hall/CRC, 2009.
9. D.C. Montgomery and E.A. Peck., "Introduction to Linear Regression Analysis", 5th edition, Wiley, 2012
10. M.R. Anderberg, "Cluster Analysis for Applications", 1st edition, Academic Press, 1973.
11. D .F. Morrison, "Multivariate Statistical Analysis", Brooks/Cole; New edition 2004.
12. Wes Mc Kinney, Python for Data Analysis, O'Reilly Media; 2nd edition, 2017.

Course Designers

1. Dr. N. Chitra ncmat@tce.edu
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20CB390	SOFTWARE ENGINEERING LAB	Category	L	T	P	Credit
		PC	0	0	2	1

Preamble

This course focuses on providing hands-on experience in designing, developing and testing software systems. Consequently students take up a group project, working through a number of stages for the development of software.

Prerequisite

NIL

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Develop software requirements specification for given software	15
CO2	Perform Structured System Analysis and Structured Design for given requirement specification	10
CO3	Construct object oriented design diagrams based on requirement specification.	15
CO4	Produce efficient, reliable, robust and cost-effective software solutions.	20
CO5	Construct white-box and black-box test cases using various test generation methods	15
CO6	Use of appropriate CASE tools and program analysis tools for a given software	25

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value	-	1.2, 2.1.1,2.1.2,2.1.3, 2.1.5, 2.3.1, 2.3.2,2.4.3,2.4.4,3.1.1, 3.1.2, 3.2.3, 3.2.4, 3.2.5,3.2.6, 4.1.1, 4.1.2, 4.4.1, 4.4.3,4.5.1,4.5.3,4.5.5
CO2	TPS3	Apply	Value	-	1.2, 2.1.1,2.1.2,2.1.3, 2.1.5, 2.3.1, 2.3.2,2.4.3,2.4.4,3.1.1, 3.1.2, 3.2.3, 3.2.4, 3.2.5,3.2.6, 4.1.1, 4.1.2, 4.4.1, 4.4.3,4.5.1,4.5.3,4.5.5
CO3	TPS3	Apply	Value	-	1.2, 2.1.1,2.1.2,2.1.3, 2.1.5, 2.3.1, 2.3.2,2.4.3,2.4.4,3.1.1, 3.1.2, 3.2.3, 3.2.4, 3.2.5,3.2.6, 4.1.1, 4.1.2, 4.4.1, 4.4.3,4.5.1,4.5.3,4.5.5
CO4	TPS3	Apply	Value	-	1.2, 2.1.1,2.1.2,2.1.3, 2.1.5, 2.3.1, 2.3.2,2.4.3,2.4.4,3.1.1, 3.1.2, 3.2.3, 3.2.4, 3.2.5,3.2.6, 4.1.1, 4.1.2, 4.4.1,

					4.4.3,4.5.1,4.5.3,4.5.5
CO5	TPS3	Apply	Value	-	1.2, 2.1.1,2.1.2,2.1.3, 2.1.5, 2.3.1, 2.3.2,2.4.3,2.4.4,3.1.1, 3.1.2, 3.2.3, 3.2.4, 3.2.5,3.2.6, 4.1.1, 4.1.2, 4.4.1, 4.4.3,4.5.1,4.5.3,4.5.5
CO6	TPS3	Apply	Value	-	1.2, 2.1.1,2.1.2,2.1.3, 2.1.5, 2.3.1, 2.3.2,2.4.3,2.4.4,3.1.1, 3.1.2, 3.2.3, 3.2.4, 3.2.5,3.2.6, 4.1.1, 4.1.2, 4.4.1, 4.4.3,4.5.1,4.5.3,4.5.5

Mapping with Programme Outcomes and Programme Specific Outcomes

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

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Phases	Deliverables	Marks	Course Outcomes
Continuous Assessment			
Review 1 – Requirements specification	Technical Report	10	CO1
Review 2 –Design and implementation	Technical Report	20	CO2,CO3,CO4
Review 3 -Testing and Use of CASE tools	Technical Report	20	CO5 and CO6
End-Semester Examination			
Demonstration	Prototype	60	CO1, CO2, CO3, CO4, CO5 and CO6
Case Study Presentation and viva voce	Poster/PPT	40	

Assessment Pattern: Psychomotor

Psychomotor Skill	Miniproject /Practical Component/Observation
Perception	-

Set	-
Guided Response	-
Mechanism	-
Complex Overt Responses	-
Adaptation	-
Origination	-

List of Experiments/Activities with CO Mapping

Ex.No	**List of Experiments**	**Hours**	**CO**
1.	Collect the requirements and Identify project scope, Objectives, deliverables	4	CO1
2.	Identify the individual Phases/ modules of the project	2	CO2
3.	Develop Class responsibility collaborator(CRC) Model	4	CO3
4.	Build a Prototype and develop modules of the project	4	CO4
5.	Prepare test plan, perform validation testing, coverage analysis, memory leaks, develop test case hierarchy, Site check and site monitor	4	CO5
6.	Track configuration items and document functional dependencies.	2	CO6
7.	Perform post execution analysis using dynamic program analysis tools	4	CO6

A possible set of applications may be the following:

a. E-Library System
b. Inventory System
c. Course Registration System
d. Quiz System
e. Student Marks Analyzing System
f. Reservation Systems for Airlines, Railways etc.
g. Stock Management System
h. Real-Time Scheduler
i. Simulator Software for Parallel Processing Operation

Learning Resources

1. Ian Sommerville , "Software Engineering" , 10th Edition, John Wiley and sons,2015.
2. Roger S. Pressman, “Software Engineering: A Practitioner's Approach”, 7th Edition, McGraw Hill Education, 2017
3. PankajJalote, “Software Engineering: A Precise Approach “,Wiley, 2010
4. Carlo Ghezzi, Jazayeri Mehdi, Mandrioli Dino, “Fundamentals of Software Engineering”, 2nd edition,2002
5. Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides, “Design Patterns: Elements of Object-Oriented Reusable Software”, 2015
6. Shari Lawrence Pfleeger and Joanne, “M. Atlee Software Engineering: Theory and Practice”, 2006
7. Bertrand Meyer, “Touch of Class: Learning to Program Well with Objects and Contracts”, 2009
8. Martin Fowler, “UML Distilled: A Brief Guide to the Standard Object Modeling Language”, 2018

Course Designers:

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CURRICULUM AND DETAILED SYLLABI

FOR

B.Tech DEGREE (Computer Science and Business Systems) PROGRAMME

FOURTH SEMESTER

FOR THE STUDENTS ADMITTED FROM THE

ACADEMIC YEAR 2020 - 2021 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
(A Govt. Aided, ISO 9001:2008 certified Autonomous Institution affiliated to Anna University)
B.Tech Degree (Computer Science and Business systems) Programme
COURSES OF STUDY
(For the candidates admitted from 2020 – 2021onwards)

FOURTH SEMESTER

Sl. No	COURSE CODE	COURCE TITLE	CATEGORY	CONTACT HOURS	No.of Hours / Week			Credits
					L	T	P	
THERORY COURSES								
1	20CB410	Operating Systems	PC	3	3	0	0	3
2	20CB420	Database Management Systems	PC	3	3	0	0	3
3	20CB430	Introduction to Innovation, IP Management & Entrepreneurship	HSS	3	3	0	0	3
4	20CBPA0	Marketing Research & Marketing Management	PE	2	2	0	0	2
THEORY CUM PRACTICAL COURSES								
5	18MAFH0	Operations Research	OE	4	2	0	2	3
6	20CB460	Software Design with UML	PC	4	2	0	2	3
7	20CB470	Design Thinking	ES	4	2	0	2	3
PRACTICAL COURSES								
8	20CB480	Operating Systems Lab	PC	2	0	0	2	1
9	20CB490	Database Management Systems Lab	PC	2	0	0	2	1
AUDIT COURSES								
10	18CHAC0	Essence of Indian Knowledge	AC	2	2	0	0	-
			TOTAL	**29**	**19**	**0**	**10**	**22**

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

Note:

1 Hour Lecture is equivalent to 1 credit

1 Hour Tutorial is equivalent to 1 credit

2 Hours Practical is equivalent to 1 credit

THIAGARAJAR COLLEGE OF ENGINEERING, MADURAI- 625 015
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B.Tech Degree (Computer Science and Business systems) Programme
SCHEME OF EXAMINATIONS
(For the candidates admitted from 2020 – 2021onwards)

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	20CB410	Operating Systems	3	50	50	100	25	50
2	20CB420	Database Management Systems	3	50	50	100	25	50
3	20CB430	Introduction to Innovation, IP Management & Entrepreneurship	3	50	50	100	25	50
4	20CBPA0	Marketing Research & Marketing Management	3	50	50	100	25	50
THEORY CUM PRACTICAL								
5	18MAFH0	Operations Research	3	50	50	100	25	50
6	20CB460	Software Design with UML	3	50	50	100	25	50
7	20CB470	Design Thinking	3	50	50	100	25	50
PRACTICAL								
8	20CB480	Operating Systems Lab	3	50	50	100	25	50
9	20CB490	Database Management Systems Lab	3	50	50	100	25	50

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

20CB410	OPERATING SYSTEMS

Category	L	T	P	Credit
PC	3	0	0	3

Preamble

Operating systems is a core part of computer-science education. Although this field is undergoing rapid change, as computers are now prevalent in virtually every application, the fundamental concepts remain fairly clear. It provides a clear description of the *concepts* that underlie operating systems. The fundamental concepts and algorithms are based on those used in existing commercial operating systems.

Prerequisite

Basics of Computer Architecture and Organization

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Illustrate the functions Operating System and the types of OS used in different applications	10
CO2	Describe the basics of processes and threads	10
CO3	Construct process scheduling algorithms to schedule the given set of processes	15
CO4	Perform Interprocess communication between concurrently executing processes	10
CO5	Develop solutions to handle deadlock by prevention, avoidance, detection and recovery methods	15
CO6	Perform memory management using contiguous allocation and non-contiguous allocation	20
CO7	Construct storage management solutions to store and retrieve the file system in secondary storage devices	20

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond		1.2,2.3.2
CO2	TPS2	Understand	Respond	Guided Response	1.2,2.3.2
CO3	TPS3	Apply	Value	Mechanism	1.2, 2.3.2,4.3.2
CO4	TPS3	Apply	Value	Mechanism	1.2, 2.3.2,4.3.2
CO5	TPS3	Apply	Value	Mechanism	1.2, 2.3.2,4.3.2
CO6	TPS3	Apply	Value	Mechanism	1.2, 2.3.2,4.3.2
CO7	TPS3	Apply	Value	Mechanism	1.2, 2.3.2,4.3.2

Mapping with Programme Outcomes and Programme Specific Outcomes

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

CO 1	M	L											L		
CO 2	M	L											L		
CO 3	S	M	L		L				M			M	M		L
CO 4	S	M	L		L				M			M	M		L
CO 5	S	M	L		L				M			M	M		L
CO 6	S	M	L		L				M			M	M		L
CO 7	S	M	L		L				M			M	M		L

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Assignment			Terminal Examination
	1	**2**	**3**	1	2	3	
Remember	30	10	10	-	-	-	10
Understand	40	30	20	10	10		20
Apply	30	60	70	90	90	100	70
Analyse	-	-	-	-	-	-	-
Evaluate	-	-	-	-	-	-	-
Create	-	-	-	-	-	-	-

Assessment Pattern: Psychomotor

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

Sample Questions for Course Outcome Assessment**

Course Outcome 1(CO1):

1. What are the functions of Operating System?
2. Define Interrupts.
3. Illustrate the steps taken by the Operating System, when a system call is issued by a user process.

Course Outcome 2(CO2):

1. Give the states and state transition that occurs in a process life cycle.
2. List the differences between processes and threads.

3. Illustrate with an example the concept of Multithreading.
4. What are the various types of Thread? Give Example.

Course Outcome 3(CO3):

1. Consider the given set of processes and apply First Come First Serve Scheduling, Shortest Remaining Time First Scheduling and Non Pre-emptive Priority CPU Scheduling algorithm to schedule the given set of processes.

Process Id	Burst Time (milliseconds)	Arrival Time (milliseconds)	Priority (Low number represents higher priority)
P1	8	0	4
P2	4	0	3
P3	1	2	1
P4	4	4	2
P5	7	6	5

Draw the Gantt chart for each scheduling algorithm and compute the average waiting time and average turn-around time for each of the given algorithms.

2. Illustrate the scheduling parameters used to compare the different scheduling algoritms.
3. Suppose the following jobs arrive for processing at the times indicated, each job will run the listed amount of time.

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

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

Course Outcome 4 (CO4):

1. Give a solution to the readers-writers problem after explaining its nature?
2. Implement Semaphore solution to the Synchronization of Producer-Consumer problem
3. Discuss how file sharing semantics of unix can be implemented. Can processing of the link and unlink commands of unix lead to deadlocks .Discuss how such deadlocks can be avoided

Course Outcome 5 (CO5):

1. Considering a system with five processes P_0 through P_4 and three resources of type A, B, C. Resource type A has 10 instances, B has 5 instances and type C has 7 instances. Suppose at time t_0 following snapshot of the system has been taken:

Process	Allocation	Max	Available
	A B C	A B C	A B C
P_0	0 1 0	7 5 3	3 3 2
P_1	2 0 0	3 2 2	
P_2	3 0 2	9 0 2	
P_3	2 1 1	2 2 2	
P_4	0 0 2	4 3 3	

Question1. What will be the content of the Need matrix?

Question2. Is the system in a safe state? If Yes, then what is the safe sequence?
Question3. What will happen if process P_1 requests one additional instance of resource type A and two instances of resource type C?

2. Illustrate the wait-for graph method of deadlock detection approach?
3. What is Deadlock? Give examples of deadlock?

Course Outcome 6(CO6):

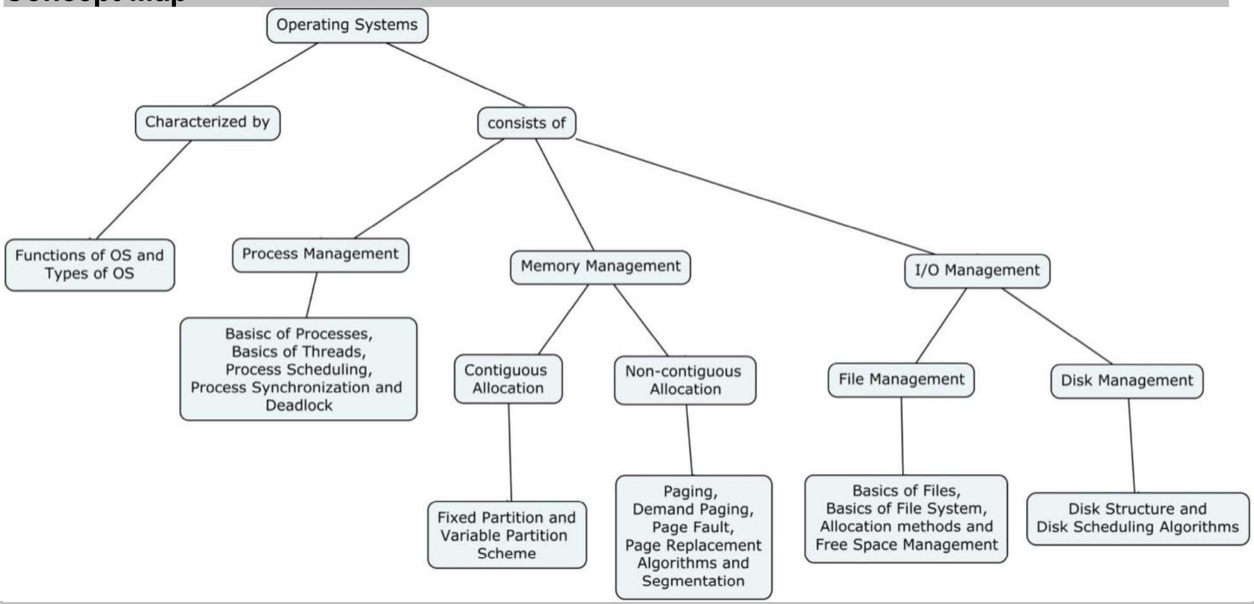
1. Given memory partitions of 100K, 500K, 200K, 300K, and 600K (in order), how would each of the First-fit, Best-fit, and Worst-fit algorithms place processes of 212K, 417K, 112K, and 426K (in order)? Which algorithm makes the most efficient use of memory?
2. Consider the following page reference string 7,0,2,0,3,0,4,2,3,0,3,2,1,2,0,1,7,0,2.
   How many page faults would occur in the case?
   a. LRU
   b. FIFO
   c. Optimal algorithms
   assuming three, five or six frames. Note that initially all frames are empty.

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

Course Outcome (CO7):

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

Concept Map



Syllabus

Introduction: Concept of Operating Systems (OS), Generations of OS, Types of OS, OS Services, Interrupt handling and System Calls, Basic architectural concepts of an OS, Concept of Virtual Machine, Resource Manager view, process view and hierarchical view of an OS. **Processes**: Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching. **Thread**: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads. **Process Scheduling**: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time. **Scheduling algorithms**: Pre-emptive and non-pre-emptive, FCFS, SJF, RR; Multiprocessor scheduling: Real Time scheduling: RM and EDF. **Inter-process Communication**: Concurrent processes, precedence graphs, Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Semaphores, Strict Alternation, Peterson's Solution, The Producer / Consumer Problem, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem, Barber's shop problem. **Deadlocks**: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery. **Concurrent Programming:** Critical region, conditional critical region, monitors, concurrent languages and communicating sequential process (CSP). **Memory Management**: Basic concept, Logical and Physical address maps, Memory allocation: Contiguous Memory allocation – Fixed and variable partition–Internal and External fragmentation and Compaction. **Virtual Memory**: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page allocation, Partitioning, Paging, Hashed Page table and Inverted Page table,Page fault, Working Set, Segmentation, Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU). **I/O Hardware**: I/O devices, Device controllers, Direct Memory Access, Principles of I/O. **File Management**: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed),Free-space management (bit vector, linked list, grouping), directory implementation(linear list, hash table), efficiency and performance. **Disk**

Management: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks. **Case study:** UNIX OS file system, shell, filters, shell programming, programming with the standard I/O, UNIX system calls and Minix Operating System.

Learning Resources

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne: Operating System Concepts Essentials, ninth edition, John Wiley and Sons, 2013.
2. Operating Systems: Internals and Design Principles, William Stallings, Pearson Education, 2018.
3. Operating System: A Design-oriented Approach, Charles Patrick Crowley, McGrawHill Eductaion,2017.
4. Operating Systems: A Modern Perspective, Gary J. Nutt, Pearson, 1997.
5. Design of the Unix Operating Systems. Maurice J. Bach. Pearson Education India, 2015.
6. Understanding the Linux Kernel, Daniel Pierre Bovet, Marco Cesati, O'Reilly Media.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1	**Basics of OS and Processes**	**(5)**	
1.1	**Introduction:** Concept of Operating Systems (OS), Generations of OS, Types of OS, OS Services, Interrupt handling and System Calls, Basic architectural concepts of an OS, Concept of Virtual Machine, Resource Manager view, process view and hierarchical view of an OS.	2	CO1
1.2	**Processes**: Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching.	2	CO2
1.3	**Thread**: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads.	1	CO2
2	**Process Scheduling**	**(3)**	
2.1	**Process Scheduling**: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time.	1	CO3
2.2	**Scheduling algorithms**: Pre-emptive and non-pre-emptive, FCFS, SJF, RR; Multiprocessor scheduling: Real Time scheduling: RM and EDF.	2	CO3
3	**Process Synchronization and Deadlocks**	**(11)**	
3.1	**Inter-process Communication**: Concurrent processes, precedence graphs, Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution	1	CO4
3.2	Synchronization Solutions: Semaphores, Strict Alternation, Peterson's Solution, Event Counters, Monitors, Message Passing and Hardware solutions	3	CO4
3.3	Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem, Barber's shop problem.	2	CO4
3.4	**Concurrent Programming:** Critical region, conditional critical region, monitors, concurrent languages, Communicating Sequential Process (CSP)	2	CO4

3.5	**Deadlocks**: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.	3	CO5
4	**Memory Management**	**(8)**	
4.1	**Memory Management**: Basic concept, Logical and Physical address maps, Memory allocation: Contiguous Memory allocation – Fixed and variable partition– Internal and External fragmentation and Compaction.	2	CO6
4.2	**Virtual Memory**: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page allocation, Partitioning	1	CO6
4.3	Paging, Hashed Page table and Inverted Page table Page fault, Working Set and Segmentation	2	CO6
4.4	Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU).	3	CO6
5	**Storage Management**	**(9)**	
5.1	**I/O Hardware**: I/O devices, Device controllers, Direct Memory Access, Principles of I/O.	1	CO7
5.2	**File Management**: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed)	2	CO7
5.3	Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance.	2	CO7
5.4	**Disk Management**: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks.	2	CO7
5.5	**Case study:** UNIX OS file system, shell, filters, shell programming, programming with the standard I/O, UNIX system calls and Minix Operating Systems	2	CO7
	Total No of Hours	**36**	

Course Designers:

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20CB420	DATABASE MANAGEMENT SYSTEMS

Category	L	T	P	Credit
PC	3	0	0	3

Preamble

This course helps the students to understand the basic concepts and functionalities of Database Management Systems such as data modelling, data storage and retrieval, data manipulation and effective database design. It also facilitate the students to know about indexing mechanisms used for data retrieval, concurrent access of data, recovery and access control mechanisms.

It also makes the students to understand different types of databases and to learn basic concepts of data warehousing and mining.

Prerequisite

Data Structures and Algorithms

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage in %
CO1	Develop different data models such as E-R model, Relational model and object oriented model for a given application	15
CO2	Illustrate the use of relational query languages for data retrieval and manipulation operations	20
CO3	Develop efficient database for a given application using dependency theories and normalization methods	15
CO4	Explain the concepts of query processing and query optimization methods	10
CO5	Construct different data access structures such as indices and hashing for the fast retrieval of data	15
CO6	Illustrate transaction, concurrency and recovery mechanisms to maintain data integrity and consistency in a multi user environment	15
CO7	Describe the need for database security methods and the concepts of different kinds of databases	10

CO Mapping with CDIO Curriculum Framework

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

					4.4.4
CO6	TPS3	Apply	Value		1.2, 2.1.1, 2.1.2, 2.1.5, 4.4.3, 4.4.4
CO7	TPS2	Understand	Respond		1.2, 2.1.1

Mapping with Programme Outcomes and Programme Specific Outcome

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

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

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

Assessment Pattern: Psychomotor

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

Sample Questions for Course Outcome Assessment

Course Outcome1 (CO1):

1. A university registrar's office maintains data about the following entites: (A) courses, including number, title, credits, syllabus, and prerequisites; (b) course offerings, including course number, year, semester, section number, instructor(s), timings and class rooms; (c) students, including student-id, name and program; and (d) instructors, including identification number, name, department, and title. Further, the enrollment of students in courses and grades awarded to students in each course they are enrolled for must be appropriately modeled.
   i. Construct an E-R diagram for the registrar's office. Document all assumptions you make about the mapping constraints.
   ii. Convert the E-R model into a relational model and give equivalent SQL Commands to construct the relational database with appropriate constraints

2. A company database needs to store information about employees (identified by ssn, with salary and phone as attributes), departments (identified by dno, with dname and budget as attributes), and children of employees (with name and age as attributes). Employees work in departments; each department is managed by an employee; a child must be identified uniquely by name when the parent (who is an employee; assume that only one parent works for the company) is known. We are not interested in information about a child once the parent leaves the company.
   i. Draw an ER diagram that captures this information and convert this into an relational model

Course Outcome2 (CO2):

1. LIVES(employee-name, street, city)
WORKS(employee-name, company-name, salary)
LOCATED-IN(company-name, city)
MANAGES(employee-name, manager-name)

   Answer the following queries using Relational Algebra.
   i. Find the name of all employees who work for the 'City Bank company '.
   ii. Find the name and city of all employees who work for City Bank.
2. Consider the following tables and give results for the following queries in relational algebra:
   Reserves(sid, bid, day)
   Sailors (sid, sname, rating, age)
   Boats(bid, bname,color)
   i. Find names of sailors who've reserved a green boat
   ii. Find sailors rated > 7 who've reserved boat #103

3. Considering the schema structure given below
   CUSTOMER(<u>custno</u>, custname, city, phone)
   ITEM (<u>Itemno</u>, Itemname, Itemprice, QtyOnhand)
   INVOICE (<u>Invno</u> , Invdate , Custno
   INVITEM <u>(Invno , Itemno</u> , Qty)
   Answer the following queries in SQL. (Apply)
   i. Find the customers who are not from 'Madurai'
   ii. Display all item name along with the quantity sold.

Course Outcome3 (CO3):

1. Given the following relation instance, list out the functional dependencies holds on this relation.

X	Y	Z
1	4	2
1	5	3
1	6	3
3	2	2

2. Consider the universal relation R = {A,B,C,D,E,F,G,H,I,J} and set of functional dependencies F = {{A,B} -> {C}, {B,D} -> {E,F}, {A,D} -> {G,H}, {A} -> {I}, {H} -> {J}}.
   i. Compute the keys for R.
   ii. Compute the closure of F. List only the non-trivial functional dependencies with single attribute on right hand side.
3. Develop a relational database for the Library Management application by following the various design phases of normalization. (Apply)

Course Outcome4 (CO4):

1. Describe the steps in query processing (Understand)
2. Let relations r1(A,B,C) and r2(C,D,E) have the following properties: r1 has 20,000 tuples, r2 has 45,000 tuples, 25 tuples of r1 fit on one block, and 30 tuples of r2 fit on one block. Estimate the number of block transfers and seeks required using Nested Loop Join strategy for r1 natural joined with r2. (Understand)
3. Consider the query: Find the names of all customers who have an account at some branch located in Brooklyn, Write an efficient relational_algebra expression for this query. (Understand)

Course Outcome5 (CO5):

1. Suppose that we are using extendable hashing on a file that contains records with the following search key values 2, 3, 5, 7, 11, 17, 19, 23, 29, 31. Show the extendable hash structure for this file, if the hash function is h(x)= x mod 5 and buckets can hold 3 records.
2. Construct a B+ Tree with order 3 as follows: Insert sequence : 5, 8, 1, 7, 3, 12, 9, 6 Deletion sequence: 9, 8, 12.

Course Outcome6 (CO6):

1. Consider the following ordering Schedule - S of transactions:
   a. T3: W(X); T2: R(X); T3: commit; T1: W(Y); T1: commit; T2: R(Y);
   b. T2: W(Z); T2: commit; T4: R(X); T4: R(Y); T4:W(Z); T4: commit.

   Identify whether given transactions are view serializable. (Apply)
2. Consider the following schedules involving two transactions. Determine which one is conflict serializable schedule and which is not.

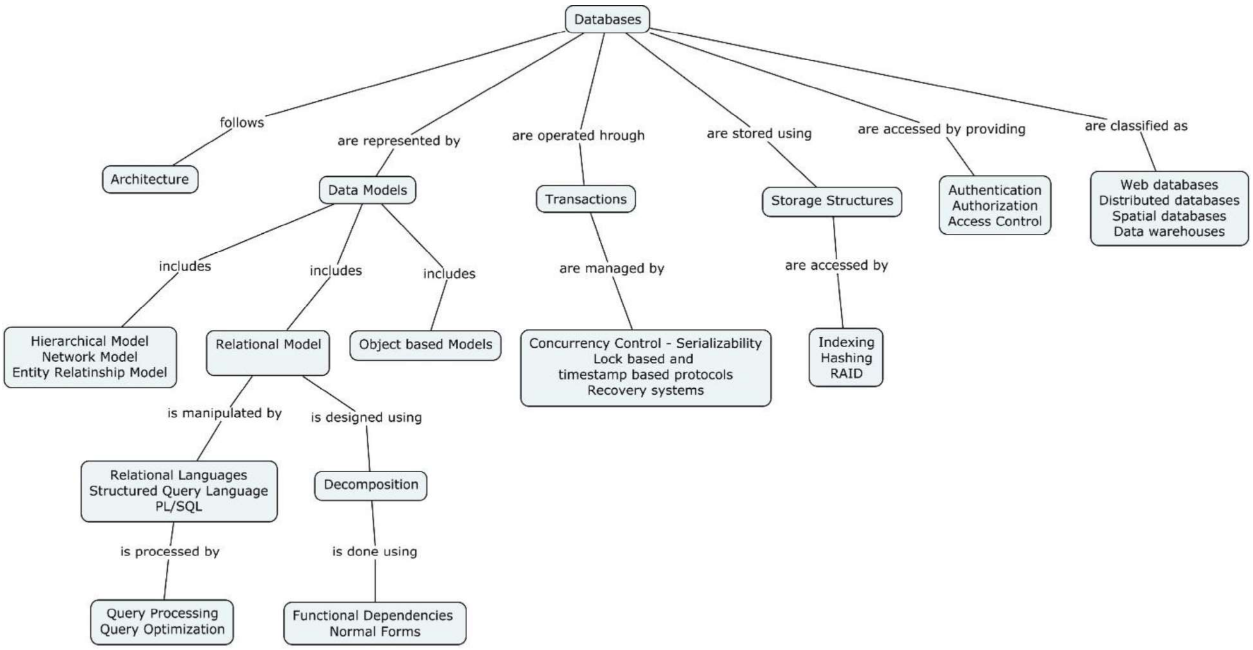
$$S_1 : r_1(X); r_1(Y); r_2(X); r_2(Y); w_2(Y); w_1(X)$$

$$S_2 : r_1(X); r_2(X); r_2(Y); w_2(Y); r_1(Y); w_1(X)$$

Course Outcome7 (CO7):

1. Compare and contrast DBMS with data warehouse systems (understand)
2. Illustrate the different data fragmentation techniques and mention their advantages. (understand)

Concept Map



Syllabus

Introduction: Introduction to Database. Hierarchical, Network and Relational Models.

Database system architecture: Data Abstraction, Data Independence, Data Definition Language (DDL), Data Manipulation Language (DML).

Data models: Entity-relationship model, network model, relational and object oriented data models, integrity constraints, data manipulation operations.

Relational query languages: Relational algebra, Tuple and domain relational calculus,SQL3, DDL and DML constructs, PL/SQL – Sub programs – Procedures, Functions, Triggers, Open source and Commercial DBMS - MYSQL,ORACLE, DB2, SQL server, In-memory Databases.

Relational database design: Domain and data dependency, Armstrong's axioms, Functional Dependencies, Normal forms, Dependency preservation, Lossless design, Denormalization

Query processing and optimization: Evaluation of relational algebra expressions, Query equivalence, Join strategies, Query optimization algorithms.

Storage strategies: Indices, B-trees, Hashing, RAID

Transaction processing: Concurrency control, ACID property, Serializability of scheduling, Locking and timestamp based schedulers, Multi-version and optimistic, Concurrency Control schemes, Database recovery.

Database Security: Authentication, Authorization and access control, DAC, MAC and RBAC models, Intrusion detection, SQL injection.

Advanced topics: Object oriented and object relational databases, Logical databases, Web databases, Distributed databases, Spatial Databases, Data warehousing and data mining.

Learning Resources

1. Avi Silberschatz, Henry F.Korth, S.Sudarshan, “Database System Concepts”, 7th Edition, Tata McGrawHill, 2019.
2. Ramez Elmasri and Shamkan tB.Navathe, “Fundamentals of Database System”, 7th edition, Pearson Education, 2017.

3. Raghu Ramakrishnan, Johannes Gehrke, "Database Management Systems", 3rd Edition, Tata McGraw Hill, 2002.
4. J. D. Ullman, "Principles of Database and Knowledge – Base Systems", Vol 1, computer science press, 2016.
5. Serge Abiteboul, Richard Hull, Victor Vianu , "Foundations of Databases", Pearson, 1994.
6. https://onlinecourses.nptel.ac.in/noc18_cs15/preview

Course Contents and Lecture Schedule

Module No.	Topic	No. of Lectures	Course Outcome
1	**Introduction to Database (5)**		
1.1	Introduction to databases – purpose, architecture of database systems	1	CO1
1.2	Data Abstraction, Data Independence, Data Definition Language (DDL), Data Manipulation Language (DML).	1	CO1
1.3	Data Models - Hierarchical, Network, Relational Model and Object oriented data model	1	CO1
1.4	Entity-relationship model – Concepts, integrity constraints, ER model design issues	1	CO1
1.5	ER Diagram - Concepts and notations, extended ER features, Reduction to relational models	1	CO1
2	**Relational Query Languages (7)**		
2.1	Relational Algebra - Selection, Projection, Cross product, Join and Set operators	1	CO2
2.2	Relational Algebra – additional operations, Tuple and domain calculus	1	CO2
2.3	SQL – DDL , DML commands, Set operations	1	CO2
2.4	SQL – DML – Joins, Aggregate functions	1	CO2
2.5	SQL – Sub-queries, TCL and DCL	1	CO2
2.6	PL/SQL – Sub programs – Procedures, Functions, Triggers	1	CO2
2.7	Practice of SQL in open source and commercial data bases, in-memory databases	1	CO2
3	**Relational Database Design (5)**		
3.1	Domain and data dependency	1	CO3
3.2	Functional Dependencies, Armstrong's axioms – Closure sets	1	CO3
3.3	Normal forms	2	CO3
3.4	Decomposition - Dependency preservation, Lossless design, Denormalization	1	CO3
4	**Query Processing and Optimization (4)**		
4.1	Evaluation of relational algebra expressions	1	CO4
4.2	Query equivalence – equivalence rules	1	CO4
4.3	Join strategies	1	CO4
4.4	Query optimization algorithms	1	CO4

5	**Storage Strategies (5)**		
5.1	Indices – Ordered and Hash indices	1	CO5
5.2	B-trees – Indexing and File Organization	2	CO5
5.3	Hashing – static and dynamic hashing	2	CO5
6	**Transaction Processing (5)**		
6.1	ACID property, Concurrency control	1	CO6
6.2	Serializability of scheduling	1	CO6
6.3	Locking and timestamp based schedulers, Multi-version and optimistic	1	CO6
6.4	Concurrency Control schemes	1	CO6
6.5	Database recovery	1	CO6
7	**Database Security(2)**		
7.1	Authentication, Authorization and access control	1	CO7
7.2	DAC, MAC and RBAC models	1	CO7
7.3	Intrusion detection, SQL injection		CO7
8	**Advanced Topics(3)**		
8.1	Object oriented and object relational databases,	1	CO7
8.2	Logical databases, Web databases, Distributed database, Spatial databases	1	CO7
8.3	Data warehousing and data mining	1	CO7
	Total	**36**	

Course Designers:

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20CB430	INTRODUCTION TO INNOVATION, IP MANAGEMENT & ENTREPRENEURSHIP

Category	L	T	P	Credit
HSS	3	0	0	3

Preamble

The course covers the various aspects in a business development process based on innovative technological ideas. The course discusses the obstacles that the management and founders will face in a research-oriented company. In addition, the course also analyses and discusses the challenges and opportunities in making an innovative product reach to the large set of users in the market. The course encompasses R&D and innovation processes followed in an established, larger company. The course also covers the development problems of an entrepreneurial start-up enterprise. Besides theoretical knowledge of innovation processes, several sessions are devoted to class discussions to enrich the knowledge of the users.

Prerequisite

Nil

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Explain the different steps in a business development process (Understand)	10
CO2	Demonstrate the requirements and responsibilities put on management, board members and shareholders in different development situations(Apply)	15
CO3	Interpret the market situation to know the opportunities and threats (Apply)	20
CO4	Sketch the needs for financial resources as well as obstacles in the early stages of the development of a business(Apply)	20
CO5	Formulate a business plan based on the innovative idea in technology(Apply)	15
CO6	Sketch the intellectual property rights and legislationto introduce the products in the market (Apply)	20

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	Guided Response	1.1.1, 2.1.1, 4.6.2
CO2	TPS3	Apply	Value	Mechanism	1.1, 2.1,2.2,2.5.1,4.1.2
CO3	TPS3	Apply	Value	Mechanism	1.1, 2.1,2.2,2.5.1,4.1.2
CO4	TPS3	Apply	Value	Mechanism	1.1, 2.1,2.2,2.5.1,4.1.2
CO5	TPS3	Apply	Value	Mechanism	1.1, 2.1,2.2,2.5.1,4.1.2
CO6	TPS3	Apply	Value	Mechanism	1.1, 2.1,2.2,2.5.1,4.1.2

Mapping with Programme Outcomes and Programme Specific Outcomes

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

S- Strong; M-Medium; L-Low

AssessmentPattern: Cognitive Domain

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

Assessment Pattern: Psychomotor

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

Sample Questions for Course Outcome Assessment**

Course Outcome 1(CO1):

1. How innovation helps in product design? List some of the innovation types. Give example to each type.
2. Explain the dimensions of the innovation. How innovation mapping is done in the product design process?

3. What do you mean by sources of innovation? Explain it with suitable examples.

Course Outcome 2(CO2):
1. Analyse how the situational outlook questionnaire acting as diagnostic tool to decide what kind of innovations might be helpful in establishing the appropriate context for innovation.
2. List the environmental factors which contribute to stifling innovation. Also consider that as an engineer you are going to design on innovative solution for societal problem. How the above list of environmental factors affects your innovative process? Will it affect the efficiency of your innovation?

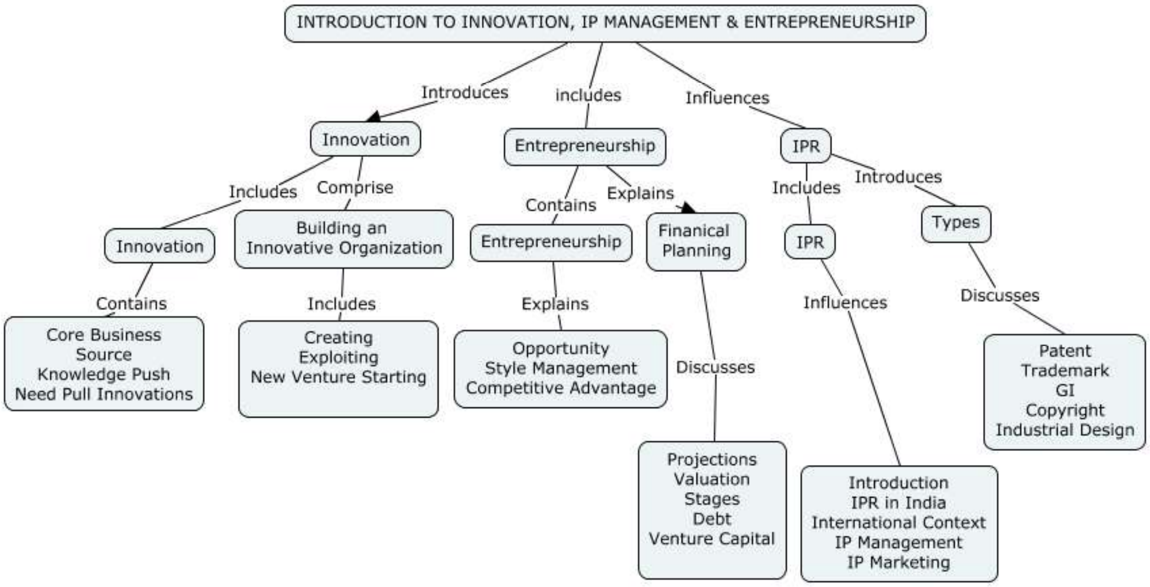
Course Outcome 3(CO3):
1. "XYZ is planned to become an academic entrepreneurship. But while doing that policies he wants to find some factors which acts as a barriers for his academic entrepreneurship. Institutional policy is one of the factors". Can you analyze each institutional variable and give suitable solution to avoid such a problem?
2. How the family background and religion affect an individual's propensity to establish a new venture? Analyze this factor and give proper alternative to overcome this problem.

Course Outcome 4 (CO4):
1. How venture debt is acting as dominant form of financing for start-ups? Also discuss how long term debt is used by modern companies.
2. Differentiate between the different stages of funding. Analyze the suitable structure of a venture capital firm for start-ups.

Course Outcome 5 (CO5):
1. "Are intellectual property rights human rights?" Justify your answer.
2. A company XYZ is allocating one patent filing assignment to you. You want to design software for that company and you want to file that. Is it possible to file that patent in India? Give description for your answer.

Course Outcome 6(CO6):
1. "Agricultural university in India is planning to cultivate one new variety of mangos in their field. They want to make that variety as their own variety to avoid others to cultivate it without their permission". If they want to done this which type of IPR is suitable for them. Analyze different types of IPR and choose suitable one.
2. How idea patent differs from product patent.

Concept Map



Syllabus

Innovation: What and Why?

- Innovation as a core business process, Sources of innovation, Knowledge push vs. need pull innovations.
- Class Discussion- Is innovation manageable or just a random gambling activity?

Building an Innovative Organization

- Creating new products and services, Exploiting open innovation and collaboration, Use of innovation for starting a new venture
- Class Discussion- Innovation: Co-operating across networks vs. 'go-it-alone' approach

Entrepreneurship:

- Opportunity recognition and entry strategies
- Entrepreneurship as a Style of Management
- Maintaining Competitive Advantage- Use of IPR to protect Innovation

Entrepreneurship- Financial Planning:

- Financial Projections and Valuation
- Stages of financing
- Debt, Venture Capital and other forms of Financing

Intellectual Property Rights (IPR)

- Introduction and the economics behind development of IPR: Business Perspective
- IPR in India – Genesis and Development
- International Context
- Concept of IP Management, Use in marketing

Types of Intellectual Property

- Patent- Procedure, Licensing and Assignment, Infringement and Penalty
- Trademark- Use in marketing, example of trademarks- Domain name
- Geographical Indications- What is GI, Why protect them?
- Copyright- What is copyright
- Industrial Designs- What is design? How to protect?

- Class Discussion- Major Court battles regarding violation of patents between corporate companies

Home Assignment:

Case study materials book will be given to students. Students are required to meet in groups before coming to class and prepare on the case for the day. Instructor may ask the student groups to present their analysis and findings to the class.

Further, the topic for class discussion will be mentioned beforehand and students should be ready to discuss these topics (in groups) in class. Students are required to meet in groups before coming to class and prepare on the topic. Few topics are mentioned below as examples. Instructor can add or change any topic as per requirement.

Topic 1- Is innovation manageable or just a random gambling activity?

Topic 2- Innovation: Co-operating across networks vs. 'go-it-alone' approach

Topic 3- Major Court battles regarding violation of patents between corporate companies

Learning Resources

1. Joe Tidd, John Bessant. "Managing Innovation: Integrating Technological, Market and Organizational Change", third edition, John Wiley & Sons, 2005.
2. Case Study Materials: To be distributed for class discussion

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1.	**Innovation: What and Why?**		
1.1	Innovation as a core business process, Sources of innovation, Knowledge push vs. need pull innovations.	2	CO1
1.2	Class Discussion- Is innovation manageable or just a random gambling activity?	3	CO1
2.	**Building an Innovative Organization**		
2.1	Creating new products and services, Exploiting open innovation and collaboration, Use of innovation for starting a new venture	2	CO2
2.2	Class Discussion- Innovation: Co-operating across networks vs. 'go-it-alone' approach	3	CO2
3.	**Entrepreneurship**		
3.1	Opportunity recognition and entry strategies	2	CO3
3.2	Entrepreneurship as a Style of Management	2	CO3
3.3	Maintaining Competitive Advantage- Use of IPR to protect Innovation	2	CO3
4.	**Entrepreneurship- Financial Planning**		
4.1	Financial Projections and Valuation	2	CO4
4.2	Stages of financing	2	CO4

4.3	Debt, Venture Capital and other forms of Financing	2	CO4
5.	**Intellectual Property Rights (IPR)**		
5.1	Introduction and the economics behind development of IPR: Business Perspective	1	CO5
5.2	IPR in India – Genesis and Development	2	CO5
5.3	International Context	2	CO5
5.4	Concept of IP Management, Use in marketing	1	CO5
6.	**Types of Intellectual Property**		
6.1	Patent- Procedure, Licensing and Assignment, Infringement and Penalty	1	CO6
6.2	Trademark- Use in marketing, example of trademarks- Domain name	1	CO6
6.3	Geographical Indications- What is GI, Why protect them?	1	CO6
6.4	Copyright- What is copyright	1	CO6
6.5	Industrial Designs- What is design? How to protect?	1	CO6
6.6	Class Discussion- Major Court battles regarding violation of patents between corporate companies	3	CO6
	TOTAL HOURS	36	

Course Designers:

1. Ms. R. Nagarathna nacse@tce.edu
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20CBPA0	MARKETING RESEARCH & MARKETING MANAGEMENT

Category	L	T	P	Credit
PE	2	0	0	2

Preamble

This subject covers application of management theories, problem solving methods and different techniques in order to find problems in marketing and suitable solutions for the same. This course is also reviews systematic process and concepts involved in marketing and decision making in marketing process. The course is also explores the concept of communicating tools to bridge the people and industry. Many modern tools and methodologies are included to reach the people to satisfy their needs.

Prerequisite

Nil

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Understand basic marketing concept and application of statistical tools in Marketing research	20
CO2	Comprehend the dynamics of marketing and analyze how its various components interact with each other in the real world	15
CO3	Leverage marketing concepts for effective decision making	10
CO4	Classify different methods of pricing, promotion and distribution strategy	20
CO5	Apply various strategies of Internet Marketing	15
CO6	Analyze the demand in micro economics and statistical tools based on the environment.	20

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS 2	Understand	Respond	Guided Response	1.1.1,2.1.3
CO2	TPS 2	Understand	Respond	Guided Response	1.1.1,2.1.3,2.1.4
CO3	TPS 3	Apply	Value	Mechanism	2.1.3,2.1.4,2.1.5
CO4	TPS 3	Apply	Value	Mechanism	2.2.4
CO5	TPS 3	Apply	Value	Mechanism	2.5.4,4.3.4
CO6	TPS 4	Analyse	Organise	Complex Overt Responses	2.5.4,3.1.5,3.2.5

Mapping with ProgrammeOutcomesandProgramme Specific Outcomes

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

S- Strong; M-Medium; L-Low

AssessmentPattern: Cognitive Domain

Cognitive Levels	ContinuousAssessmentTests			Assignment			Terminal Examination
	1	**2**	**3**	1	2	3	
Remember	20	20	20	-	-	-	20
Understand	30	20	20	-	-	-	20
Apply	50	60	60	100	60	60	60
Analyse	0	0	0	0	40	40	0
Evaluate	0	0	0	0	0	0	0
Create	0	0	0	0	0	0	0

AssessmentPattern: Psychomotor

Psychomotor Skill	Miniproject/Assignment/Practical Component
Perception	
Set	
Guided Response	30
Mechanism	70
Complex Overt Responses	
Adaptation	
Origination	

Sample Questions for Course Outcome Assessment**

CourseOutcome1(CO1):

1. How the customer markets are classified? Give parameter which basically works to classify them in different category. Mention example for each market type.
2. List the strategies which followed in marketing objectives of the product life cycle.
3. “Consumer behaviour is a more function of person’s age or generation”. Justify your answer.

CourseOutcome2(CO2):
1. Examine the product positioning characteristics while designing new product for marketing.
2. Explain the role of customer relationship management in today's competitive business world.
3. List 4 P's of business marketing. How each involved in modern management policies?

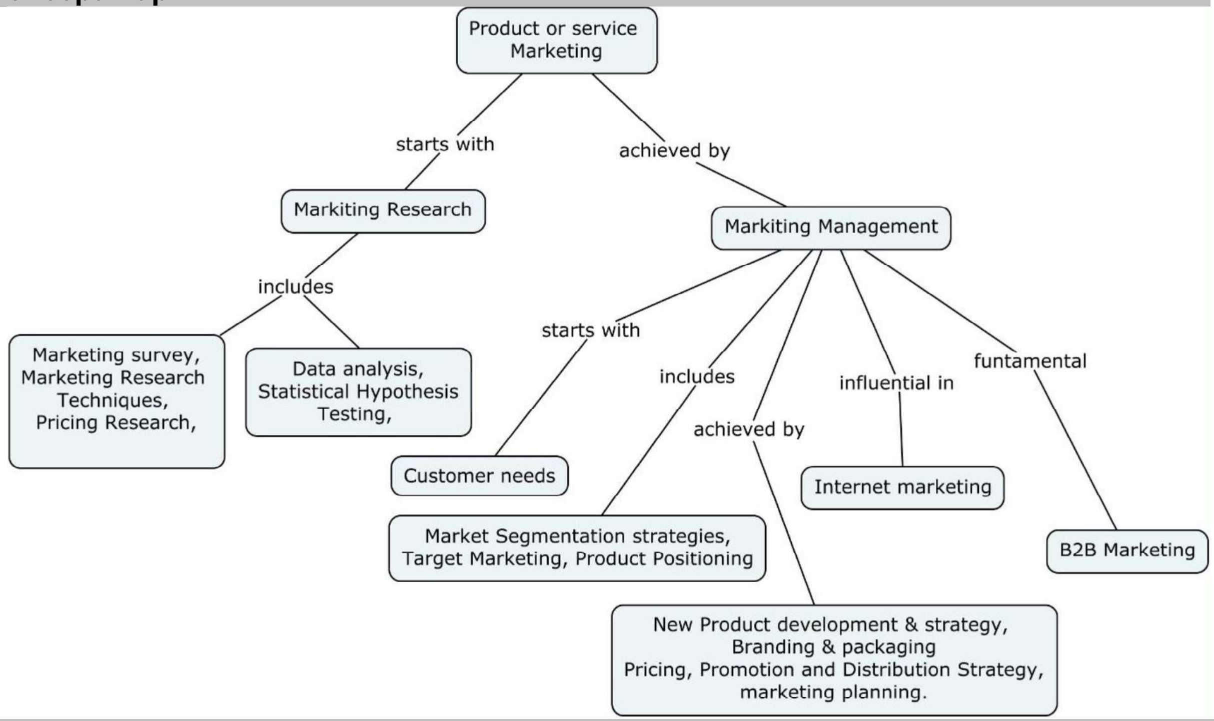
CourseOutcome3(CO3):
1. How does branding affect the improvement in selling? Is medium of branding related to the popularization ratio?
2. Consider the different means of differentiating products and services. Which ones have the most impact on your choices? Why? Can you think of certain brands that excel on a number of these different means of differentiation?
3. What marketing strategies are appropriate at each stage of the product life cycle if you are developing one billing softwaare?

Course Outcome 4 (CO4):
1. Consider the situation that you are going to open a new start-up. You planned to advertise your company to get more order in short term period. How to implement creative advertising strategy in this situation?
2. As a consumer, which pricing method do you prefer to deal with? Why? If the average price were to stay the same, which would you prefer a firm to do: (1) set one price and not deviate or (2) employ slightly higher prices most of the year but offer slightly discounted prices or specials for certain occasions?

Course Outcome 5 (CO5):
1. Is internet marketing more effective than traditional based on classic media such as TV, radio, magazines, etc.? Analyze your answer and prove it.
2. How internet marketing reach the all levels of the people without spending more cost? Analyze it.

CourseOutcome6(CO6):
1. In the given business situation, need to analyse the model based on different aspects. In this case which will be the better tool to get optimal decision? How multivariate helps in this situation.
2. Client is asking the manager to design one questioner related to target audience for his soap product. In that situation if you are the manager how will you design that survey form? How will you allocate weights for each parameter? Design that survey form.

Concept Map



Syllabus

Marketing Concepts and Applications: Introduction to Marketing & Core Concepts, Marketing of Services, Importance of marketing in service sector.

Marketing Planning & Environment: Elements of Marketing Mix, Analyzing needs & trends in Environment - Macro, Economic, Political, Technical & Social

Understanding the consumer: Determinants of consumer behavior, Factors influencing consumer behavior

Market Segmentation: Meaning & Concept, Basis of segmentation, selection of segments, Market Segmentation strategies, Target Marketing, Product Positioning

Product Management: Product Life cycle concept, New Product development & strategy, Stages in New Product development, Product decision and strategies, Branding & packaging

Pricing, Promotion and Distribution Strategy: Policies & Practices – Pricing Methods & Price determination Policies, Sentimental analysis. Marketing Communication – The promotion mix, Advertising & Publicity, 5 M's of Advertising Management. Marketing Channels, Retailing, Marketing Communication, Advertising

Marketing Research: Introduction, Type of Market Research, Scope, Objectives & Limitations
Marketing Research Techniques, Survey Questionnaire design & drafting, Pricing Research, Media Research, Analytical attribute approaches-Determinant Gap Maps.

Data Analysis: Use of various statistical tools – Descriptive & Inference Statistics, Statistical Hypothesis Testing, Multivariate Analysis - Discriminant Analysis, Cluster Analysis, Segmenting and Positioning, Factor Analysis

Internet Marketing: Introduction to Internet Marketing. Mapping fundamental concepts of Marketing (7Ps, STP); Strategy and Planning for Internet Marketing

Business to Business Marketing: Fundamental of business markets. Organizational buying process. Business buyer needs. Market and sales potential. Product in business markets. Price in business markets. Place in business markets. Promotion in business markets. Relationship, networks and customer relationship management. Business to Business marketing strategy

Home Assignments:

1. **Written Analyses of Cases –** Students are expected to report on their analysis and recommendations of what to do in specific business situations by applying concepts and principles learned in class (Case Studies to be shared by Faculty) e.g. "Marketing Myopia"
2. Field visit & live project covering steps involved in formulating Market Research Project
3. Measuring Internet Marketing Effectiveness: Metrics and Website Analytics

Learning Resources

1. Philip Kotler, Marketing Management: Analysis, Planning, Implementation, and Control, 9th Edition, Prentice Hall, 1997
2. William J. Stanton, Charles M. Futrell, Fundamentals of Marketing, 8th Edition, McGraw-Hill, 1987
3. V.S. Ramaswamy, Marketing Management: A Strategic Decision Making Approach, 5th Edition, McGraw Hill, 2017
4. RajendraNargundkar, Marketing Research: Text and Cases, 4th Edition, McGraw-Hill, 2019
5. GC Beri, Marketing Research, 5th Edition, Tata McGraw Hill, 2013
6. Donald Cooper, Pamela Schindler, Marketing Research: Concepts And Cases, Tata McGraw Hill, 2005
7. RajanSaxena, Marketing Management, 4th Edition, McGraw Hill, 2009
8. S.A.Sherlekar, Marketing Management, Himalaya Publishing, 2010
9. S.M. Jha, Services Marketing, Himalaya Publishing, 2009

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1.	**Marketing Concepts and Applications**		
1.1	Introduction to Marketing & Core Concepts	1	CO1
1.2	Marketing of Services		CO1
1.3	Importance of marketing in service sector		CO1
1.4	Marketing Planning & Environment: Elements of Marketing Mix	1	CO1
1.5	Analyzing needs & trends in Environment		CO1
1.6	Macro, Economic, Political, Technical & Social		CO1
1.7	Understanding the consumer: Determinants of consumer behavior	1	CO1
1.8	Factors influencing consumer behavior		CO1
1.9	Market Segmentation: Meaning & Concept	1	CO1
1.10	Basis of segmentation, selection of segments		CO2
1.11	Market Segmentation strategies		CO2
1.12	Target Marketing	1	CO2
1.13	Product Positioning		CO2
2.	**Product Management**		CO1
2.1	Product Life cycle concept	1	CO3
2.2	New Product development & strategy		CO3
2.3	Stages in New Product development	1	CO3
2.4	Product decision and strategies		CO3
2.5	Branding & packaging		CO3
3.	**Pricing, Promotion and Distribution Strategy**		
3.1	Policies & Practices – Pricing Methods & Price	1	CO4

	determination Policies, sentimental analysis		
3.2	Marketing Communication	1	CO4
3.3	The promotion mix	1	CO4
3.4	Advertising & Publicity		CO4
3.5	5 M's of Advertising Management	1	CO4
3.6	Marketing Channels		CO4
3.7	Retailing, Marketing Communication, Advertising	1	CO4
4.	**Marketing Research**		
4.1	Introduction, Type of Market Research, Scope	1	CO6
4.2	Objectives & Limitations Marketing Research Techniques		CO6
4.3	Survey Questionnaire design & drafting	1	CO6
4.4	Pricing Research, Media Research, Analytical attribute approaches-Determinant Gap Maps.		CO4
4.5	Data Analysis: Use of various statistical tools	1	CO6
4.6	Descriptive & Inference Statistics, Statistical Hypothesis Testing		CO6
4.7	Multivariate Analysis - Discriminant Analysis	1	CO6
4.8	Cluster Analysis, Segmenting and Positioning, Factor Analysis		CO6
5.	**Internet Marketing**		
5.1	Introduction to Internet Marketing	1	CO5
5.2	Mapping fundamental concepts of Marketing (7Ps, STP)	1	CO5
5.3	Strategy and Planning for Internet Marketing	1	CO5
6.	**Business to Business Marketing**		
6.1	Fundamental of business markets	1	CO1
6.2	Organizational buying process. Business buyer needs		CO2
6.3	Market and sales potential	1	CO2
6.4	Product in business markets. Price in business markets	1	CO2
6.5	Place in business markets. Promotion in business markets	1	CO2
6.6	Relationship, networks and customer relationship management	1	CO2
6.7	Business to Business marketing strategy		CO2
	Total	24	

Course Designers:

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18MAFH0	OPERATIONS RESEARCH

Category	L	T	P	Credit
OE	2	0	2	3

Preamble

The course aims to formulate and solve problems using linear programming, transportation problems, assignment problems, inventory control, queueing mechanism and simulation methodology. Eventually, the course provides a thorough understanding towards problem formulation and modelling / solving real world problems by choosing appropriate problem solving techniques.

Prerequisite

NIL

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Interpret the optimization problem using the appropriate mathematical model and derive solutions by validating the model.	15
CO2	Construct and solve problems using linear programming concepts and apply the simplex algorithm	15
CO3	Apply the transportation and assignment problems to various applications and test for optimality	15
CO4	Interpret the project by performing appropriate scheduling techniques and generate the needed time statistical chart along with the inventory cost analysis with the help of quantity discount models.	20
CO5	Construct and solve the queueing model by applying various performance measures.	15
CO6	Apply the simulation methodology for various scheduling, queuing and inventory systems.	20

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS 3	Apply	Value	Mechanism	1.2, 2.1, 4.5.3
CO2	TPS 3	Apply	Value	Mechanism	1.2, 2.1, 4.5.3
CO3	TPS 3	Apply	Value	Mechanism	1.2, 2.1, 4.5.3
CO4	TPS 3	Apply	Value	Mechanism	1.2, 2.1, 4.5.3
CO5	TPS 3	Apply	Value	Mechanism	1.2, 2.1, 4.5.3
CO6	TPS 3	Apply	Value	Mechanism	1.2, 2.1, 4.5.3

Mapping with Programme Outcomes and Programme Specific Outcomes

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

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Assignment			Terminal Examination
	1	**2**	**3**	**1**	**2**	**3**	
Remember	20	20	20	-	-	-	20
Understand	40	20	20	-	-	-	20
Apply	40	60	60	100	100	100	60
Analyse							
Evaluate							
Create							

Assessment Pattern: Psychomotor

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

Sample Questions for Course Outcome Assessment**

Course Outcome 1(CO1):

1. How will you construct a mathematical model.
2. Describe the phase formulating the problem
3. A firm manufactures two products A and B on which the profits earned per unit are Rs 3 and Rs 4 respectively. Each product is processed on two machines M1 and M2. Product

A requires one minute of processing time on M1 and two minutes on M2 while B requires one minute on M1 and one minute on M2. Machine M1 is available for not more than 7 hours, while machine M2 is available for 10 hours during any working day. Formulate the number of units of products A and B to be manufactured to get maximum profit.

Course Outcome 2(CO2):

1. A company makes two products (X and Y) using two machines (A and B). Each unit of X that is produced requires 50 minutes processing time on machine A and 30 minutes processing time on machine B. Each unit of Y that is produced requires 24 minutes processing time on machine A and 33 minutes processing time on machine B. At the start of the current week there are 30 units of X and 90 units of Y in stock. Available processing time on machine A is forecast to be 40 hours and on machine B is forecast to be 35 hours. The demand for X in the current week is forecast to be 75 units and for Y is forecast to be 95 units. Company policy is to maximise the combined sum of the units of X and the units of Y in stock at the end of the week.
2. Formulate the problem of deciding how much of each product to make in the current week as a linear program. Solve this linear program graphically.
3. A gold processor has two sources of gold ore, source A and source B. In order to kept his plant running, at least three tons of ore must be processed each day. Ore from source A costs $20 per ton to process, and ore from source B costs $10 per ton to process. Costs must be kept to less than $80 per day. Moreover, Federal Regulations require that the amount of ore from source B cannot exceed twice the amount of ore from source A. If ore from source A yields 2 oz. of gold per ton, and ore from source B yields 3 oz. of gold per ton, how many tons of ore from both sources must be processed each day to maximize the amount of gold extracted subject to the above constraints?
4. The Best Stuffing Company manufactures two types of packing tins- round & flat. Major production facilities involved are cutting and joining. The cutting department can process 200 round tins or 400 flat tins per hour. The joining department can process 400 round tins or 200 flat tins per hour. If the contribution towards profit for a round tin is the same as that of a flat tin, what is the optimal production level? Formulate a linear programming model for this problem and find the optimal solution using simplex method.

Course Outcome 3(CO3):

1. Obtain an initial basic feasible solution to the following transportation problem by using least- cost method.

	D_1	D_2	D_3	Supply
O_1	9	8	5	25
O_2	6	8	4	35
O_3	7	6	9	40
demand	30	25	45	

2. The ICARE Company has three plants located throughout a state with production capacity 50, 75 and 25 gallons. Each day the firm must furnish its four retail shops R1, R2, R3, & R4 with at least 20, 20 , 50, and 60 gallons respectively. The transportation costs (in Rs.) are given below. The economic problem is to distribute the available product to different retail shops in such a way so that the total transportation cost is minimum?

Company	Retail				Supply
	R1	R2	R3	R4	
P1	3	5	7	6	50
P2	2	5	8	2	75
P3	3	6	9	2	25
Demand	20	20	50	60	

3. Obtain an Initial BFS to the following Transportation problem using VAM method?

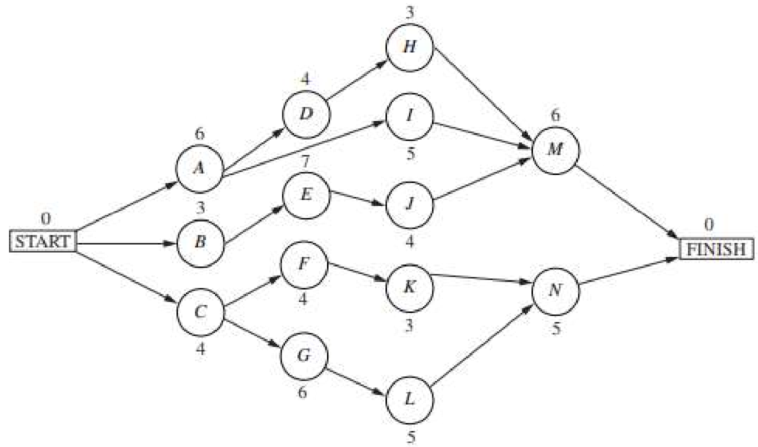
Origin	Destination				Supply
	1	2	3	4	
1	20	22	17	4	120
2	24	37	9	7	70
3	32	37	20	15	50
Demand	60	40	30	110	240

4. Solve the assignment problem:

	1	2	3	4	5
A	6	5	8	11	16
B	1	13	16	1	10
C	16	11	8	8	8
D	9	14	12	10	16
E	10	13	11	8	16

Course Outcome 4 (CO4):

1. Ken Johnston, the data processing manager for Stanley Morgan Bank, is planning a project to install a new management information system. He now is ready to start the project, and wishes to finish in 20 weeks. After identifying the 14 separate activities needed to carry out this project, as well as their precedence relationships and estimated durations (in weeks), Ken has constructed the following project network:



(a) Find all the paths and path lengths through this project network. Which of these paths is a critical path? (b) Find the earliest times, latest times, and slack for each activity. Will Ken be able to meet his deadline if no delays occur? (c) Use the information from part (b) to determine which of the paths is a critical path. What does this tell Ken about which activities he should focus most of his attention on for staying on schedule? (d) Use the information from part (b) to determine what the duration of the project would be if the only delay is that activity I takes 2 extra weeks. What if the only delay is that activity H takes 2 extra weeks? What if the only delay is that activity J takes 2 extra weeks?

2. Using the PERT three-estimate approach, the three estimates for one of the activities are as follows: optimistic estimate 30 days, most likely estimate 36 days, pessimistic estimate 48 days. What are the resulting estimates of the mean and variance of the duration of the activity?
3. Binford Tools manufactures garden tools. It uses inventory, overtime, and subcontracting to absorb demand fluctuations. Expected demand, regular and overtime production capacity, and subcontracting capacity are provided in the following table for the next four quarters for its basic line of steel garden tools:

Quarter	Demand	Regular Capacity	Overtime Capacity	Subcontracting Capacity
1	9,000	9,000	1,000	3,000
2	12,000	10,000	1,500	3,000
3	16,000	12,000	2,000	3,000
4	19,000	12,000	2,000	3,000

The regular production cost per unit is \$20, the overtime cost per unit is \$25, the cost to subcontract a unit is \$27, and the inventory carrying cost is \$2 per unit. The company has 300 units in inventory at the beginning of the year. Determine the optimal production schedule for the four quarters that will minimize total costs.

Course Outcome 5 (CO5):

1. Consider a network node that can serve 1 and store 2 packets altogether. Packets arrive to the node according to a Poisson process. Serving a packet involves two independent sequentially performed tasks: the ERROR CHECK and the packet TRANSMISSION to the output link. Each task requires an exponentially distributed time with an average of 30msec. Give, that we observe that the node is empty in 60% of the time, what is the average time spend in the node for one packet?

2. Packets arrive to a communication node with a single output link according to a Poisson Process. Give the Kendall notation for the following cases: 1. the packet lengths are exponentially distributed, the buffer capacity at the node is infinite 2. the packet length is fixed, the buffer can store n packets 3. the packet length is L with probability $p_L$amd l with probability p_l and there is no buffer in the node
3. In a computer network a link has a transmission rate of C bit/s. Messages arrive to this link in a Poisson fashion with rate λ messages per second. Assume that the messages have exponentially distributed length with a mean of 1/μ bits and the messages are queued in a FCFS fashion if the link is busy. a) Determine the minimum required C for given λ and μ such that the average system time (service time + waiting time) is less than a given time T_0.

Course Outcome 6(CO6):

1. Bakery Shop keeps stock of a popular brand of cake. Previous experience indicates the daily demand as given below:

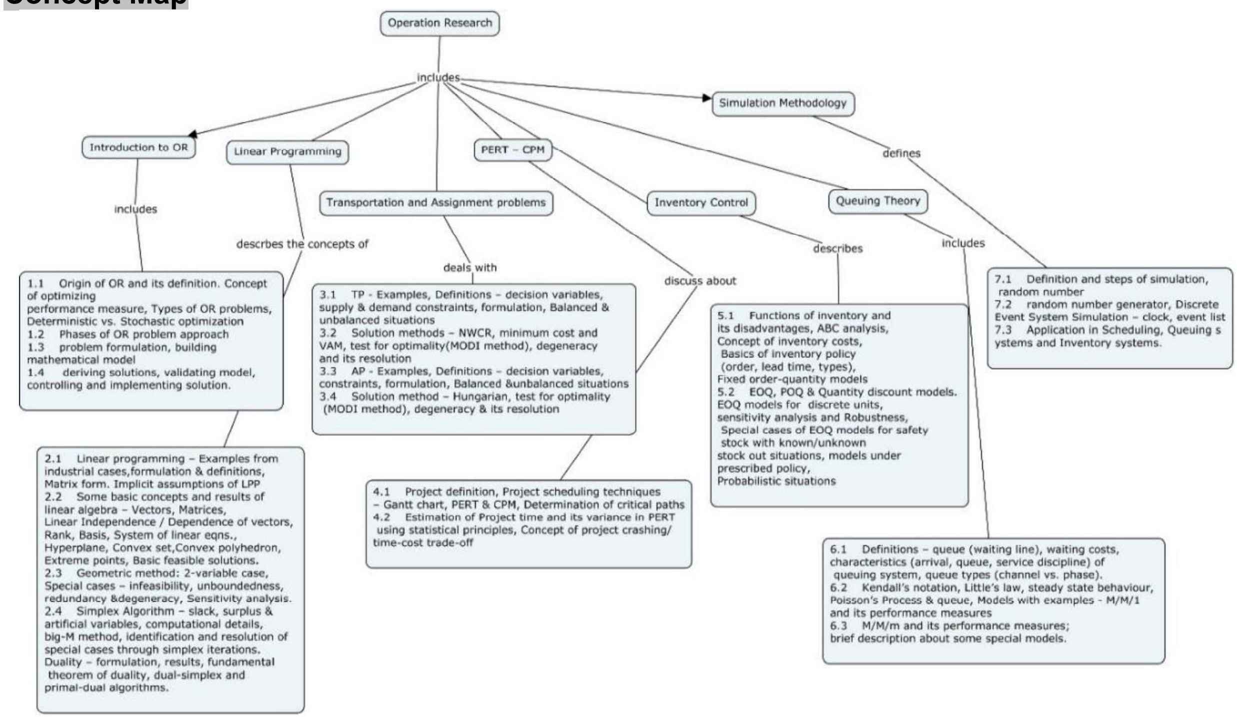
Daily demand	Probability
0	0.01
15	0.15
25	0.20
35	0.50
45	0.12
50	0.02

   Consider the following sequence of random numbers: 21, 27, 47, 54, 60, 39, 43, 91, 25, 20. Using this sequence, simulate the demand for the next 10 days. Find out the stock situation, if the owner of the bakery shop decides to make 30 cakes every day. Also estimate the daily average demand for the cakes on the basis of simulated data.
2. Generate a sequence of 15 random numbers for which seed is 342, constant multiplier is 20, increment is 45 and modulus is 30Question 3
3. People arrive at the New Delhi Railway station to buy tickets according to the following distribution.

Inter-arrival Time (Min.)	Frequency
2	10
3	20
4	40
5	20
6	10

The service time is 5 minutes and there is only one ticket counter. The Railway station incharge is interested in predicting the operating characteristics of this counter during a typical operating day from 10.00 a.m. to 11.00 a.m. Use simulation to determine the average waiting time before service and average time a person spends in the system.

Concept Map



Syllabus

THEORY COMPONENT:

Introduction to OR:

Origin of OR and its definition. Concept of optimizing performance measure, Types of OR problems, Deterministic vs. Stochastic optimization, Phases of OR problem approach – problem formulation, building mathematical model, deriving solutions, validating model, controlling and implementing solution.

Linear Programming:

Linear programming – Examples from industrial cases, formulation & definitions, Matrix form. Implicit assumptions of LPP.

Some basic concepts and results of linear algebra – Vectors, Matrices, Linear Independence/Dependence of vectors, Rank, Basis, System of linear eqns., Hyperplane, Convex set, Convex polyhedron, Extreme points, Basic feasible solutions.

Geometric method: 2-variable case, Special cases – infeasibility, unboundedness, redundancy &degeneracy, Sensitivity analysis.

Simplex Algorithm – slack, surplus & artificial variables, computational details, big-M method, identification and resolution of special cases through simplex iterations.

Duality – formulation, results, fundamental theorem of duality, dual-simplex and primal-dual algorithms.

Transportation and Assignment problems:
TP - Examples, Definitions – decision variables, supply & demand constraints, formulation, Balanced & unbalanced situations, Solution methods – NWCR, minimum cost and VAM, test for optimality (MODI method), degeneracy and its resolution.
AP - Examples, Definitions – decision variables, constraints, formulation, Balanced &unbalanced situations, Solution method – Hungarian, test for optimality (MODI method), degeneracy & its resolution.
PERT – CPM:
Project definition, Project scheduling techniques – Gantt chart, PERT & CPM, Determination of critical paths, Estimation of Project time and its variance in PERT using statistical principles, Concept of project crashing/time-cost trade-off.
Inventory Control:
Functions of inventory and its disadvantages, ABC analysis, Concept of inventory costs, Basics of inventory policy (order, lead time, types), Fixed order-quantity models – EOQ, POQ & Quantity discount models. EOQ models for discrete units, sensitivity analysis and Robustness, Special cases of EOQ models for safety stock with known/unknown stock out situations, models under prescribed policy, Probabilistic situations.
Queuing Theory:
Definitions – queue (waiting line), waiting costs, characteristics (arrival, queue, service discipline) of queuing system, queue types (channel vs. phase).
Kendall's notation, Little's law, steady state behaviour, Poisson's Process & queue, Models with examples - M/M/1 and its performance measures; M/M/m and its performance measures; brief description about some special models.
Simulation Methodology:
Definition and steps of simulation, random number, random number generator, Discrete EventSystem Simulation – clock, event list, Application in Scheduling, Queuing systems and Inventory systems.
PRACTICAL COMPONENT:
1. Formulation of linear programming problems.
2. Solution of linear programming problem using graphical method with:
    i. Multiple constraints
    ii. Unbounded solution
    iii. Infeasible solution
    iv. Alternative or multiple solution
3. Enumeration of all basic solutions for linear programming problem.
4. Solution of linear programming problem with simplex method.
5. Problem solving using Big M method.
6. Problem solving using two phase method.
7. Solution on primal problem as well as dual problem.
8. Solution based on dual simplex method.
9. Verification of weak duality, strong duality and complementary slackness property.
10. Solution of transportation problem.
11. Solution of assignment problem.
12. Solution of integer programming problem using Branch and Bound method.
13. Solution of integer programming problem using Gomory's cutting plane method.
14. Simulation: Random number generation.
15. Monte Carlo method.
16. Performance measures for M/M/1 queuing model.
17. ABC analysis.
18. Inventory model.

Learning Resources

1. Hamdy A. Taha, “Operations Research - An Introduction”, MacMillan Co., Eighth Edition 2010.
2. K.G. Murthy,”Linear Programming”,Wiley,1983
3. G. Hadley ,”Linear Programming”,Narosa,2002
4. H.M. Wagner,”Principles of Operations Research with Application to Managerial Decisions” ,PHI,Second Edition,1980.
5. Hiller and Lieberman, “ Introduction to Operations Research” Tata McGraw Hill, Eighth Edition, 2005
6. Thomas L. Saaty ,”Elements of Queuing Theory”, Dover Publications,2000.
7. A. Ravi Ravindran,”Operations Research and Management Science, Hand Book”, CRC Press,2007.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Lectures	Course Outcome
1	**Introduction to OR**		
1.1	Origin of OR and its definition. Concept of optimizing performance measure, Types of OR problems, Deterministic vs. Stochastic optimization	1	CO1
1.2	Phases of OR problem approach	1	CO1
1.3	problem formulation, building mathematical model	1	CO1
1.4	deriving solutions, validating model, controlling and implementing solution.	1	CO1
2	**Linear Programming**		
2.1	Linear programming – Examples from industrial cases, formulation & definitions, Matrix form. Implicit assumptions of LPP	1	CO2
2.2	Some basic concepts and results of linear algebra – Vectors, Matrices, Linear Independence / Dependence of vectors, Rank, Basis, System of linear eqns., Hyperplane, Convex set,Convex polyhedron, Extreme points, Basic feasible solutions.	2	CO2
2.3	Geometric method: 2-variable case, Special cases – infeasibility, unboundedness, redundancy &degeneracy, Sensitivity analysis.	1	CO2
2.4	Simplex Algorithm – slack, surplus & artificial variables, computational details, big-M method, identification and resolution of special cases through simplex iterations. Duality – formulation, results, fundamental theorem of duality, dual-simplex and primal-dual algorithms.	1	CO2
3	**Transportation and Assignment problems**		
3.1	TP - Examples, Definitions – decision variables, supply & demand constraints, formulation, Balanced & unbalanced situations	1	CO3
3.2	Solution methods – NWCR, minimum cost and VAM, test for optimality(MODI method), degeneracy and its resolution	1	CO3

3.3	AP - Examples, Definitions – decision variables, constraints, formulation, Balanced &unbalanced situations	1	CO3
3.4	Solution method – Hungarian, test for optimality (MODI method), degeneracy & its resolution	1	CO3
4	**PERT – CPM**		
4.1	Project definition, Project scheduling techniques – Gantt chart, PERT & CPM, Determination of critical paths	1	CO4
4.2	Estimation of Project time and its variance in PERT using statistical principles, Concept of project crashing/time-cost trade-off	1	CO4
5	**Inventory Control**		
5.1	Functions of inventory and its disadvantages, ABC analysis, Concept of inventory costs, Basics of inventory policy (order, lead time, types), Fixed order-quantity models	1	CO4
5.2	EOQ, POQ & Quantity discount models. EOQ models for discrete units, sensitivity analysis and Robustness, Special cases of EOQ models for safety stock with known/unknown stock out situations, models under prescribed policy, Probabilistic situations	2	CO4
6	**Queuing Theory**		
6.1	Definitions – queue (waiting line), waiting costs, characteristics (arrival, queue, service discipline) of queuing system, queue types (channel vs. phase).	2	CO5
6.2	Kendall's notation, Little's law, steady state behaviour, Poisson's Process & queue, Models with examples - M/M/1 and its performance measures	1	CO5
6.3	M/M/m and its performance measures; brief description about some special models.	1	CO5
7	**Simulation Methodology**		
7.1	Definition and steps of simulation, random number	1	CO6
7.2	random number generator, Discrete Event System Simulation – clock, event list	1	CO6
7.3	Application in Scheduling, Queuing systems and Inventory systems.	2	CO6
	TOTAL HOURS	**24**	

Course Contents and Lecture Schedule for Laboratory

Module No.	Topic	No. of Hours	Course Outcome
1	Formulation of linear programming problems	2	CO1
2	Solution of linear programming problem using graphical method with: i. Multiple constraints ii. Unbounded solution iii. Infeasible solution iv. Alternative or multiple solution	2	CO2
3	Enumeration of all basic solutions for linear	2	

	programming problem with simplex method.		CO2
4	Problem Solving using Big M and two-phase method	2	CO2
5	Solution on primal problem as well as dual problem, dual simplex method and Verification of weak duality, strong duality and complementary slackness property	2	CO2
6	Solution of Transportation and Assignment problem	2	CO3
7	Solution of integer programming problem using Branch and Bound method and Gomory's cutting plane method	2	CO3
8	ABC analysis.	2	CO4
9	Monte Carlo method	2	CO5
10	Performance measures for M/M/1 queuing model	2	CO5
11	Simulation: Random number generation.	2	CO6
12	Inventory model	2	CO6
	TOTAL HOURS	**24**	

Course Designers:

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20CB460	SOFTWARE DESIGN WITH UML

Category	L	T	P	Credit
PC	2	0	2	3

Preamble

This course highlights the concept of Object Oriented software design and design patterns to get acquainted with UML diagrams in analysis and design. Focus will be on Object Oriented analysis of the system requirements followed by system design. This course helps in learning software design in a real world perspective.

Prerequisite

Nil

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Explain the concepts of modelling in software development life cycle	10
CO2	Analyze the system requirements for real world problems using use case diagrams	15
CO3	Create sequence and collaboration diagram for finding objects of the process involved	20
CO4	Create logical view design of given software using structural diagrams	20
CO5	Draw State chart and activity diagram to demonstrate the behaviour of the given software	20
CO6	Draw component and deployment models for given software specification	15

*** Weightage depends on Bloom's Level, number of contact hours

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	-	1.2,2.1.2,2.5.2
CO2	TPS3	Apply	Value	-	1.2,2.1.2, 2.1.5, 3.1.1,3.1.2, 3.2.3,3.2.5, 4.3.1, 4.3.2, 4.3.3, 4.4.1,4.4.2,4.4.3,4.4.4,4.5.1, 4.5.3,
CO3	TPS3	Apply	Value	-	1.2,2.1.2, 2.1.5, 3.1.1,3.1.2, 3.2.3,3.2.5, 4.3.1, 4.3.2, 4.3.3, 4.4.1,4.4.2,4.4.3,4.4.4,4.5.1, 4.5.3,
CO4	TPS3	Apply	Value	-	1.2,2.1.2, 2.1.5, 3.1.1,3.1.2, 3.2.3,3.2.5, 4.3.1, 4.3.2, 4.3.3, 4.4.1,4.4.2,4.4.3,4.4.4,4.5.1, 4.5.3,
CO5	TPS3	Apply	Value	-	1.2,2.1.2, 2.1.5, 3.1.1,3.1.2,

					3.2.3,3.2.5, 4.3.1, 4.3.2, 4.3.3, 4.4.1,4.4.2,4.4.3,4.4.4,4.5.1, 4.5.3,
CO6	TPS3	Apply	Value	-	1.2,2.1.2, 2.1.5, 3.1.1,3.1.2, 3.2.3,3.2.5, 4.3.1, 4.3.2, 4.3.3, 4.4.1,4.4.2,4.4.3,4.4.4,4.5.1, 4.5.3,

Mapping with Programme Outcomes and Programme Specific Outcomes

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

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests 1	2	3	Practical	Terminal Examination
Remember	20	20	20		-
Understand	20	20	20		20
Apply	60	60	60	100	80
Analyse	-	-	-	-	-
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Assessment Pattern: Psychomotor

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

Sample Questions for Course Outcome Assessment**

Course Outcome 1 (CO1):

1. List the factors to consider when selecting an appropriate software development process.

(Remember)

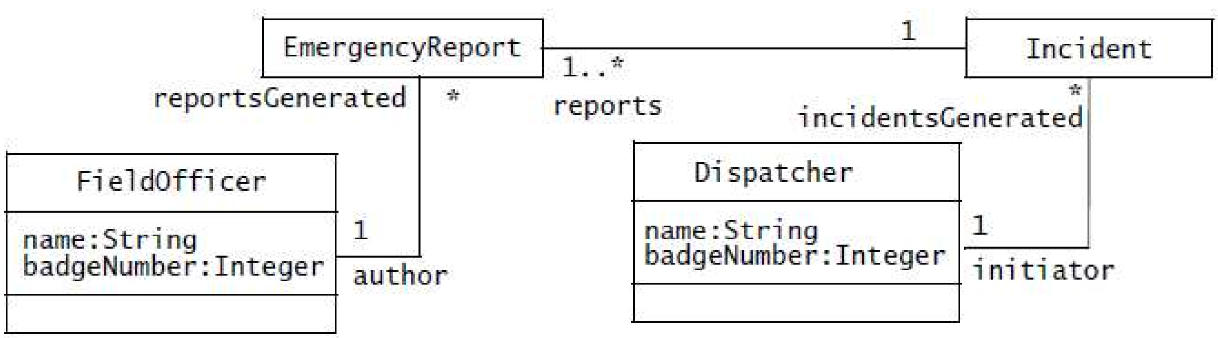
2. What makes software design different from coding? (Understand)
3. What are the characteristics of a quality software? (Understand)

Course Outcome 2 (CO2):

1. What is dependency? Where can it be used? Explain the stereotypes that can be used along with it. (Understand)
2. Create a Use Case Diagram (in UML) with users, Auctions , searching in an Internet auction system (Apply)
3. Draw the Use case diagram for the Traffic control management system (Apply)

Course Outcome 3 (CO3):

1. Give some examples of situations where collaboration diagrams may be beneficial and Explain the relations between collaboration diagram and sequence diagram. (Understand)
2. Draw a sequence diagram for the “warehouseOnFire scenario-report Emergency” given below. Include objects and instances of other classes you may need. Draw only the first five message sends. (Apply)



3. Develop Collaboration diagrams for the purchase journey of a consumer on an e-commerce website depicting simplistic interactions between small numbers of objects the user signing in using their unique Id to access an interface of profiles, products, etc. (Apply)

Course Outcome 4 (CO4):

1. Briefly describe system’s classes, attributes, operations and relationships using Class diagrams (Understand)
2. Distinguish strong and weak aggregations with an example. (Understand)
3. Create a class diagram for ATMs system (Ex class-Bank, Customer, ATM, Account-Savings/Current, and ATM Transaction.) (Apply)

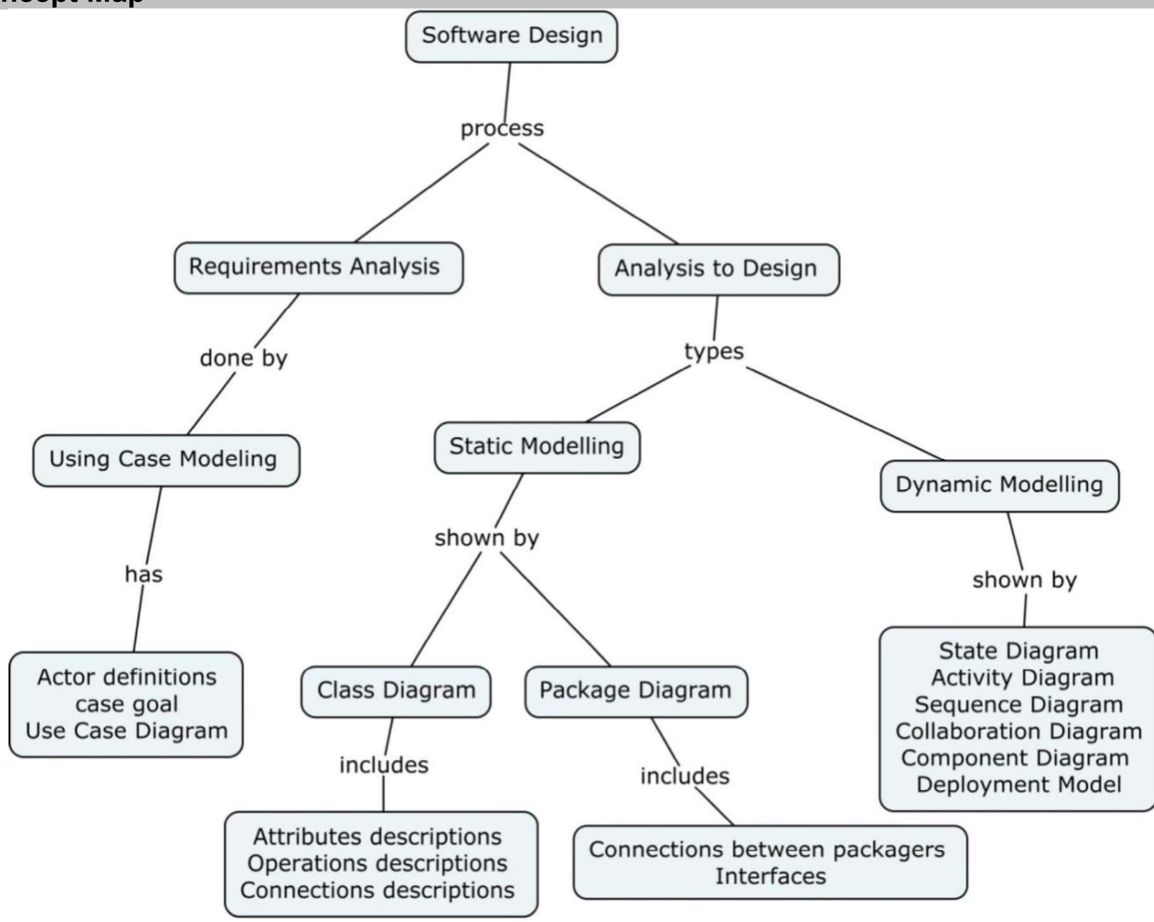
Course Outcome 5 (CO5):

1. What is a message? How it will be represented in UML? Mention its types. (Understand)
2. Consider the process of ordering a pizza over the phone. Draw an activity diagram representing each step of the process, from the moment you pick up the phone to the point where you start eating the pizza. Do not represent any exceptions. Include activities that others need to perform. (Apply)
3. Add exception handling to the activity diagram you developed in Exercise 2-15. Consider at least three exceptions (e.g., delivery person wrote down wrong address, delivery person brings wrong pizza, store out of anchovies). (Apply)

Course Outcome 6 (CO6):

1. Consider a system that includes a Web server and two database servers. Both Database servers are identical: the first acts as a main server, and the second acts as a redundant back-up in case the first one fails. Users use Web browsers to access data through the Web server. They also have the option of using a proprietary client that accesses the databases directly. Draw a UML deployment diagram representing the hardware/software mapping of this system. **(Apply)**
2. Draw a UML deployment diagram for Client/server architectural style (UML component diagram). Clients request services from one or more Servers. The Server has no knowledge of the Client. **(Apply)**
3. Develop aA UML deployment diagram representing the allocation of components to different nodes. Web browsers on PCs and Macs can access a WebServer that provides information from a Database. **(Apply)**

Concept Map



Syllabus

Introduction to on Object Oriented Technologies and the UML Method.

- Software development process: The Waterfall Model vs. The Spiral Model.
- The Software Crisis, description of the real world using the Objects Model.
- Classes, inheritance and multiple configurations.
- Quality software characteristics.
- Description of the Object Oriented Analysis process vs. the Structure Analysis Model.

Introduction to the UML Language.
- Standards.
- Elements of the language.
- General description of various models.
- The process of Object Oriented software development.
- Description of Design Patterns.
- Technological Description of Distributed Systems.

Requirements Analysis Using Case Modeling
- Analysis of system requirements.
- Actor definitions.
- Writing a case goal.
- Use Case Diagrams.
- Use Case Relationships.

Transfer from Analysis to Design in the Characterization Stage: Interaction Diagrams.
- Description of goal.
- Defining UML Method, Operation, Object Interface, Class.
- Sequence Diagram.
- Finding objects from Flow of Events.
- Describing the process of finding objects using a Sequence Diagram.
- Describing the process of finding objects using a Collaboration Diagram.

The Logical View Design Stage: The Static Structure Diagrams.
- The Class Diagram Model.
- Attributes descriptions.
- Operations descriptions.
- Connections descriptions in the Static Model.
- Association, Generalization, Aggregation, Dependency, Interfacing, Multiplicity.

Package Diagram Model.
- Description of the model.
- White box, black box.
- Connections between packagers.
- Interfaces.
- Create Package Diagram.
- Drill Down.

Dynamic Model: State Diagram / Activity Diagram.
- Description of the State Diagram.
- Events Handling.
- Description of the Activity Diagram.
- Exercise in State Machines.

Component Diagram Model.
- Physical Aspect.
- Logical Aspect.
- Connections and Dependencies.

- User face.
- Initial DB design in a UML environment.

Deployment Model.
- Processors.
- Connections.
- Components.
- Tasks.
- Threads.
- Signals and Events.

Laboratory:
The following UML diagrams will be practiced by the students for applications such as ATM Systems, Stock Maintenance System and Remote Procedure Call Implementation etc.

1. Class Diagram
2. Object Diagram
3. Use Case Diagram
4. Sequence Diagram
5. Collaboration Diagram
6. State Chart Diagram
7. Activity Diagram
8. Component Diagram
9. Deployment Diagram

Learning Resources

1. Grady Booch, James Rumbaugh, Ivar Jacobson, "*The Unified Modelling LanguageUser Guide",* 2005
2. Bernd Bruegge and Allen H. Dutoit*, "Object-Oriented Software Engineering: using UML, Patterns, and Java", 2009*
3. Erich Gamma, Richard Helm, Ralph Johnson, and John M. Vlissides, *"Design Patterns: Elements of Reusable Object-Oriented Software*", 1994

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1	**Introduction to on Object Oriented Technologies and the UML Method**		
1.1	Software development process: The Waterfall Model vs. The Spiral Model, The Software Crisis, description of the real world using the Objects Model	1	CO1
1.2	Classes, inheritance and multiple configurations, Quality software characteristics.	1	CO1
1.3	Description of the Object Oriented Analysis process vs. the Structure Analysis Model	1	CO1
2	**Introduction to the UML Language**		
2.1	Standards, Elements of the language, General description of various models	1	CO1
2.2	The process of Object Oriented software development, Description of Design Patterns	1	CO1
2.3	Technological Description of Distributed Systems	1	CO1

3	**Requirements Analysis Using Case Modeling**		
3.1	Analysis of system requirements, Actor definitions, Writing a case goal	2	CO2
3.2	Use Case Diagrams, Use Case Relationships	2	CO2
4	**Transfer from Analysis to Design in the Characterization Stage: Interaction Diagrams**		
4.1	Description of goal, Defining UML Method, Operation, Object Interface, Class Diagram, Object Diagram	1	CO3
4.2	Sequence Diagram, Finding objects from Flow of Events. Describing the process of finding objects using a Sequence Diagram	1	CO3
4.3	Describing the process of finding objects using a Collaboration Diagram	1	CO3
5	**The Logical View Design Stage: The Static Structure Diagrams**		
5.1	The Class Diagram Model, Attributes descriptions, Operations descriptions, Connections descriptions in the Static Model	1	CO4
5.2	Association, Generalization, Aggregation, Dependency, Interfacing, Multiplicity	2	CO4
6	**Package Diagram Model**		
6.1	Description of the model, White box, black box Connections between packagers, Interfaces	1	CO4
6.2	Create Package Diagram, Drill Down	1	CO4
7	**Dynamic Model: State Diagram / Activity Diagram**		
7.1	Description of the State Diagram, Events Handling, Exercise in State Machines	1	CO5
7.2	Description of the Activity Diagram	1	CO5
8	**Component Diagram Model**		
8.1	Physical Aspect, Logical Aspect, Connections and Dependencies, User face	1	CO6
8.2	Initial DB design in a UML environment.	1	CO6
9	**Deployment Model**		
9.1	Processors, Connections, Components, Tasks	1	CO6
9.2	Threads, Signals and Events.	1	CO6
		24	

Module No.	**Topic**	**No. of Hours**	**Course Outcome**
1	Implementation of Use Case Diagram	2	CO2
2	Implementation of Class Diagram	4	CO4
3	Implementation of Object Diagram	2	CO4
4	Implementation of Sequence Diagram	3	CO3
5	Implementation of Collaboration Diagram	3	CO3

6	Implementation of State Chart Diagram	3	CO5
7	Implementation of Activity Diagram	3	CO5
8	Implementation of Component Diagram	2	CO6
9	Implementation of Deployment Diagram	2	CO6
		24	
	Total Hours	**48**	

Course Designers:

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20CB470	DESIGN THINKING

Category	L	T	P	Credit
ES	2	0	2	3

Preamble

Design Thinking (DT) is a Behavioural oriented course. In this course learners can able to recognize the importance of Design Thinking in Businesses. The Activities such as Doodling and Story Telling is included to present the ideas and prototype. This course also helps to create value proposition statements as part of their presentations. The outcome of the course is to make students recognize how Agile and DT complement each other to deliver customer satisfaction

Prerequisite

Nil

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage in %
CO1	Conduct an immersion activity and fill up the Design Thinking question template	20
CO2	Recognize the steps to create problem statements in the define phase of Design Thinking	10
CO3	Apply the steps in the ideate phase of Design Thinking	15
CO4	Create a prototype to Recognize the importance of service value proposition	15
CO5	Test a prototype created through a Design Thinking process	15
CO6	Demonstrate the design thinking driven project based on customer satisfaction	25

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value	Mechanism	1.1, 1.2, 2.1.1, 3.1.2, 3.2.3, 3.2.6, 4.1.2
CO2	TPS3	Apply	Value	Mechanism	1.1, 1.2, 2.1.2, 2.5.1, 2.5.2, 3.1.2, 3.2.3, 3.2.6, 4.1.2
CO3	TPS3	Apply	Value	Mechanism	1.1, 1.2, 2.1.3, 3.1.2, 3.2.3, 3.2.6, 4.1.2, 4.3.1
CO4	TPS3	Apply	Value	Mechanism	1.1, 1.2, 2.1.4, 3.1.2, 3.2.3, 3.2.6, 4.1.2, 4.4.1
CO5	TPS3	Apply	Value	Mechanism	1.1, 1.2, 2.1.5, 3.1.2, 3.2.3, 3.2.6, 4.1.2, 4.4.1
CO6	TPS4	Analyze	Organise	Complex Overt Responses	1.1, 1.2, 2.1.5, 3.1.2, 3.2.3, 3.2.6, 4.1.2, 4.4.1, 4.5.1,4.5.5

Mapping with Programme Outcomes and Programme Specific Outcomes

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

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

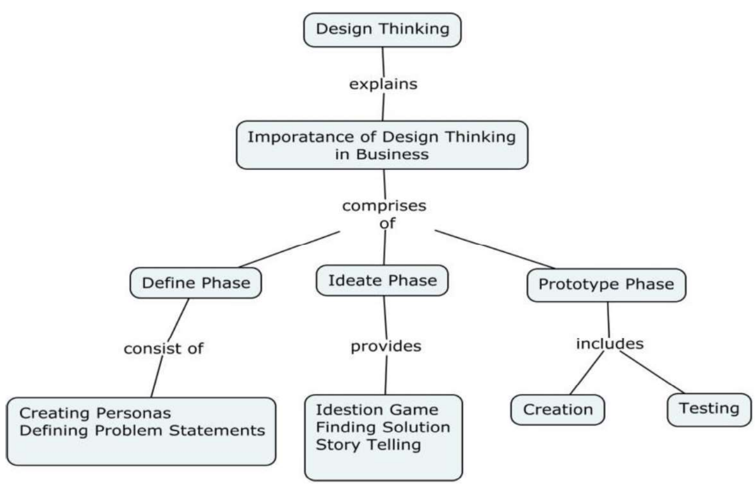
S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Phases	Deliverables	Marks	Course Outcomes
Continuous Assessment			
Review 1 – Problem Identification and Definition	Technical Report	10	CO1 and CO2
Review 2 – Ideating Solutions	Technical Report	20	CO3
Review 3 –Creating a Prototype	Technical Report	20	CO4 and CO5
End-Semester Examination			
Project	Prototype	100	CO6

- The report and presentation will be evaluated based on Rubrics
- Project Demonstration and Poster presentation will be evaluated by two faculty members nominated by their respective Head of the Department.

Concept Map



Syllabus

1.0 Importance of Design Thinking in Business: Needs Assessment, Stakeholder Identification, Stakeholder Requirement Project Time Constraint.

2.0 Define Phase : Creating Personas, Problem Statements, Defining Problem Statements

3.0 Ideate Phase : Introduction, Ideation game, Ideate to find solutions, Story Telling

4.0 Prototype phase: Importance, Creating Prototype, Value Proposition Statement, Testing

Learning Resources

1. NirEyal -Hooked, Portfolio, 2014
2. Rod Judkins -The Art of Creative Thinking ,Hachette Book Publishing,2015
3. Dan Senor and Saul singer-Start Up nation,Twelve Publisher, 2011

4. Simon Sinek -Start with Why, Portfolio, 2011

Online Resources:

1 Understanding Design thinking WF NEN
2 Design Thinking and Innovation at Apple Wei Li
3 Stanford Webinar- Design Thinking = Method, Not Magic
4 Stanford Design Thinking Virtual Crash Course
5 So Many Uses- activity to spark creativity and design

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1	**Importance of Design Thinking in Business (11)**		
1.1	Why is Design Thinking important for business	1	CO1
1.2	Why is Design Thinking important for you?	2	CO1
1.3	What is DT?	1	CO1
1.4	What is empathy?	1	CO1
1.5	How to empathize?	2	CO1
1.6	Intro to Immersion Activity	1	CO1
1.7	Immersion activity	3	CO1
2	**Define Phase (5)**		
2.1	Creating personas	2	CO2
2.2	Problem statements	1	CO2
2.3	Defining problem statements	2	CO2
3	**Ideate Phase (8)**		
3.1	How to Ideate?	1	CO3
3.2	Ideation games	2	CO3
3.3	Ideate to find solutions	2	CO3
3.4	Let’s doodle!	1	CO3
3.5	What is Storytelling in DT?	2	CO3
4	**Prototype Phase (12)**		
4.1	Why is a Prototype important in Design Thinking?	1	CO4
4.2	Prototype your idea	3	CO4
4.3	Value Proposition Statement	2	CO4
4.4	Testing in Design Thinking	1	CO5
4.5	Test the Prototype	2	CO5
4.6	Role of DT in your work	1	CO5
4.7	How Agile and DT complement each other to deliver customer satisfaction	1	CO5
4.8	Share your Satori	1	CO5
Project		12	CO6
	Total	**48**	

Course Designers:

1. Dr.R.Leena Sri rlsit@tce.edu
2. TCS Design Thinking Team

20CB480	OPERATING SYSTEMS LAB

Category	L	T	P	Credit
PC	0	0	2	1

Preamble

This practical course enables the students to study and clearly understand the fundamental design and implementation ideas in the engineering of Operating Systems.

Prerequisite

Basics of C Programming and Unix/Linux Operating System

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Develop bash shell scripts using basic Unix/Linux commands (Apply)	10
CO2	Compute the average waiting time and turnaround time for the given set of processes by using CPU scheduling algorithms FCFS, SJFS, Priority and Round Robin (Apply)	20
CO3	Construct Inter Process Communication between processes using shared memory, pipes and message queue method based system calls (Apply)	15
CO4	Construct Semaphore based synchronization solution to the classical synchronization problem (Apply)	10
CO5	Develop solution to handle deadlock with an avoidance and detection approach (Apply)	20
CO6	Construct the First fit and Best fit memory allocation methods used by the memory manager (Apply)	15
C07	Develop solution to allocate files on the secondary storage device (Apply)	10

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value	Mechanism	1.2, 2.3.2,4.5.3
CO2	TPS3	Apply	Value	Mechanism	1.2, 2.3.2, 4.5.3
CO3	TPS3	Apply	Value	Mechanism	1.2, 2.3.2, 4.5.3
CO4	TPS3	Apply	Value	Mechanism	1.2, 2.3.2, 4.5.3
CO5	TPS3	Apply	Value	Mechanism	1.2, 2.3.2, 4.5.3
CO6	TPS3	Apply	Value	Mechanism	1.2, 2.3.2, 4.5.3
CO7	TPS3	Apply	Value	Mechanism	1.2, 2.3.2, 4.5.3

Mapping with Programme Outcomes and Programme Specific Outcomes

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

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

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

Assessment Pattern: Psychomotor

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

List of Experiments/Activities with CO Mapping

Sl.No	Experiments	No. of hours	CO
1.	Basic Unix/Linux/Minix File system and data manipulation commands.	2	CO1
2.	Implementing bash shell scripting with various control statements	2	CO1
3.	Given the list of processes, their CPU burst times and arrival times print the Gantt chart for the scheduling algorithms FCFS and SJFS. For each of the scheduling policies, compute and print the average waiting time and average turnaround time.	2	CO2
4.	Given the list of processes, their CPU burst times and arrival	2	CO2

	times print the Gantt chart for Priority scheduling algorithm. Compute and print the average waiting time and average turnaround time.		
5.	Given the list of processes, their CPU burst times and arrival times print the Gantt chart for Round Robin scheduling algorithm. Compute and print the average waiting time and average turnaround time.	2	CO2
6.	Develop processes executing and communicating using Shared Memory based Unix/Linux system calls	2	CO3
7.	Develop applications performing Inter Process Communication using pipes or message queues system calls	2	CO3
8.	Implement the Producer – Consumer synchronization problem using semaphores system calls in UNIX/Linux	2	CO4
9.	Implement Bankers Algorithm for Deadlock Avoidance	2	CO5
10.	Implement Deadlock detection approach for single instance and multiple instance resource types.	2	CO5
11.	Implement First fit and Best fit memory management schemes	2	CO6
12.	Implement the Disk Scheduling algorithm and indexing, hashing based allocation method	2	CO7
	Total No. of Hours	24	

Learning Resources

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne: Operating System Concepts Essentials, ninth edition, John Wiley and Sons, 2013.
2. Operating Systems: Internals and Design Principles, William Stallings, Pearson Education, 2018.
3. Operating System: A Design-oriented Approach, Charles Patrick Crowley, McGrawHill Eductaion,2017.
4. Operating Systems: A Modern Perspective, Gary J. Nutt, Pearson, 1997.
5. Design of the Unix Operating Systems. Maurice J. Bach. Pearson Education India, 2015.
6. Understanding the Linux Kernel, Daniel Pierre Bovet, Marco Cesati, O’Reilly Media.

Course Designers

1. Dr.P.Chitra pccse@tce.edu
2. Dr.G.MadhuPriya gmadhupriya@tce.edu

20CB490	DATABASE MANAGEMENT SYSTEMS LAB

Category	L	T	P	Credit
PC	0	0	2	1

Preamble

This course helps the students to design database applications using different data models and implement them using Structured Query Language (SQL). This course facilitates the students to perform different database operations such as storage, retrieval and manipulation of data using RDBMS and helps the students to execute procedures, functions, packages and triggers against the databases.

Students can develop front end applications in high level languages and these applications can operate with the data on backend databases.

Prerequisite

Nil

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Develop E-R and Relational models for the given real world database application	10
CO2	Build relational schemas using functional dependencies and normal forms	10
CO3	Write SQL queries for data storage, retrieval and manipulation against the relational schemas.	30
CO4	Construct and use different database objects, complex data types using SQL.	10
CO5	Develop sub programs such as Procedures, Functions, Triggers and Packages using PL/SQL and use them for data manipulation.	25
CO6	Develop an application in high level language and make use of APIs to interact with databases	15

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value		1.2, 2.1.1, 2.1.2, 2.1.5, 2.2.3, 2.4.3, 3.1, 4.4.3, 4.4.4, 4.5
CO2	TPS3	Apply	Value		1.2, 2.1.1, 2.1.2, 2.1.5, 2.2.3, 2.4.3, 3.1, 4.4.3, 4.4.4, 4.5
CO3	TPS3	Apply	Value		1.2, 2.1.1, 2.1.2, 2.1.5, 2.2.3, 2.4.3, 3.1, 4.4.3, 4.4.4, 4.5
CO4	TPS3	Apply	Value		1.2, 2.1.1, 2.1.2, 2.1.5, 2.2.3, 2.4.3, 3.1, 4.4.3, 4.4.4, 4.5
CO5	TPS3	Apply	Value		1.2, 2.1.1, 2.1.2, 2.1.5, 2.2.3, 2.4.3, 3.1, 4.4.3, 4.4.4, 4.5
CO6	TPS3	Apply	Value		1.2, 2.1.1, 2.1.2, 2.1.5, 2.2.3, 2.4.3, 3.1, 4.4.3, 4.4.4, 4.5

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO 1	S	M	L		L	M	L	M	M	M		M	M	L	M
CO 2	S	M	L		L	M	L	M	M	M		M	M	L	M
CO 3	S	M	L		M	M	L	M	M	M		M	M	L	M
CO 4	S	M	L		M	M	L	M	M	M		M	M	L	M
CO 5	S	M	L		M	M	L	M	M	M		M	M	L	M
CO 6	S	M	L		M	M	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
Analyse	-	-
Evaluate	-	-
Create	-	-

Assessment Pattern: Psychomotor

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

List of Experiments/Activities with CO Mapping

Module No.	Topic	No. of Hours	Course Outcome
1.	Design of database application using E-R model and Relational Model	2	CO1
2.	Identification of functional dependencies and normalization of schemas	2	CO2
3.	Creation of database using SQL – DDL commands along with the integrity constraints(using standard data of reasonable size)	2	CO3
4.	Manipulation of database using SQL – DML commands and Practice of DCL and TCL commands (using standard data of reasonable size)	2	CO3
5.	Implementation of Simple Queries involving Date Functions, String Functions , Math Functions, Aggregate Functions (Group by and having clause) - (using standard data of reasonable size)	2	CO3
6.	Implementation of Complex Queries involving Joins, set operators, sub queries, (using standard data of reasonable size) and evaluation of queries	2	CO3
7.	Implementation of Complex queries such as correlated sub queries, hierarchical queries and spatial queries	2	CO3
8.	Creation of various database objects such as index, sequence, synonym, complex data types (LOB,BFILE), collection types, structured types using SQL	2	CO4
9.	Implementation of PL/SQL Procedure, Function along with cursor	2	CO5
10.	Implementation of PL/SQL Trigger (Row and Statement Triggers)	2	CO5
11.	Implementation of Package using PL/SQL	2	CO5
12.	Development of database application in high level language using APIs and Demonstration of a complete database application	2	CO6
	Total	**24**	

Course Designers:

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2. Dr.M. Nirmala Devi mnit@tce.edu

CURRICULUM AND DETAILED SYLLABI

FOR

B.TECH DEGREE (Computer Science and Business Systems) PROGRAMME

FIFTH SEMESTER

FOR THE STUDENTS ADMITTED FROM THE

ACADEMIC YEAR 2020 – 2021 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
(A Govt. Aided, ISO 9001:2008 certified Autonomous Institution affiliated to Anna University)
B.Tech Degree (Computer Science and Business Systems) Programme
COURSES OF STUDY
(For the candidates admitted from 2020 – 2021 onwards)

FIFTH SEMESTER

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	No.of Hours / Week			Credits
				L	T	P	
THEORY COURSES							
1	20CB510	Design and Analysis of Algorithms	PC	3	0	0	3
2	20CB520	Compiler Design	PC	3	0	0	3
3	20CB530	Fundamentals of Management	HSS	2	0	0	2
4	20CB540	Business Strategy	HSS	2	0	0	2
5	20CB550	Business Communication & Value Science - III	Project	2	0	0	2
6	18XXGX0	General Elective – I	GE	3	0	0	3
THEORY CUM PRACTICAL COURSES							
7	20CBPX0	Program Elective – I	PSE	3	0	2	4
PRACTICAL COURSES							
8	20CB570	Design and Analysis of Algorithms Lab	PC	0	0	4	2
9	20CB580	Compiler Design Lab	PC	0	0	2	1
10	20CB590	Mini Project	Project	0	0	2	1
			TOTAL	**18**	**0**	**10**	**23**

PC : Program Core
PSE : Program Specific Elective
HSS : Humanities and Social Science
GE : General Elective
L : Lecture
T : Tutorial
P : Practical

Note:

1 Hour Lecture is equivalent to 1 credit

1 Hour Tutorial is equivalent to 1 credit

2 Hours Practical is equivalent to 1 credit

THIAGARAJAR COLLEGE OF ENGINEERING, MADURAI- 625 015
(A Govt. Aided, ISO 9001:2008 certified Autonomous Institution affiliated to Anna University)
B.Tech Degree (Computer Science and Business Systems) Programme
SCHEME OF EXAMINATIONS
(For the candidates admitted from 2020 – 2021onwards)

FIFTH SEMESTER

S.No.	Course Code	Name of the Course	Duration of Terminal Exam. in Hrs.	Marks			Minimum Marks for Pass	
				Continuous Assessment	Terminal Exam *	Max. Marks	Terminal Exam	Total
THEORY								
1	20CB510	Design and Analysis of Algorithms	3	50	50	100	25	50
2	20CB520	Compiler Design	3	50	50	100	25	50
3	20CB530	Fundamentals of Management	3	50	50	100	25	50
4	20CB540	Business Strategy	3	50	50	100	25	50
5	20CB550	Business Communication & Value Science - III	-	100	-	100	-	50
THEORY CUM PRACTICAL COURSES								
6	20CBPX0	Program Elective – I	3	50	50	100	25	50
PRACTICAL								
7	20CB570	Design And Analysis of Algorithms Lab	3	50	50	100	25	50
8	20CB580	Compiler Design Lab	3	50	50	100	25	50
9	20CB590	Mini Project	-	50	50	100	25	50

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

20CB510	DESIGN AND ANALYSIS OF ALGORITHMS

Category	L	T	P	Credit	Terminal Exam Type
PC	3	-	-	3	Theory

Preamble

This course enables the students to understand and apply algorithms for solving various computational problems. The different approaches used in algorithms help them to identify clear and efficient ways to solve a problem by increasing the efficiency in regards to time and space complexity with correctness of proof.

Prerequisite

NIL

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Use the asymptotic analysis to identity the performance of algorithm with correctness of proof	15
CO2	Familiarize with various algorithm design techniques and structuring of data	20
CO3	Apply various design algorithms to analyze the problem solving techniques	15
CO4	Illustrate the various graph algorithms to synthesize and model the engineering problems	20
CO5	Solve tractability and Intractability of an algorithm by applying the algorithm techniques	15
CO6	Construct approximation and randomization algorithms to analyse the effectiveness of running time for algorithms	15

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value	-	1.2, 2.1.1, 2.1.3
CO2	TPS2	Understand	Respond	-	1.2, 2.1.1, 2.4.6
CO3	TPS3	Apply	Value	-	1.2,2.1.1
CO4	TPS3	Apply	Value	-	1.2, 2.1.1
CO5	TPS3	Apply	Value	-	1.2, 2.1.1
CO6	TPS3	Apply	Value	-	1.2, 2.1.1,2.1.4

Mapping with Programme Outcomes and Programme Specific Outcomes

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

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

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

Sample Questions for Course Outcome Assessment**

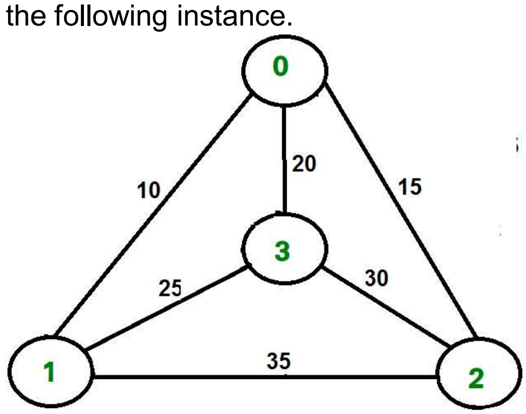
** (2 to 3 at the cognitive level of course outcome)

Course Outcome 1(CO1):

1. Show that if f (n) and g(n) are monotonically increasing functions, then so are the functions f(n)+ g(n) and f (g(n)), and if f(n) and g(n) are in addition nonnegative, then f (n) . g(n) is monotonically increasing.
2. Solve the sorting problems by proving that it terminates / it sorts the set of numbers and determine the time complexity with correctness of proof.
3. For linear / binary search algorithm determine the complexities based on recursive, iterative procedures.

Course Outcome 2(CO2):

1. Suppose we have a stick of length n for some positive integer n. Let p, l ∈ {1, 2, ..., n} denote the utility of a stick of length l. Design a dynamic programming based algorithm which, given n and p1, . . . , pn as inputs, finds a way to break a stick of length n into pieces such that the total utility (the sum of utilities of the pieces) is maximized.
2. Apply the Branch and Bound Method (using the MST-based bounding scheme) seen in class for the TSP to solve the following instance.



3. Solve using dynamic programming to find the optimal parenthesization of a matrix-chain product. Using the algorithm, find the optimal parenthesization of a matrix-chain product whose sequence of dimensions is (5,10,3,12,5)

Course Outcome 3(CO3):

1. Let n denotes the number of vertices in the graph. Prove that if there exists an k^n factor approximation algorithm for the Travelling Salesman problem for any positive integer k, then P = NP.
2. Minimize the usage of bins by defining the n items with different weights {4, 8, 1, 4, 2, 1} and the bin capacity is c = 12. Construct an algorithm for bin packing.
3. Give the formulation of modified knapsack problem using branch and bound and find the optimal solution using least cost branch and bound with n=4, m=15, (p1…p4) = (15 15 17 23), (w1…w4) = (3 5 6 9).

Course Outcome 4 (CO4):

1. Let G be an undirected weighted graph. Each edge f in G has a real weight w(f) which could possibly be negative. Let T1 and T2 be two different minimum spanning trees of G. Let e = (u,v) be an edge that is in T1 but not in T2. Let P be the unique path between u and v in T2. Show that P has an edge e 0 such that w(e 0) = w(e).
2. [Hamiltonian path] Let G be an undirected graph with n vertices. A Hamiltonian path of G is a path which visits each vertex of G exactly once. Design a O(poly(n)· 2 n) time algorithm to determine if G has a hamiltonian path, and to find a Hamiltonian path in case G has one, where poly(n) is any polynomial function of n.
3. Let G be a connected, weighted graph. Prove that, if all edge weights in G are distinct, then G has exactly one MST.

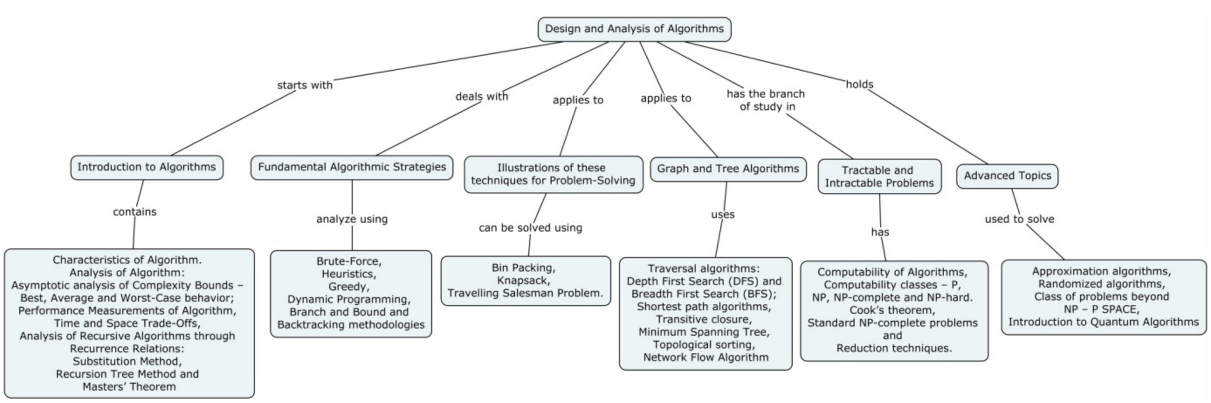
Course Outcome 5 (CO5):

1. Let X be an NP-Complete problem. Consider a decision problem Z Є NP such that X<=Z. Then defend that Z is also NP-Complete.
2. Prove whether 3SAT is NP complete generate the proof of correctness
3. Construct a pseudo-code to implement the naive polynomial-evaluation algorithm that computes each term of the polynomial from scratch. Calculate the running time of this algorithm.

Course Outcome 6(CO6):

1. Solve a O(log n) factor approximation algorithm for the Set Cover problem
2. Construct a 2 factor approximation algorithm for the Vertex Cover problem. [Hint: try to find polynomial time computable lower bound on the size of a minimum vertex cover.]
3. Consider the Quick Sort problem where a Central Pivot is a pivot that divides the array in such a way that one side has at-least 1/4 elements. Determine
    a. How many times while loop runs before finding a central pivot?
    b. Compute the Overall time complexity.

Concept Map



Syllabus

Introduction: Characteristics of Algorithm. Analysis of Algorithm: Asymptotic analysis of Complexity Bounds – Best, Average and Worst-Case behavior; Time and Space Trade-Offs, Analysis of Recursive Algorithms through Recurrence Relations: Substitution Method, Recursion Tree Method and Masters' Theorem.

Fundamental Algorithmic Strategies: Greedy, Dynamic Programming, Branch and Bound and Backtracking methodologies;

Illustrations of these techniques for Problem-Solving, Bin Packing, Knapsack, Travelling Salesman Problem.

Graph and Tree Algorithms: Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS); Shortest path algorithms, Minimum Spanning Tree, Topological sorting, Network Flow Algorithm.

Tractable and Intractable Problems: Computability classes – P, NP, NP-complete and NP-hard. Cook's theorem, Standard NP-complete problems and Reduction techniques.

Advanced Topics: Approximation algorithms, Randomized algorithms, Class of problems beyond NP – P SPACE.

Learning Resources

Text Books:

1. Fundamental of Computer Algorithms, E. Horowitz and S. Sahni.
2. The Design and Analysis of Computer Algorithms, A. Aho, J. Hopcroft and J. Ullman.

Reference Books:

1. Introduction to Algorithms, T. H. Cormen, C. E. Leiserson and R. L. Rivest.
2. Computer Algorithms: Introduction to Design and Analysis, S. Baase.
3. The Art of Computer Programming, Vol. 1, Vol. 2 and Vol. 3, .D. E. Knuth.
4. Quantum Computation and Quantum Information, Michael A. Nielsen and Isaac L. Chuang

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1.	**Introduction**		
1.1	Characteristics of Algorithm& Analysis of Algorithm	1	CO1
1.2	Asymptotic analysis of Complexity Bounds	1	CO1
1.3	Best, Average and Worst-Case behavior	1	CO1
1.4	Time and Space Trade-Offs	1	CO1
1.5	Analysis of Recursive Algorithms through Recurrence Relations: Substitution Method	1	CO1
1.6	Recursion Tree Method & Masters' Theorem	1	CO1
2.	**Fundamental Algorithmic Strategies**		
2.1	Greedy	2	CO2

2.2	Dynamic Programming	2	CO2
2.3	Branch and Bound	2	CO2
2.4	Backtracking methodologies	1	CO2
3	**Illustrations of these techniques for Problem-Solving**		
3.1	Bin Packing	2	CO3
3.2	Knapsack	2	CO3
3.3	Travelling Salesman Problem	2	CO3
4	**Graph and Tree Algorithms**		
4.1	Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS)	1	CO4
4.2	Shortest path algorithms	2	CO4
4.3	Minimum Spanning Tree	1	CO4
4.4	Topological sorting	1	CO4
4.5	Network Flow Algorithm	2	CO4
5	**Tractable and Intractable Problems**		
5.1	Computability classes – P & NP	1	CO5
5.2	Computability classes – NP complete & NP Hard	1	CO5
5.3	Cook's theorem	1	CO5
5.4	Standard NP-complete problems	1	CO5
5.5	Reduction techniques	1	CO5
6	**Advanced Topics**		
6.1	Approximation algorithms	2	CO6
6.2	Randomized algorithms	2	CO6
6.3	Class of problems beyond NP – P SPACE	1	CO6
	TOTAL	36	

Course Designers:

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2. Mrs. J. Felicia Lilian jflcse@tce.edu

20CB520	COMPILER DESIGN

Category	L	T	P	Credit	Terminal Exam Type
PC	3	0	0	3	Theory

Preamble

This course is intended as a primer to this various stages typical in the design of standard compilers, starting with the front-end stages of compilation, and giving a peek into back-end and some recent advancement in the area. At the end of the course, students should be able to appreciate the underlying concepts in compiler design, and be motivated to learn the art of analyzing and transforming programs for performance.

Prerequisite

Data Structures and Algorithms, Formal Languages and Automata Theory

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage in %
CO1	Describe the role of each phase of a compiler; develop a lexical analyzer for recognizing the tokens.	15
CO2	Compute the formal and practical properties of different approaches to parsing	20
CO3	Construct semantic analyzer for type checking	15
CO4	Assemble the symbol table and construct intermediate code generator to translate the source program into intermediate code	15
CO5	Construct code optimizers to optimize the target code generated	20
CO6	Implement a basic compiler for any programming language	15

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	Guided Response	1.2, 4.3.2
CO2	TPS3	Apply	Value	Mechanism	1.2, 2.1.2, 3.2.3, 4.5.3
CO3	TPS3	Apply	Value	Mechanism	1.2, 2.1.2, 3.2.3, 4.3.2
CO4	TPS3	Apply	Value	Mechanism	1.2, 2.1.2, 3.2.3, 4.5.3
CO5	TPS3	Apply	Value	Mechanism	1.2, 2.1.2, 3.2.3, 4.5.3
CO6	TPS3	Apply	Value	Mechanism	1.2, 2.1.2, 3.2.3, 4.5.3

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	L											L		
CO2	S	M	L			L	L	L		L		L	M	L	L
CO3	S	M	L			L	L	L		L		L	M	L	L
CO4	S	M	L			L	L	L		L		L	M	L	L
CO5	S	M	L			L	L	L		L		L	M	L	L
CO6	S	M	L	L		L	L	L		L		L	M	L	L

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive levels	Continuous Assessment Tests			Assignments			Terminal examination
	1	2	3	1	2	3	
Remember	20	10	10				20
Understand	20	30	30				20
Apply	60	60	60	100	100	100	60
Analyse							
Evaluate							
Create							

Assessment Pattern: Psychomotor

Psychomotor Skill	Miniproject /Assignment/Practical Component
Perception	
Set	
Guided Response	30
Mechanism	70
Complex Overt Responses	
Adaptation	
Origination	

Sample Questions for Course Outcome Assessment**

Course Outcome 1(CO1):

1. Distinguish between compiler and interpreter
2. What is the role of lexical analyzer?
3. Write the regular expression for the language "All strings of digits with even numbers"
4. Define the term finite automata. Distinguish between NFA and DFA

Course Outcome 2(CO2):

1. Discuss SLR parsing and construct SLR parsing table for the grammar
   E→E+T/T
   T→T*F/F
   F→(E)/id
2. Construct CLR parsing table for the given context free grammar
   S→AA
   A→aA|b
3. Construct the operator precedence relations table for the following grammar and show the parser movements for the given input string i) *id=id ii) id*id=id. The grammar is S→L=R, S→R, L→*R, L→id, R→L

Course Outcome 3(CO3):

1. For the Syntax Directed Definition give annotated parse trees for the following expressions (3+4)*(5+6) and 1*2*3*(4+5)
2. Obtain Syntax Translated Transition for the following grammar
   E -> E+T | T

```
T -> T*F | F
F -> INTLIT
```

Draw a parse tree for S=2+3*4

3. Apply the S-attributed definition and constructs syntax tree for a simple expression grammar involving only the binary operations + and -, as usual these operators are at the same precedence level and are jointly left associative. All non terminal have one synthesized attribute node which represents a node of the syntax tree. Production: E→E1+T, E→T, T→(E), T→id/num

Course Outcome 4 (CO4):

1. Apply Back patching to generate intermediate code for the following input
   x:=2+y;
   if x<y then x:=x+y;
   repeat
   y:=y*2;
   while x>10 do x:=x/2
   until x<y
   write the semantic rule and derive the parse tree for the given code
2. How activation record is relevant to the intermediate code generation phase with respect to procedure declarations?
3. Consider the regular expression (a – b) * (c + d) + (a – b) convert the following intermediate forms
   a) infix to postfix b) Three address code c) syntax tree

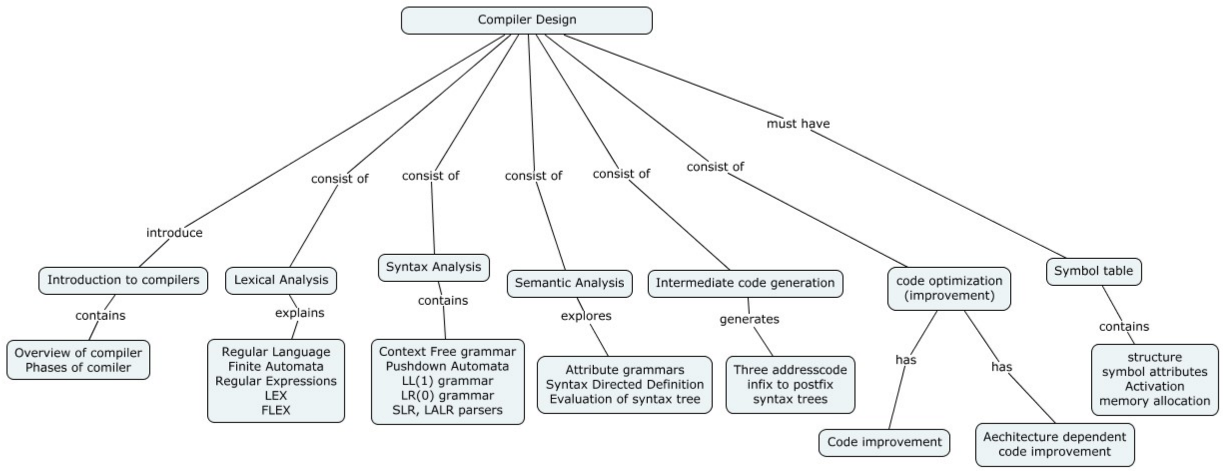
Course Outcome 5 (CO5):

1. *for (i=2; i<=n; i++)*
   a[i] = TRUE;
   count = 0;
   s = sqrt(n);
   for (i=2; i<=s; i++)
   if (a[i]) / i has been found to be a prime */ {*
   count++;
   *for (j=2*i; j<=n; j = j+i)*
   a[j] = FALSE; / no multiple of i is a prime */*
   }
   a) Translate the program into three-address statements of the type we have been using in this section. Assume integers require 4 bytes.
   b) Construct the flow graph for your code from (a).
   c) Identify the loops in your flow graph from (b).
2. Construct an algorithm will do flow – of – control optimizations in a sliding peephole on target machine code
3. Implement various code optimization techniques in a C program of quick sort

Course Outcome 6(CO6):

1. Generate code using code generation algorithm for the sum of prime numbers from 1 to N
2. Devise a register-allocation strategy on the assumption that we automatically store all registers on the stack before each procedure call and restore them after the return.
3. A certain loop requires 5 loads, 7 stores, and 8 arithmetic operations. What is the minimum initiation interval for a software pipelining of this loop on a machine that executes each operation in one clock tick, and has resources enough to do, in one clock tick: a) 3 loads, 4 stores, and 5 arithmetic operations. b) 3 loads, 3 stores, and 3 arithmetic operations.

Concept Map



Syllabus

Introduction: Phases of compilation and overview. Lexical Analysis (scanner): Regular languages, finite automata, regular expressions, relating regular expressions and finite automata, scanner generator (lex, flex).

Syntax Analysis (Parser): Context-free languages and grammars, push-down automata, LL(1) grammars and top-down parsing, operator grammars, LR(O), SLR(1), LR(1), LALR(1) grammars and bottom-up parsing, ambiguity and LR parsing, LALR(1) parser generator (yacc, bison)

Semantic Analysis: Attribute grammars, syntax directed definition, evaluation and flow of attribute in a syntax tree.

Symbol Table: Basic structure, symbol attributes and management Run-time environment: Procedure activation, parameter passing, value return, memory allocation, scope.

Intermediate Code Generation: Translation of different language features, different types of intermediate forms.

Code Improvement (optimization): control-flow, data-flow dependence etc.; local optimization, global optimization, loop optimization, peep-hole optimization etc.

Architecture dependent code improvement: instruction scheduling (for pipeline), loop optimization (for cache memory) etc. Register allocation and target code generation.

Advanced topics: Type systems, data abstraction, compilation of Object Oriented features and non-imperative programming languages

Learning Resources

1. V. Aho, R. Sethi and J. Ullman, 1. Compilers: Principles, Techniques and Tools,, 2nd Edition, Pearson, 2007
2. Randy Allen, Ken Kennedy, “Optimizing Compilers for Modern Architectures: A Dependence-based Approach”, Morgan Kaufmann Publishers, 2002.
3. Keith D Cooper and Linda Torczon, “Engineering a Compiler”, Morgan Kaufmann Publishers Elsevier Science, 2004.
4. https://onlinecourses.nptel.ac.in › noc22_cs14 › preview

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome

1.	**Introduction (5)**		
1.1	Phases of compilation and overview	1	CO1
1.2	Lexical Analysis (scanner): Regular languages, finite automata, regular expressions	2	CO1
1.3	Relating regular expressions	1	CO1
1.4	Finite automata, scanner generator	1	CO1
2.	**Syntax Analysis (Parser) (8)**		
2.1	Context-free languages and grammars	1	CO2
2.2	push-down automata	1	CO2
2.3	LL(1) grammars and top-down parsing, operator grammars	1	CO2
2.4	LR(O)	1	CO2
2.5	SLR (1)	1	CO2
2.6	LR(1)	1	CO2
2.7	LALR(1) grammars	1	CO2
2.8	Bottom-up parsing		CO2
2.9	Ambiguity and LR parsing	1	CO2
2.10	LALR(1) parser generator (yacc, bison)		CO2
3.	**Semantic Analysis (5)**		
3.1	Attribute grammars, and flow of attribute in a syntax tree.	2	CO3
3.2	Syntax Directed Definition, Evaluation	2	CO3
3.3	Evaluation and flow of attribute in a syntax tree	1	CO3
4.	**Symbol Table & Intermediate Code Generation (5)**		
4.1	Basic Structure, Symbol Attributes and Management	1	CO4
4.2	Run-Time Environment: Procedure Activation	1	CO4
4.3	Parameter Passing, Value Return	1	CO4
4.4	Memory Allocation, Scope.	1	CO4
4.5	Translation of different language features	1	CO4
4.6	Different types of Intermediate forms		CO4
5.	**Code Improvement (optimization) (7)**	5	
5.1	Control-Flow	1	CO5
5.2	Data-Flow Dependence	1	CO5
5.3	Loop Optimization	1	CO5
5.4	Peep-Hole Optimization	2	CO5
5.5	Local Optimization	1	CO5
5.6	Global Optimization	1	CO5
6.	**Architecture dependent code improvement**	4	
6.1	Instruction Scheduling (for Pipeline)	2	CO6
6.2	Loop Optimization (for Cache Memory)	1	CO6
6.3	Register allocation and target code generation	1	CO6
7.	**Advanced topics**	3	
7.1	Type Systems, Data Abstraction,	1	CO6
7.2	Compilation of Object Oriented Features	1	CO6
7.3	Non-Imperative Programming Languages	1	CO6
	Total	**36**	

Course Designers:

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2. Mr.V.Janakiraman vjncse@tce.edu

20CB530	FUNDAMENTALS OF MANAGEMENT	Category	L	T	P	Credit	Terminal Exam Type
		HSS	2	-	-	2	Theory

Preamble

This course will teach students the management theories, evolution of management over the years and few basic concepts without going into the details. After studying this course the students will develop an understanding about how organizations work and find it easier to grasp the intricacies of other management areas such as finance, marketing, strategy etc. which will be taken up in future terms.

Prerequisite

NIL

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Understand the role of management responsibilities, its evolution in comparison with traditional and modern approaches	15
CO2	Understand the various functions of a management	15
CO3	Interpret the organization behaviour by balancing the work, handling stress, decision making and diverse culture	20
CO4	Apply the various organizational design and structures to build the value proportion by inheriting the downsides	15
CO5	Apply the ethical principles with social responsibilities	20
CO6	Apply the role of a leader and to lead an organization	15

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	-	1.1, 4.1
CO2	TPS2	Understand	Respond	-	1.1, 4.2
CO3	TPS3	Apply	Value	-	1.1, 2.5, 3.1,4.2
CO4	TPS3	Apply	Value	-	2.5, 3.1, 4.1
CO5	TPS3	Apply	Value	-	2.5, 3.1, 4.1
CO6	TPS3	Apply	Value	-	2.5, 3.1, 4.1

Mapping with Programme Outcomes and Programme Specific Outcomes

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

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Assignment			Terminal Examination
	1	2	3	1	2	3	
Remember	40	20	20	-	-	-	20
Understand	60	40	40	100	-	-	40
Apply	-	40	40	-	100	100	40
Analyse	-	-	-	-	-	-	-
Evaluate	-	-	-	-	-	-	-
Create	-	-	-	-	-	-	-

Sample Questions for Course Outcome Assessment**

** (2 to 3 at the cognitive level of course outcome)

Course Outcome 1(CO1):
1. What are the levels of management
2. What do you mean by contingency theory of management what are its implications and relevance? Also state how does this approach differs from systems approach
3. What are the different theories of management
4. Explain a short note on the following a) System theory b) Administrative theory c) Classical theory

Course Outcome 2(CO2):
1. What is creativity ?Explain the role of creativity in decision making also discuss its process and the way an individual can made more creative).
2. What are the different styles of plans? Describe various steps in the planning process
3. Explain any four quantitative techniques used for management decision making
4. Explain Strategic Vs Operations planning.
5. What do you understand by forecasting? how it related with planning

Course Outcome 3(CO3):
1. Discuss the Relationship between the Authority, Power and Influence?
2. What advice would you give to calm down a colleague who's stressed out about a deadline?
3. Define decision- making and explain the process of decision –making that affects the efficiency of the business decisions.

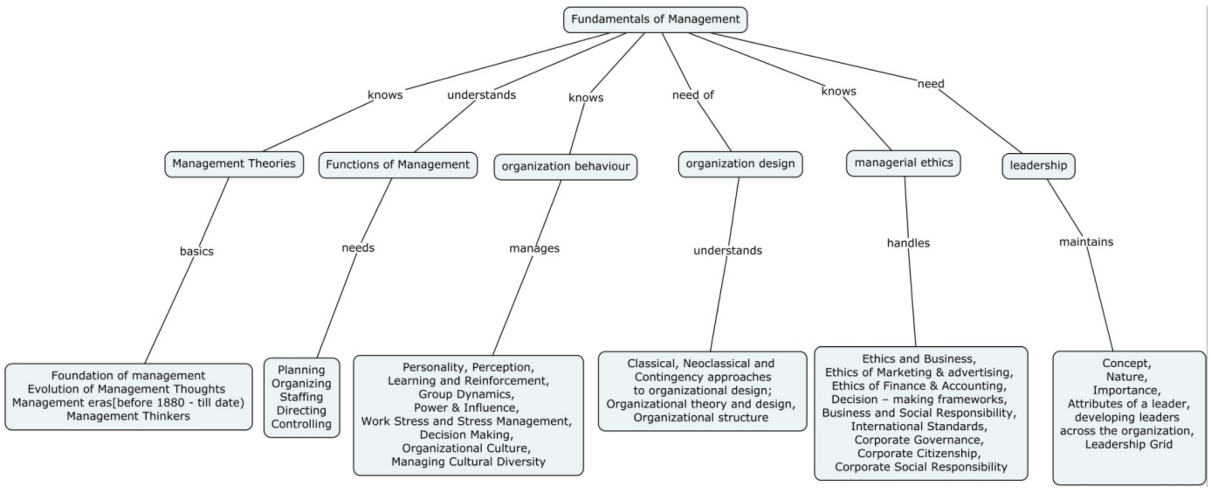
Course Outcome 4 (CO4):
1. Which organizational practices are required to reinforce the organizational intent?
2. What type of leadership and culture are required to achieve the value proposition?
3. Which organization structure should we choose, and how do we overcome its inherent downsides?

Course Outcome 5 (CO5):
1. Briefly Describe What is Ethical Behavior in a Business Environment
2. What Do You Do When a Valued Customer Behaves in an Unethical Manner?
3. How Do You Handle a Situation Where Something is Not in compliance with the Ethical Standards?

Course Outcome 6(CO6):

4. What do you understand by leadership in business? What should be the qualities of a good business leader?
5. Discuss "A successful leader is not necessarily effective".
6. Explain Herzberg's Two Factor Theory and differentiate it from Maslow's Theory of Need Hierarchy.

Concept Map



Syllabus

Management Theories: Concept and Foundations of Management, Evolution of Management Thoughts [Pre-Scientific Management Era (before 1880), Classical management Era (1880-1930), Neo-classical Management Era (1930-1950), Modern Management era (1950-on word). Contribution of Management Thinkers: Taylor, Fayol, Elton Mayo etc.

Functions of Management Planning, Organizing, Staffing, Directing, Controlling

Organization Behavior: Introduction, Personality, Perception, Learning and Reinforcement, Motivation, Group Dynamics, Power & Influence, Work Stress and Stress Management, Decision Making, Organizational Culture, Managing Cultural Diversity

Organizational Design: Classical, Neoclassical and Contingency approaches to organizational design; Organizational theory and design, Organizational structure (Simple Structure, Functional Structure, Divisional Structure, Matrix Structure)

Managerial Ethics: Ethics and Business, Ethics of Marketing & advertising, Ethics of Finance & Accounting, Decision – making frameworks, Business and Social Responsibility, International Standards, Corporate Governance, Corporate Citizenship, Corporate Social Responsibility

Leadership: Concept, Nature, Importance, Attributes of a leader, developing leaders across the organization, Leadership Grid

Learning Resources

Text Book:

1. Richard L. Daft, *Understanding the Theory and Design of Organizations*

Reference Books:

5. Stephen P. Robbins, Timothy A. Judge, NeharikaVohra, *Organizational Behavior*

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1.	**Management Theories**		
1.1	Concept and Foundations of Management, Evolution of Management Thoughts	1	CO1
1.2	Pre-Scientific Management Era (before 1880), Classical management Era (1880-1930), Neo-classical Management Era (1930-1950), Modern Management era (1950-on word)	2	CO1
1.3	Contribution of Management Thinkers: Taylor, Fayol, Elton Mayo etc.	1	CO1
2.	**Functions of Management**		
2.1	Planning, Organizing	1	CO2
2.2	Staffing, Directing	1	CO2
2.3	Controlling	1	CO2
3	**Organization Behavior**		
3.1	Introduction, Personality, Perception	1	CO3
3.2	Learning and Reinforcement, Motivation, Group Dynamics	1	CO3
3.3	Power & Influence, Work Stress and Stress Management	1	CO3
3.4	Decision Making	1	CO3
3.5	Organizational Culture, Managing Cultural Diversity	1	CO3
4	**Organizational Design**		
4.1	Classical, Neoclassical and Contingency approaches to organizational design	2	CO4
4.2	Organizational theory and design,	1	CO4
4.3	Organizational structure (Simple Structure, Functional Structure, Divisional Structure, Matrix Structure)	1	CO4
5	**Managerial Ethics**		
5.1	Ethics and Business, Ethics of Marketing & advertising	1	CO5
5.2	Ethics of Finance & Accounting	1	CO5
5.3	Decision – making frameworks, Business and Social Responsibility	1	CO5
5.4	International Standards, Corporate Governance	1	CO5
5.5	Corporate Citizenship, Corporate Social Responsibility	1	CO5
6	**Leadership**		
6.1	Concept, Nature, Importance	1	CO6
6.2	Attributes of a leader, developing leaders across the organization	1	CO6
6.3	Leadership Grid	1	CO6
	TOTAL	24	

Course Designers:

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2. Mrs. J. Felicia Lilian jflcse@tce.edu

20CB540	BUSINESS STRATEGY

Category	L	T	P	Credit	Terminal Exam Type
HSS	2	0	0	2	Theory

Preamble

This course includes a study of strategic planning including mission statement development, analysis of the external environment and internal organizational factors, development of strategic alternatives, selection of appropriate alternatives, implementation of strategies, and competitive strategies and dynamics. Special emphases are given to the integration and coordination of the functional areas within the enterprise.

Prerequisite

NIL

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage in %
CO1	Know the fundamental concepts of strategic management to analyze business situations and apply these concepts to solve business problems.	20
CO2	Understand how external forces such as social, political/legal, economic, and technological, influence strategic decision-making and firm performance.	15
CO3	Apply External Environments of Firm with Competitive Strategy	20
CO4	Analyze the business portfolio using corporate strategies	20
CO5	Verify Strategic Alliances, Joint Ventures, and Mergers & Acquisitions using growth strategy	15
CO6	Determine the best way to implement a proposed strategy using 7S tools	10

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	Guided Response	1.2, 4.3.2
CO2	TPS3	Apply	Value	Mechanism	1.2, 2.1.2, 3.2.3, 4.5.3
CO3	TPS3	Apply	Value	Mechanism	1.2, 2.1.2, 3.2.3, 4.3.2
CO4	TPS3	Apply	Value	Mechanism	1.2, 2.1.2, 3.2.3, 4.5.3
CO5	TPS3	Apply	Value	Mechanism	1.2, 2.1.2, 3.2.3, 4.5.3
CO6	TPS3	Apply	Value	Mechanism	1.2, 2.1.2, 3.2.3, 4.5.3

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	L											L		
CO2	S	M	L			L	L	L		L		L	M	L	L
CO3	S	M	L			L	L	L		L		L	M	L	L
CO4	S	M	L			L	L	L		L		L	M	L	L

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

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive levels	Continuous Assessment Tests			Assignments			Terminal examination
	1	2	3	1	2	3	
Remember	20	20	20				20
Understand	20	20	20	30	30	30	20
Apply	60	60	60	70	70	70	60
Analyse							
Evaluate							
Create							

Assessment Pattern: Psychomotor

Psychomotor Skill	**Miniproject /Assignment/Practical Component**
Perception	
Set	
Guided Response	30
Mechanism	70
Complex Overt Responses	
Adaptation	
Origination	

Sample Questions for Course Outcome Assessment**

Course Outcome 1(CO1):

1. Define Strategy. How do you consider that strategic management is a process?
2. Explain the conceptual framework of Strategic Management Process.
3. How do the terms mission, objectives, strategies, programs, budgets, procedures differ in the true sense? – Explain.

Course Outcome 2(CO2):

1. If your organization could get accurate answers to 12 questions about its competitive environment, what questions would it ask?
2. Draft a conceptual model for creating a 'strategic plan' for a company.
3. 'The intensity of competition depends on several factors.' Identify these factors and discuss briefly on them

Course Outcome 3(CO3):

1. Discuss Porter's five forces model. How does it help managers to identify the opportunities and threats confronting a company?
2. According to Porter, what determines the level of competitive intensity in an industry?
3. "Companies that fail to develop new products are putting themselves at risk. At the same time, new product developments are risky."
   (a) List the reasons for failure of new products.
   (b) List and briefly explain the factors that hinder the progress of new product development.

Course Outcome 4 (CO4):

1. M/s. XYZ Ltd., is business organized as three divisions and Head Office. The divisions are based on market groupings, which are Retail, Wholesale and Government. The divisions do not trade with each other. The main method of control of the divisions has been the requirement to earn a return on investment (ROI) of 15% per annum. The definition of return and capital employed is provided by Head Office, as is the criterion rate of 15%. The recent experience of M/s. XYZ Ltd., is that the group, as a whole, has been able to earn 15% ROI but there have been wide variations between the results obtained by different divisions. This infringes upon another group policy that forbids cross-subsidization i.e., each and every division must earn the criterion ROI. M/s. XYZ Ltd., is now considering divestment strategies and this could include the closure of one or more of-its divisions. The Head Office is aware that the Boston Product Market Portfolio Matrix (BPMPM) is widely used within the divisions in the formulation and review of marketing strategies. As it is so widely known within the group and is generally regarded by the divisions as being useful, the Head Office is considering employing this approach to assist in the divestment decision.
   (i) Evaluate the use by M/s. XYZ Ltd., of the ROI and its policy that forbids cross-subsidization.
   (ii) Describe the extent to which the BPMPM could be applied by M/s. XYZ Ltd., in its divestment decision. Evaluate the appropriateness of the use of BPMPM for this purpose.
2. Create Port-folio analysis for the above case study.
3. Given below is an extract from the literary supplement of a leading newspaper : An imprint of one's own "Earlier, Publishing houses, focusing on writing by women and books on women-oriented subject, might have been inconceivable. But now such Publishing houses, mostly with a distinct feminist slant to what they publish, have become a reality worldwide. Virago, Women's Press, Kali for Women, Stree, Labyrinth, Attic Press, Minnesota Women's Press, Street Women Press etc., have not only given women a voice long due to them, but have also earned themselves a respectable position in the Publishing Industry. In fact, Seagull Bookstore is possibly the only bookstore in the city of Kolkata that has a separate shelf for books on "gender". Seagull Bookstore has translated a lot a Mahasweta Devi's works into English, which have reached many people all over the world." Does this convey any strategy-related message? If so, write in brief a note on the same.

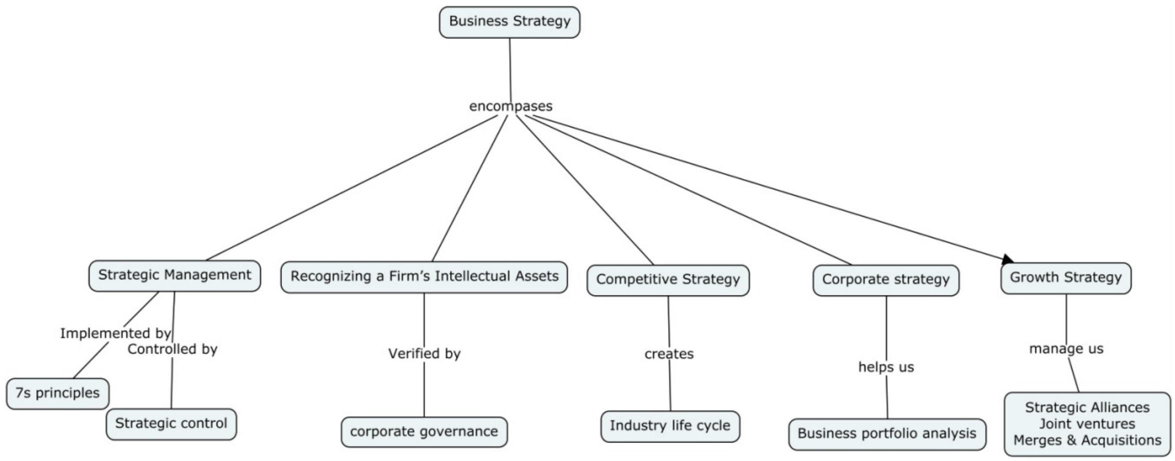
Course Outcome 5 (CO5):

1. "Joint Ventures are emerging as the best tool for reaching new markets". - Comment.
2. "In terms of Strategic Management, how does a new venture's situation differ from that of an ongoing small company?
3. Discuss how a development in a Corporation's societal (Macro) environment can affect the corporation through its task environment.

Course Outcome 6(CO6):

1. Enumerate the different stages of organizational life cycle and highlight the suitable strategies of each stage.
2. If a company which operates in stability strategy in current operations along with related diversification through backward integration. What should be the ideal mix of functional plans and policies? Highlight its features.
3. Discuss the strategies for internet economy

Concept Map



Syllabus

Introduction to Strategic Management: Importance of strategic Management – vision and objectives – schools of thought in Strategic management – Strategy Content, process, and practice – Fit Concept and Configuration Perspective in strategic management.

Internal Environment of firm – Recognizing a Firm's Intellectual Assets: Core Competence as the root of competitive advantage – sources of sustained competitive advantage – Business processes and capabilities based approach to strategy.

External Environments of firm – Competitive strategy: Five forces of industry attractiveness that shape strategy – The concept of strategic groups and industry life cycle – Generic strategies - Generic strategies and the value chain

Corporate Strategy and growth strategies: The motive for diversification- Related and unrelated diversification – Business portfolio Analysis - Expansion, Integration and Diversification - Strategic Alliances, Joint Ventures, and Mergers & Acquisitions

Strategy Implementation: Structure and Systems: The 7S Framework - Strategic Control and Corporate Governance

Learning Resources

1. Robert M. Grant (2012). Contemporary Strategic Management, Blackwell, 7th Edition.
2. M.E. Porter, Competitive Strategy, 1980. M.E. Porter,
3. Competitive Advantage, 1985 Richard Rumelt (2011). Good Strategy Bad Strategy: The Difference and Why It Matters.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1.	**Introduction to Strategic Management (5)**		
1.1	Importance of Strategic Management	1	CO1
1.2	Vision and objectives		CO1
1.3	Schools of thought in Strategic management	1	CO1
1.4	Strategy Content, process, and practice	1	CO1

1.5	Fit Concept in strategic management	1	CO1
1.6	Configuration Perspective in strategic management	1	CO1
2	**Internal Environment of firm – Recognizing a Firm's Intellectual Assets (4)**		
2.1	Core Competence as the root of competitive advantage	1	CO2
2.2	sources of sustained competitive advantage	1	CO2
2.3	Business processes	1	CO2
2.4	Capabilities based approach to strategy.	1	CO2
3	**External Environments of firm – Competitive strategy (5)**		
3.1	Five forces of industry attractiveness that shape strategy	1	CO3
3.2	The concept of strategic groups	1	CO3
3.3	Industry life cycle	1	CO3
3.4	Generic strategies	1	CO3
3.5	Generic strategies and the value chain	1	CO3
4	**Corporate Strategy (4)**		
4.1	The motive for diversification	1	CO4
4.2	Related and unrelated diversification	1	CO4
4.3	Business portfolio Analysis – Expansion	1	CO4
4.4	Integration and Diversification	1	CO4
5	**Growth strategies (4)**		
5.1	Expansion, Integration and Diversification	1	CO5
5.2	Strategic Alliances	1	CO5
5.3	Joint Ventures	1	CO5
5.4	Mergers & Acquisitions	1	CO5
6	**Strategy Implementation (2)**		
6.1	Structure and Systems	1	CO6
6.2	The 7S Framework		CO6
6.3	Strategic Control and Corporate Governance	1	CO6
	Total	**24**	

Course Designers:

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20CB550	BUSINESS COMMUNICATION &VALUE SCIENCE – III

Category	L	T	P	Credit	Terminal Exam Type
Project	2	-	-	2	Fully Internal

Preamble

This course aims at building up the cross-cultural communication and behavioral performance of the learners. It makes learners identify their strengths, weakness, opportunities and threats to become successful person in their professional life. It enables the students enhance their technical writing skills. It motivates the students to explore science and modern technology.

Prerequisite

Basic Knowledge of verbal and written English

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Interpret the basic principles of SWOT & life positions (U)	10%
CO2	Comprehend the best practices of Technical Writing and its tools (U)	20%
CO3	Demonstrate cross cultural communication and identify its common mistakes (AP)	10%
CO4	Investigate the concepts of Global, glocal and trans locational culture (AP)	30%
CO5	Apply the role of science in nation building (AP)	10%
CO6	Visualize the future of Artificial Intelligence and its impact in daily life (AP)	20%

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Value	Perception	2.4,2.5,3.1
CO2	TPS2	Understand	Respond	Guided response	3.2.1,3.2.3,3.3.1
CO3	TPS3	Apply	Respond	Perception	3.2.1,3.2.3,3.3.1
CO4	TPS3	Apply	Value	Perception	3.1,3.1.6
CO5	TPS3	Apply	Receive	Perception	3.1.6, 3.2
CO6	TPS3	Apply	Receive	Perception	3.1.6, 3.2

Mapping with Programme Outcomes and Programme Specific Outcomes

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

S-Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

No CAT will be conducted.
Summative - Activity Based Evaluation (No External Examination)Evaluation is done in

classroom activities as given below:

Assignment submission	CO1	UNDERSTAND	10
Written Test	CO2	UNDERSTAND	20
Debate /Role Play	CO3	APPLY	10
Questionnaire, Data Analysis and Report submission	CO4	APPLY	20
Album Submission	CO4	APPLY	10
Individual Presentation	CO5	APPLY	10
Futuristic view of AI	CO6	APPLY	20
		Total	100

Assessment Pattern: Psychomotor

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

Sample Questions for Course Outcome Assessment**

CourseOutcome1(CO1):(10marks)

a. Assignment on SWOT vs TOWS
b. Assignment on Adaptability to VUCA world

CourseOutcome2(CO2):(20marks)
Written Test
a. Grammar – Vocabulary, Tense, Voice
b. Paragraph writing – Linking words, Instruction and Recommendation

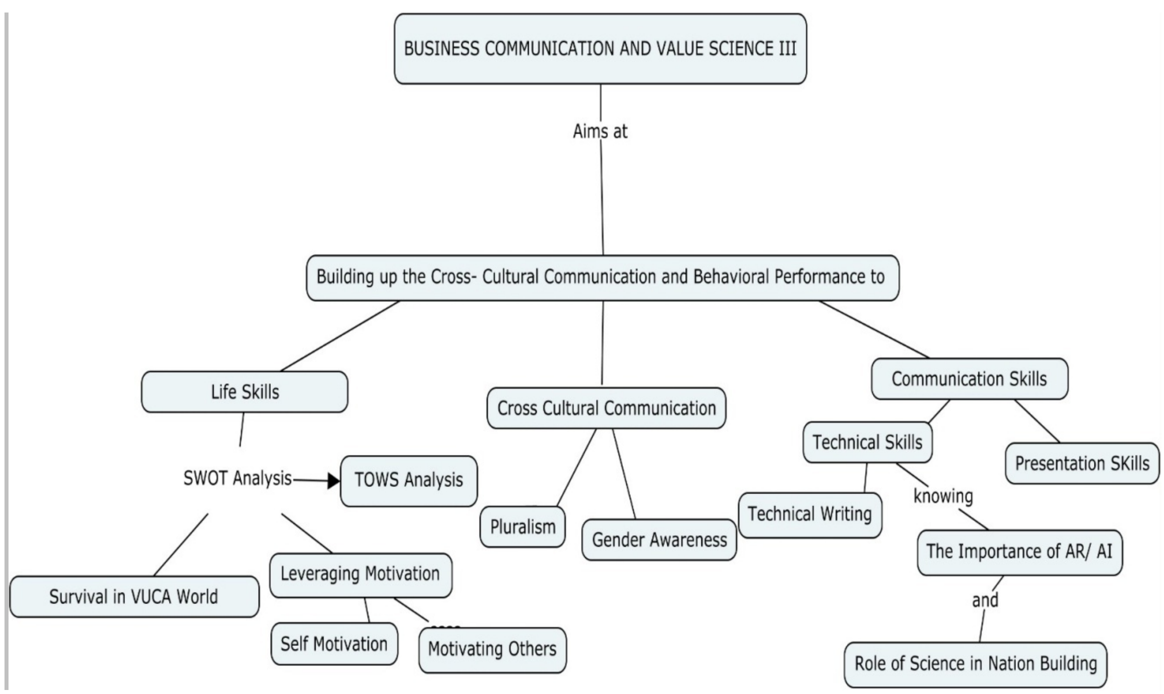
CourseOutcome3(CO3):(10 marks)
Debate / Role play – Topics based on
a. Cross- cultural communication
b. Gender awareness

CourseOutcome4(CO4):(10 + 20 Marks)
a. Album creation related to different cultures and gender awareness
b. Data Collection using questionnaire and report submission – Global, Glocal and Trans-locational

CourseOutcome5(CO5):(10 Marks)
Individual presentation related to Nation Building (Post Independence)
a. Inventors
b. Inventions

Course Outcome 6 (CO6): (20 Marks)
Short film / Any creative visualization representing the future of AI

Concept Map



Syllabus

Unit 1 : SWOT – Analysis and application in Life positions, SWOT vs TOWS , Survival in VUCA world, Leveraging Motivation

Unit 2 : Identify and Respect Pluralism in cultural spaces, Definingand Differentiating Global, Glocal, trans locational culture, Implication of Cross cultural communication and its mistakes, Culture shock,Gender Awareness.

Unit 3 : Role of Science in Nation building – Role of Science in post-Independence, Technical Writing – Introduction: Vocabulary,Email Writing (Job Cover letter), Formal Letter writing (Requisition for Internship , IV)

Unit 4 : Defining AI – Importance of AI in everyday life, Applying Technical writing in profession and Real life scenarios – Instruction & Recommendation ,Paragraph Writing.

Learning Resources

Text Books:	
There are no prescribed texts for Semester5– there will be handouts and reference links shared.	
Web References:	
1	**Examples of Technical Writing for Students** https://freelance-writing.lovetoknow.com/kinds-technical-writing
2	11 Skills of a Good Technical Writer https://clickhelp.com/clickhelp-technical-writing-blog/11-skills-of-a-good-technical-writer/
3	**13 benefits and challenges of cultural diversity in the workplace** **https://www.hult.edu/blog/benefits-challenges-cultural-diversity-workplace/**
Online Resources:	
1	https://youtu.be/CsaTslhSDI
2	https://m.youtube.com/watch?feature=youtu.be&v=IIKvV8_T95M
3	https://m.youtube.com/watch?feature=youtu.be&v=e80BbX05D7Y
4	https://m.youtube.com/watch?v=dT_D68RJ5T8&feature=youtu.be
5	https://m.youtube.com/watch?v=7sLLEdBgYYY&feature=youtu.be

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1.1	SWOT and Life positions	1	CO1
1.2	Applying SWOT in real life situations- Survival in VUCA world	1	CO1
1.3	SWOT vs TOWS ((Ted talk on biomimicry-only first 8 minutes) : https://www.youtube.com/watch?v=RHrO4t86phA	1 (Lab)	CO1
1.4	Leveraging Motivation - pat your back activity (You tube videos on Maslow's theory)	2 (Lab)	CO1

2.1	Awareness and respect for pluralism in cultural spaces (Discussion using Phir Miley sur Mera Tumhara)	1	CO3
2.2	Defining and Differentiating Global, Glocal and Trans locational culture	2	CO4
2.3	Implication of Cross-Cultural Communication and its mistakes	2	CO3
2.4	Culture Shock	2	CO3
2.5	Gender Awareness	1	CO3
3.1	Role of science in Nation building and Post-Independence	1	CO5
3.2	Individual Presentation	3	CO5
3.3	Technical writing - Vocabulary	1	CO2
3.4	Technical writing - Formal letter (Permission seeking), Letter writing (Job Cover letter)	1	CO2
4.1	Apply technical writing in real life scenarios and in Profession - Paragraph Writing, Linking words, Instructions and Recommendations	2	CO2
4.2	AI / AR - Introduction and the Importance of AI in everyday life	1	CO6
4.3	Field visit and Data Collection	2	CO4
		24 hours	

Course Designers:

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2. Dr.G. JeyaJeevakani gjjeng@tce.edu
3. Dr.RS.Swarnalakshmi rssleng@tce.edu

20CB570	DESIGN AND ANALYSIS OF ALGORITHMS LAB

Category	L	T	P	Credit	Terminal Exam Type
PC	0	0	4	2	Practical

Preamble

This course provides students with a practical approach to efficiently solve a variety of time and space complexity problems. The students will construct algorithms by using different data structures and implement them to enhance the efficiency of the algorithm.

Prerequisite

NIL

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Identifying the time complexities for various sorting and searching algorithms.	10
CO2	Identify the divide and conquer techniques and solve various recursion problem	15
CO3	Apply the greedy and dynamic programming techniques to solve the problems.	25
CO4	Apply the traversal algorithms for graphs and tree problems and determine their performance	20
CO5	Implement various branch and bound algorithms to solve the real world engineering problems	15
CO6	Design and implement algorithms to find whether they are tractable or in tractable	15

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value	-	1.2,2.1.1,2.4.3
CO2	TPS3	Apply	Value	-	1.2,2.1.1,2.4.3
CO3	TPS3	Apply	Value	-	1.2,2.1.1,2.4.3
CO4	TPS3	Apply	Value	-	1.2,2.1.1,2.4.3
CO5	TPS3	Apply	Value	-	1.2,2.1.1,2.4.3
CO6	TPS3	Apply	Value	-	1.2,2.1.1,3.1.1,4.5.1

Mapping with Programme Outcomes and Programme Specific Outcomes

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

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

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

List of Experiments/Activities with CO Mapping

1. Analyse the exponential and polynomial time complexity of Algorithms
2. Implement the Divide and Conquer algorithms – strings and sequences
3. Implement Prim's and kruskals algorithm using Greedy approach
4. Implement Knapsack problem using Greedy approach
5. Analyze and implement the matrix multiplication problem using dynamic programming
6. Application of DFS – Topological sort/Strongly connected components
7. Implement Ford Fulkerson using maximum flow algorithm
8. Implement TSP using branch and bound techniques
9. Implement Huffman coding and decoding
10. Implement Graph coloring algorithm

Module No.	Topic	No. of sessions	Course Outcome
1.	Analyse the exponential and polynomial time complexity of Algorithms	2	CO1
2.	Implement the Divide and Conquer algorithms – strings and sequences	4	CO2
3.	Implement Prim's and kruskals & Knapsack algorithm using Greedy approach	4	CO3
4.	Analyze and implement the matrix multiplication problem using dynamic programming	2	CO3
5.	Application of DFS – Topological sort/Strongly connected components	4	CO4
6.	Implement Ford Fulkerson using maximum flow algorithm	2	CO5
7.	Implement TSP using branch and bound techniques	2	CO5
8.	Implement Huffman coding and decoding	2	CO6
9.	Implement Graph coloring algorithm	2	CO6
	TOTAL	24	

Learning Resources

1. https://www.hackerrank.com/domains/algorithms
2. https://www.codechef.com/wiki/tutorials
3. Steven S. Skiena, The Algorithm Design Manual, Second Edition, Springer,2010.

Course Designers

1. Dr. A. Malini amcse@tce.edu
2. Mrs. J. Felicia Lilian jflcse@tce.edu

20CB580	COMPILER DESIGN LAB	Category	L	T	P	Credit	Terminal Exam Type
		PC	0	0	2	1	Practical

Preamble

The student should be made to be exposed to compiler writing tools. Learn to implement the different Phases of compiler. Be familiar with control flow and data flow analysis. Learn simple optimization techniques

Prerequisite

NIL

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Develop a lexical analyzer for recognizing the tokens.	15
CO2	Design and convert BNF rules into YACC form to generate various parsers.	15
CO3	Compute the formal and practical properties of different approaches to parsing	15
CO4	Design a symbol table and develop semantic analyzer for type checking	15
CO5	Generation of Intermediate Code and optimizing the target code	20
CO6	Construct a compiler-interpreter for a simple imperative programming language.	20

CO Mapping with CDIO Curriculum Framework

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

Mapping with Programme Outcomes and Programme Specific Outcomes

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

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Model Examination	Terminal Examination
Remember		
Understand		

Apply	100	100
Analyse		
Evaluate		
Create		

Assessment Pattern: Psychomotor

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

List of Experiments/Activities with CO Mapping

S.No	Name of the experiment	Total hours	Course outcome
1.	Implementation of Lexical analyzer using Lex tool	2	CO1
2.	Develop a lexical analyzer to recognize few patterns in C	2	
3.	Generate YACC specification for syntactic categories	2	CO2
4.	Convert BNF rules into YACC form and write code to generate Abstract Syntax Tree	2	
5.	Implement Recursive Descent parser for an expression grammar that generates arithmetic expressions with digits, + and *	4	CO3
6.	Generate Symbol table to store all the characters, digits and symbols	4	CO4
7.	Program to implement Type checking		
8.	Implement various intermediate code generation strategies	2	CO5
9.	Implementation of simple code optimization techniques	2	
10.	Implement the back end of the compiler which takes the three address code and produces the 8086 assembly language instructions that can be assembled and run using a 8086 assembler. The target assembly instructions can be simple move, add, sub, jump. Also simple addressing modes are used.	2	CO6
		2	
	Total hours	24	

Learning Resources

1. V. Aho, R. Sethi and J. Ullman, 1. Compilers: Principles, Techniques and Tools,, 2^{nd} Edition, Pearson, 2007
2. Randy Allen, Ken Kennedy, “Optimizing Compilers for Modern Architectures: A Dependence-based Approach”, Morgan Kaufmann Publishers, 2002.
3. Keith D Cooper and Linda Torczon, “Engineering a Compiler”, Morgan Kaufmann Publishers Elsevier Science, 2004.

Course Designers:

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2. Mr.V.Janakiraman vjncse@tce.edu

20CB590	MINI PROJECT

Category	L	T	P	Credit	Terminal Exam Type
Project	0	0	2	1	Viva-Voce

Preamble

The Mini Project is a Phase 1 project for students studying Computer Science and Business Systems. The students as a team of 3 members identify their area of specialization with a defined problem statement. They identify the functional requirements, do analysis and identify the risks that they might encounter. They develop the design for their project using UML diagrams and setup the environment to implement the project.

Prerequisite

NIL

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Identify the problem statement with proper functional and non-functional requirements for complex engineering problems	15
CO2	Plan and construct the requirement analysis by managing the project schedule to ensure time management and within-budget completion	15
CO3	Develop the design based on the design principles to create a next sketch of the interactions between the systems, its lifecycle, resource availability and risks	20
CO4	Develop the environmental setup needed for the project, based on the requirements and professional constraints	15
CO5	Implement the problem with proper bench marked dataset and test the performance with various algorithms	20
CO6	Use proper communication within the team to document the work and analyse the progress	15

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value	-	1.1, 1.2, 1.3, 2.1, 2.2, 2.4, 3.1, 3.2, 4.1, 4.2, 4.3, 4.4, 4.5
CO2	TPS4	Analyze	Organize	-	4.3.1, 4.3.2, 4.3.3, 4.3.4
CO3	TPS5	Evaluate	Organize	-	4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.1.5, 4.1.6, 4.2.1, 4.2.2, 4.2.3, 4.2.4
CO4	TPS3	Apply	Value	-	4.4.1, 4.4.2, 4.4.3, 4.4.4, 4.4.5
CO5	TPS5	Analyze	Organize	-	4.5.1, 4.5.2, 4.5.3, 4.5.4, 4.5.5
CO6	TPS3	Apply	Value	-	3.2.1, 3.2.2, 3.2.3, 3.2.4, 3.2.5, 3.2.6

Mapping with Programme Outcomes and Programme Specific Outcomes

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

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

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Phases	Deliverables	Marks	Course Outcomes
Continuous Assessment			
Review – 1 Identify the problem statement and Requirements	Technical report & Presentation	30	CO1 & CO2
Review - 2 Design and Environmental setup	Technical report & Presentation	40	CO3 & CO4
Review 3 – Implementation & Documentation	Technical report & Presentation	30	CO5 & CO6
End – Semester Examination			
Demonstration	Presentation & Viva-Voce	60	CO1, CO2, CO3, CO4, CO5 and CO6
Documentation	Report	40	

Course Designers

1. Dr. P. Chitra pccse@tce.edu
2. Mrs. J. Felicia Lilian jflcse@tce.edu

CURRICULUM AND DETAILED SYLLABI

FOR

B.TECH DEGREE (Computer Science and Business Systems) PROGRAMME

SIXTH SEMESTER

FOR THE STUDENTS ADMITTED FROM THE

ACADEMIC YEAR 2021 – 2022 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
(A Govt. Aided, ISO 9001:2008 certified Autonomous Institution affiliated to Anna University)
B.Tech Degree (Computer Science and Business Systems) Programme
COURSES OF STUDY
(For the candidates admitted from 2021 – 2022onwards)

SIXTH SEMESTER

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	No.of Hours / Week			Credits
				L	T	P	
THEORY COURSES							
1	21CB610	Computer Networks	PC	3	0	0	3
2	21CB620	Information Security	PC	3	0	0	3
3	21CB630	Artificial Intelligence	PC	3	0	0	3
4	21CB640	Financial & Cost Accounting	HSS	2	0	0	2
5	21CB650	Business Communication & Value Science - IV	Project	2	0	0	2
6	21CBPX0	Program Elective - III	PE	3	1	0	4
THEORY CUM PRACTICAL COURSES							
7	21CBPX0	Program Elective - IV	PE	2	0	2	3
PRACTICAL COURSES							
8	21CB660	Computer Networks Lab	PC	0	0	4	2
9	21CB670	Information Security Lab	PC	0	0	2	1
10	21CB680	Artificial Intelligence Lab	PC	0	0	2	1
			TOTAL	**18**	**1**	**10**	**24**

PC : Program Core
PE : Program Elective
HSS : Humanities and Social Science

L : Lecture
T : Tutorial
P : Practical

Note:

1 Hour Lecture is equivalent to 1 credit

1 Hour Tutorial is equivalent to 1 credit

2 Hours Practical is equivalent to 1 credit

THIAGARAJAR COLLEGE OF ENGINEERING, MADURAI- 625 015
(A Govt. Aided, ISO 9001:2008 certified Autonomous Institution affiliated to Anna University)
B.Tech Degree (Computer Science and Business Systems) Programme
SCHEME OF EXAMINATIONS
(For the candidates admitted from 2021 – 2022onwards)

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	21CB610	Computer Networks	3	40	60	100	27	50
2	21CB620	Information Security	3	40	60	100	27	50
3	21CB630	Artificial Intelligence	3	40	60	100	27	50
4	21CB640	Financial & Cost Accounting	3	40	60	100	27	50
5	21CB650	Business Communication & Value Science - IV	-	100	-	100	-	50
6	21CBPX0	Program Elective – III	3	40	60	100	27	50
THEORY CUM PRACTICAL COURSES								
7	21CBPX0	Program Elective – IV	3	50	50	100	22.5	50
PRACTICAL								
8	21CB660	Computer Networks Lab	3	60	40	100	18	50
9	21CB670	Information Security Lab	3	60	40	100	18	50
10	21CB680	Artificial Intelligence Lab	3	60	40	100	18	50

21CB610	COMPUTER NETWORKS

Category	L	T	P	Credit	Terminal Exam Type
PC	3	0	0	3	Theory

Preamble

The syllabus is designed for the students to learn and understand the basic concepts of computer networks and the working of its functional components. It gives a brief overview of the concepts of data communications and functions of different layers of ISO/OSI reference architecture and to understand the error detection and correction methods and types of LAN, Then the concepts of sub netting and routing mechanisms. Then the different types of protocols and network components, configure Switches and Routers.

Prerequisite

NIL

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Understand the fundamentals of data communications and functions of layered architecture	20
CO2	Apply error checking and error correction mechanisms in data Link layer for error free data transmission.	30
CO3	Apply the different protocols and network layer componentsbased on application requirements.	15
CO4	Compare the functionalities of TCP & UDP protocols in the transport layer during data transmission.	10
CO5	Apply a suitable application layer protocol based on application.	15
CO6	Understand the basic concepts of cryptography and network security.	10

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO#	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	Guided Response	1.2
CO2	TPS3	Apply	Respond	Mechanism	1.2,2.1.1,3.1.1
CO3	TPS3	Apply	Value	Mechanism	1.2, 2.1.5, 2.3.1
CO4	TPS3	Apply	Value	Mechanism	1.2, 2.1.5, 2.2.2, 2.3.1, 2.3.4
CO5	TPS3	Apply	Value	Mechanism	1.2,2.1.1,3.1.1,4.4.1
CO6	TPS2	Understand	Respond	Guided Response	1.2, 2.2.2, 2.3.1

Mapping with Programme Outcomesand Programme Specific Outcomes

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

S- Strong; M-Medium; L-Low

AssessmentPattern: Cognitive Domain

Cognitive Levels	Continuous AssessmentTests		Assignment		TerminalExamination
	1	2	1	2	
Remember	30	20		-	20
Understand	40	40	30	30	40
Apply	30	40	70	70	40
Analyse	-	-	-	-	-
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

AssessmentPattern: Psychomotor

Psychomotor Skill	Mini~~project /Ass~~ignment/Prac~~tical Component~~
Perception	-
Set	-
Guided Response	30
Mechanism	70
Complex Overt Responses	-
Adaptation	-
Origination	-

Sample Questions for Course Outcome Assessment**

** (2 to 3 at the cognitive level of course outcome)

Course Outcome1(CO1):

1. Distinguish between LAN and WAN.
2. Recall the functionalities of all layers in OSI architecture
3. What is the difference between communication and transmission?

Course Outcome2(CO2):

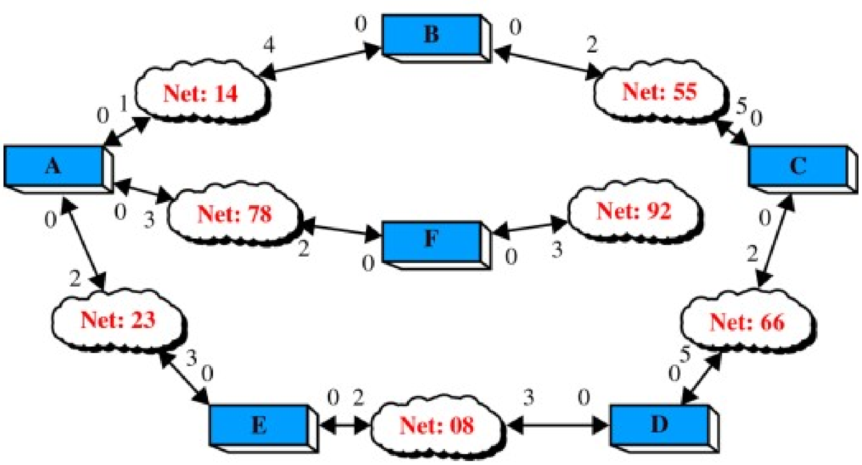
1. Discuss the principle of stop and wait flow control algorithm. Draw time line diagrams and explain how loss of a frame and loss of an ACK are handled. What is the effect of delay-bandwidth product on link utilization?
2. How is frame order and flow control is achieved using the data link layer?
3. Sixteen-bit messages are transmitted using a Hamming code, using even parity. Determine the number of check bits needed to ensure that the receiver can detect and correct single bit errors? Show the bit pattern transmitted for the message1101001100110101. (Apply) 2. A 12-bit Hamming code whose hexadecimal value is 0xE4F arrives at a receiver. Determine the original transmitted value in hexadecimal, assuming not more than 1 bit is in error. (Apply) 3. A bit

stream 10011101 is transmitted using the standard CRC method, with the generator 1001. Show the actual bit string transmitted. Suppose the third bit from the left and the second bit from the right of the transmitted message are inverted during transmission. Show that this error is detected

4. Suppose nodes A and B are on the same 10 Mbps broadcast channel, and the propagation delay between the two nodes is 245 bit times. Suppose A and B send Ethernet frames at the same time, the frames collide, and then A and B choose different values of K in the CSMA/CD algorithm. Assuming no other nodes are active, can the retransmissions from A and B collide? For our purposes, it suffices to work out the following example. Suppose A and B begin transmission at t = 0 bit times. They both detect collisions at t = 245 bit times. Suppose KA = 0 and KB = 1. At what time does B schedule its retransmission? At what time does A begin transmission? At what time does A‘s signal reach B? Does B refrain from transmitting at its scheduled time?

Course Outcome3(CO3):

1. Consider the following datagram network. Show the forwarding table in router A, such that all traffic destined to host H3 is forwarded through interface 3.Also write down a forwarding table in router A, such that all traffic from H1 destined to host H3 is forwarded through interface 3, while all traffic from H2 destined to host H3 is forwarded through interface 4.
2. An organization has granted a block of address with the beginning address 25.24.74.0/24.The organization need to have 3 subblocks to be used in 3 subnets: one subblock of 10 addresses, one subblock of 50 addresses and one subblock of 125 addresses. Design the subblocks.



For the subnet shown in the figure calculate the shortest path for all the networks form Router A by using Dijkstra algorithm (Show intermediate steps) and build the routing table for Router A.

Course Outcome 4 (CO4):

1. Consider transferring an enormous file of L bytes from Host A to Host B. Assume an MSS of 536 bytes. What is the maximum value of L such that TCP sequence numbers are not exhausted? For the calculated value of L, find how long it takes to transmit the file. Assume that a total of 66 bytes of transport, network, and link header are added to each segment before the resulting packet is sent out over a 155 Mbps link. Ignore flow control and congestion control so A can pump out the segments back to back and continuously.
2. Suppose Host A sends two TCP segments to Host B over a TCP connection. The first segment has a sequence number 90; the second has a sequence number 110. How much data is in the first segment? If the first segment is lost but the second segment arrives at B. What will be the acknowledgment number in the acknowledgment that Host B sends to Host A.

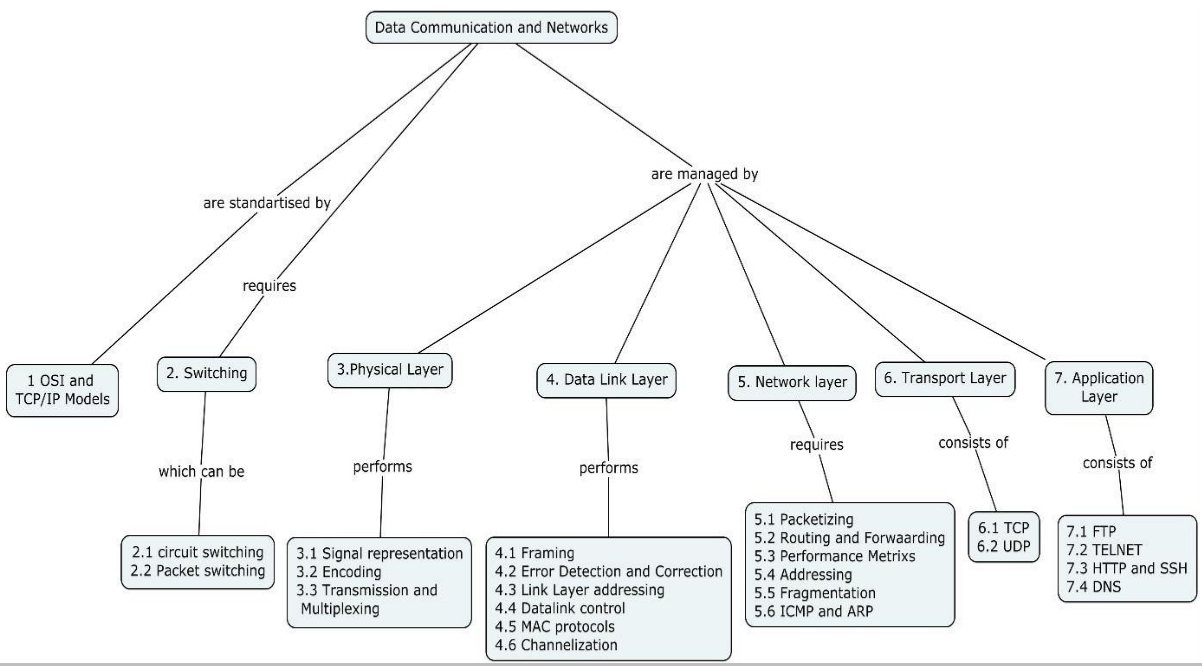
Course Outcome 5 (CO5):

1. List two non proprietary Internet applications and the application-layer protocols that they use.
2. What is the difference between network architecture and application architecture? Question 3
3. Why do HTTP, FTP, SMTP, and POP3 run on top of TCP rather than on UDP?
4. Compare various email protocols like SMTP, IMAP and POP and Outline when it is appropriate to use each.

Course Outcome6(CO6):

1. Describe the concept of Electronic mail
2. Explain the Basic concepts of Cryptography.
3. Illustrate the concept of network management

Concept Map



Syllabus

Introduction: Computer networks and distributed systems, Classifications of computer networks, Preliminaries of layered network structures.

Data communication Components: Representation of data and its flow, VariousConnection Topology, Protocols and Standards, OSI model, Transmission Media.

LAN: Wired LAN, Wireless LAN, Virtual LAN.

Techniques for Bandwidth utilization: Multiplexing – Frequency division, Time division and Wave division, Conceptson spread spectrum.

Data Link Layer and Medium Access Sub Layer: Fundamentals of Error Detection and Error Correction, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols – Stop and Wait, Go-back–N ARQ, Selective Repeat ARQ, Sliding Window,Piggybacking, Random Access, Multiple access protocols –Pure ALOHA,Slotted ALOHA, CSMA/CD,CDMA/CA

Network Layer: Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP,RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols.

Transport Layer: Process to Process Communication, User Datagram Protocol (UDP),Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service (QoS), QoSimproving techniques – Leaky Bucket and Token Bucket algorithms.

Application Layer: DNS, DDNS, TELNET, EMAIL, FTP, WWW, HTTP, SNMP, Bluetooth, Firewalls.

Network Security: Electronic mail, directory services and network management, Basic concepts of Cryptography.

Learning Resources

Text Books:

1. A. Tanenbaum, "Computer Networks", 5th Edition, Pearson Education, 2013.
2. BehrouzA.Forouzan, "Data Communication and Networking", 5th Edition, Tata McGraw-Hill,2001

Reference Books:

1. William Stallings, "Data and Computer Communication", 10th Edition, Pearson Education, 2017.
2. Kaufman, R. Perlman and M. Speciner, "Network Security", 2nd edition,Prentice Hall, 2022.

Web References:

1. https://www.udacity.com/course/computer-networking
2. http://www.learnerstv.com/
3. http://freevideolectures.com

Online Resources:

1. https://www.digimat.in/nptel/courses/video/106105081/L01.html
2. https://www.free-online-training-courses.com/networking
3. https://www.youtube.com/watch?v=1eGxPllnj4M
4. http://www.omnisecu.com/basic-networking

Course Contents and Lecture Schedule:

Module No.	Topic	No. of Hours	Course Outcome
1.	**Introduction**		
1.1	Computer networks and distributed systems, Classifications of computer networks, Preliminaries of layered network structures.	1	CO 1
2.	**Data communication Components**		
2.1	Representation of data and its flow, Various Connection Topology, Protocols and Standards	2	CO 1
2.2	OSI model, Transmission Media.	2	CO 1
3	**LAN:** Wired LAN, Wireless LAN, Virtual LAN.	2	CO 1
4.	**Techniques for Bandwidth utilization**		
4.1	Multiplexing – Frequency division, Time division and Wave division, Conceptson spread spectrum.	1	CO 1
5.	**Data Link Layer and Medium Access Sub Layer**		

5.1	Fundamentals of Error Detection and Error Correction	1	CO 2
5.2	Block coding, Hamming Distance, CRC	2	CO 2
5.3	Flow Control and Error control protocols	1	CO 2
5.4	Stop and Wait, Go-back–N ARQ, Selective Repeat ARQ	2	CO 2
5.5	Sliding Window, Piggybacking, Random Access	2	CO 2
5.6	Multiple access protocols –Pure ALOHA, Slotted ALOHA, CSMA/CD,CDMA/CA	2	CO 2
6.	**Network Layer**		
6.1	Switching, Logical addressing – IPV4, IPV6	2	CO 3
6.2	Address mapping – ARP,RARP, BOOTP and DHCP–Delivery	2	CO 3
6.3	Forwarding and Unicast Routing protocols.	2	CO 3
7.	**Transport Layer**		
7.1	Process to Process Communication, User Datagram Protocol (UDP)	2	CO 4
7.2	Transmission Control Protocol (TCP), SCTP Congestion Control;	2	CO 4
7.3	Quality of Service (QoS), QoS improving techniques – Leaky Bucket and Token Bucket algorithms.	2	CO 4
8.	**Application Layer**		
8.1	DNS, DDNS, TELNET	2	CO 5
8.2	EMAIL, FTP, WWW	2	CO 5
8.3	HTTP, SNMP, Bluetooth, Firewalls.	1	CO 5
9.	**Network Security**		
9.1	Electronic mail, directory services and network management.	2	CO 6
9.2	Basic concepts of Cryptography.	1	CO 6
		36	

Course Designers:

1. Mrs.P.Suganthi psica@tce.edu

21CB620	INFORMATION SECURITY

Category	L	T	P	Credit	Terminal Exam type
PC	3	0	0	3	Theory

Preamble

This course covers information security principles, an area of study that engages in protecting the confidentiality, integrity, and availability of information. Information security is concerned with user identification, authentication and access control based on individual or group privileges.

Prerequisite

Nil

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Understand basic information security goals such as availability, integrity, accuracy, and confidentiality.	10
CO2	Implement the various access control models such as Discretionary, mandatory, roll-based etc.	15
CO3	Design appropriate security policies to protect the data confidentiality in par with international standards.	15
CO4	Develop systems representing flow of information and evaluate assurance using formal methods.	20
CO5	Carrying out detection of malicious logic, vulnerability and intrusion in various applications.	20
CO6	Constructing security architecture in operating systems and databases.	20

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	-	1.2,1.3,2.2,2.3,2.5.4,4.2
CO2	TPS3	Apply	Value	-	1.2,2.1,2.2,4.1,4.2
CO3	TPS3	Apply	Value	-	1.2, 2.1.2,4.4,4.5,4.6
CO4	TPS3	Apply	Value	-	1.2,2.3,4.2,4.3,4.4,4.5,4.6
CO5	TPS3	Apply	Value	-	1.2,2.1,2.3,4.5
CO6	TPS3	Apply	Value	-	1.2,2.1,2.5,3.1.5,4.3,4.5,4.6

Mapping with Programme Outcomes and Programme Specific Outcomes

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

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

S- Strong; M-Medium; L-Low

AssessmentPattern: Cognitive Domain

Cognitive Levels	ContinuousAssessment Tests		Assignment		Terminal Examination
	1	2	1	2	
Remember	30	20			20
Understand	30	40	50	50	40
Apply	40	40	50	50	40
Analyse					
Evaluate					
Create					

Sample Questions for Course Outcome Assessment**

** (2 to 3 at the cognitive level of course outcome)

Course Outcome 1(CO1):

1. Elaborate on CIA triad as a guiding principle for information security within health care organization.
2. What arethe differences between the systems development life cycle (SDLC) and the information security life cycle?
3. Design a template for security policy based on Acceptable use policy.

Course Outcome 2(CO2):

1. Find the differences between Bell-LaPadula model and Biba model of security.
2. Why is an access control model important and find the access control best for business?
3. Your organization has become worried about recent attempts to gain unauthorized access to the R&D facility. Therefore, you are asked to implement a system that will require individuals to present a password and enter a PIN at the security gate before gaining access. What is this type of system called?

Course Outcome 3(CO3):

1. In some applications, a passcode consisting of some number of digits is required (for example, a PIN). Using the number-to-letter conversion on a telephone,
a. What passcode corresponds to the password "hello"?
b. Find as many passwords as you can that correspond to the passcode 5465, where each password is an English dictionary word.
2. Develop a construction to show that a system implementing the Chinese Wall model can support the Bell-LaPadula Model.

3. ISO/IEC 27001 is the world's best-known standard for information security management systems (ISMS) and their requirements. Justify the given statement.

Course Outcome 4 (CO4):

1. A common technique for inhibiting password guessing is to disable an account after three consecutive failed login attempts.
a. Discuss how this technique might prevent legitimate users from accessing the system. Why is this action a violation of the principle of least common mechanism?
b. One can argue that this is an example of fail-safe defaults, because by blocking access to an account under attack, the system is defaulting to a known, safe state. Do you agree or disagree with this argument? Justify your answer.
2. Suppose you are the developer of a computer product that can process critical data and will likely run in a hostile environment. You have an outstanding design and development team, and you are very confident in the quality of their work.
a. Explain why you would add assurance steps to your development environment.
b. What additional information (if any) would you need in order to decide whether or not the product should be formally evaluated?
3. Consider the rule of transitive confinement. Suppose a process needs to execute a sub process in such a way that the child can access exactly two files, one only for reading and one only for writing.
a. Could capabilities be used to implement this? If so, how?
b. Could access control lists implement this? If so, how?

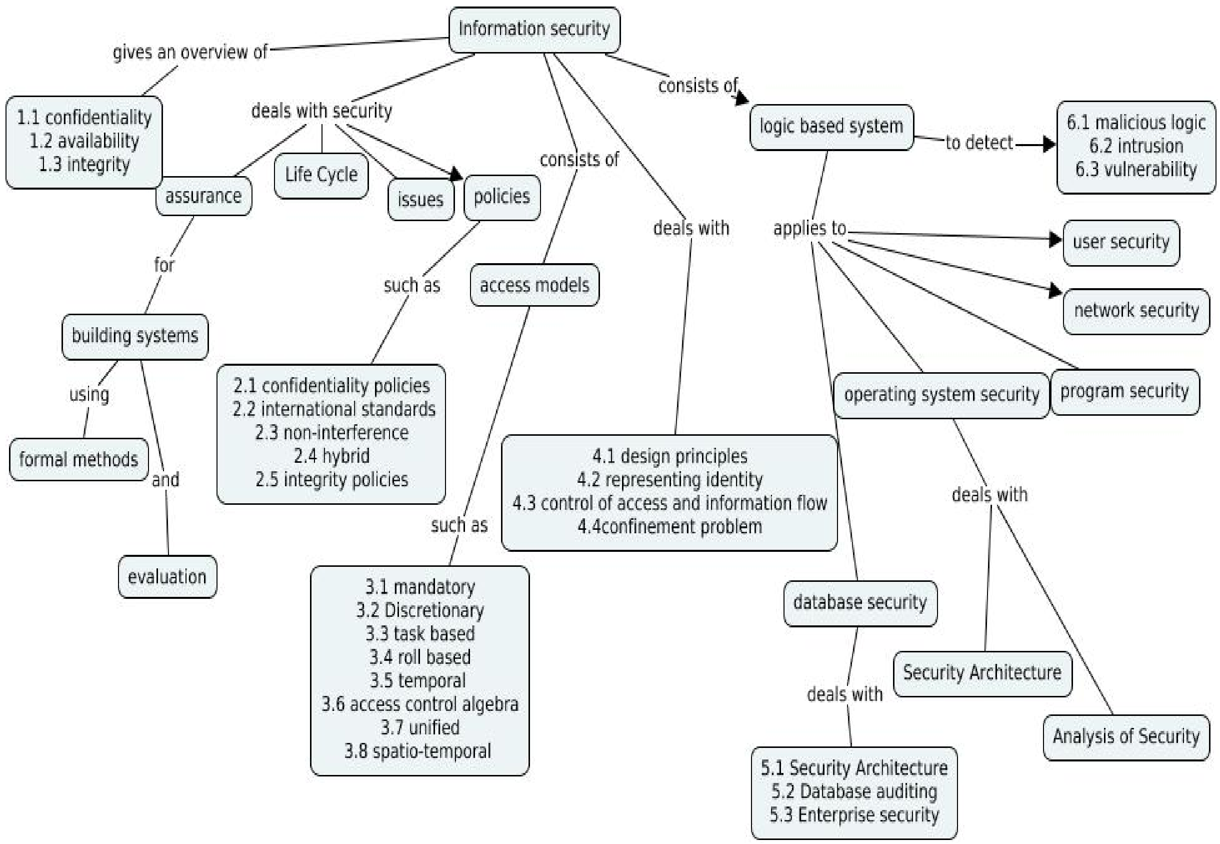
Course Outcome 5 (CO5):

1. Tripwire does not encipher the signature blocks. What precautions must installers take to ensure the integrity of the database?
2. An attacker breaks into a Web server running on a Windows 2000–based system. Because of the ease with which he broke in, he concludes that Windows 2000 is an operating system with very poor security features. Is his conclusion reasonable? Why or why not?
3. You have been hired as the security officer for Compute Computers, Inc. Your boss asks you to determine the number of erroneous login attempts that should be allowed before a user's account is locked. She is concerned that too many employees are being locked out of their accounts unnecessarily, but is equally concerned that attackers may be able to guess passwords. How would you determine an appropriate value for the threshhold?

Course Outcome 6(CO6):

1. What are the significant differences between segmentation and paging? Give one significant security advantage of segmentation over paging.
2. It is sometimes argued that digital rights management (DRM) is, in some sense, the modern incarnation of multilevel security (MLS).
a. List some significant similarities between DRM and MLS.
b. List some significant differences between DRM and MLS.
3. Google's Native Client (NaCl) is a technology designed to allow untrusted code to run securely in a Web browser. The primary advantage is speed, but there are many security issues, some of which are reminiscent of issues faced by NGSCB. Outline the NaCl security architecture.

Concept Map



Syllabus

Overview of Security Parameters: Confidentiality, integrity and availability; Security violation and threats; Security policy and procedure; Assumptions and Trust; Security Assurance, Implementation and Operational Issues; Security Life Cycle.

Access Control Models: Discretionary, mandatory, roll-based and task-based models, unified models, access control algebra, temporal and spatio-temporal models.

Security Policies: Confidentiality policies, integrity policies, hybrid policies, non-interference and policy composition, international standards.

Systems Design: Design principles, representing identity, control of access and information flow, confinement problem. Assurance: Building systems with assurance, formal methods, evaluating systems.

Logic-based System: Malicious logic, vulnerability analysis, auditing, intrusion detection. Applications: Network security, operating system security, user security, program security. Special Topics: Data privacy, introduction to digital forensics, enterprise security specification.

Operating Systems Security: Security Architecture, Analysis of Security in Linux/Windows.

Database Security: Security Architecture, Enterprise security, Database auditing.

Learning Resources

Textbooks:

1. Ross Anderson, “Security Engineering”, 3rd Edition, wiley, 2019.
2. Matt Bishop, “Computer Security: Art and Science”, 2nd Edition, Pearson Education, 2019.
3. Mark Stamp, “Information Security: Principles and Practice”, wiley, 3rd Edition, 2021.

Reference books:

1. C.P. Pfleeger, S.L. Pfleeger, J. Margulies., “Security in Computing”, 5th Edition, Pearson Education, 2015.
2. David Wheeler, “Secure Programming HOWTO”, 7th Edition, 2015.
3. Michael Zalewski, “Browser Security Handbook”, 2008.
4. M. Gertz, S. Jajodia., “Handbook of Database Security”, springer, 2008.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1.	**Overview of Security Parameters**		
1.1	Confidentiality, integrity and availability	1	CO1
1.2	Security violation and threats	1	CO1
1.3	Security policy and procedure; Assumptions and Trust	1	CO1
1.4	Security Assurance, Implementation, Operational Issues and life cycle.	1	CO1
2.	**Access Control Models**		
2.1	Discretionary, mandatory, roll-based models	2	CO2
2.2	Task-based models, unified models	1	CO2
2.3	Access control algebra, temporal models	1	CO2
2.4	Spatio-temporal models	1	CO2
3.	**Security Policies**		
3.1	Confidentiality policies, integrity policies, Hybrid policies	2	CO3
3.3	Non-interference and policy composition	2	CO3
3.4	International standards.	1	CO3
4.	**Systems Design**		
4.1	Design principles	1	CO4
4.2	representing identity	1	CO4
4.3	control of access and information flow	1	CO4
4.4	confinement problem	2	CO4
4.5	Assurance: Building systems with assurance	1	CO4
4.6	Formal methods, evaluating systems.	1	CO4

5.	**Logic-based System**		
5.1	Malicious logic, vulnerability analysis	1	CO5
5.2	auditing, intrusion detection	1	CO5
5.3	Applications: Network security, operating system security	2	CO5
5.4	user security, program security	1	CO5
5.5	Special Topics: Data privacy	1	CO5
5.6	introduction to digital forensics	1	CO5
5.7	enterprise security specification	1	CO5
6.	**Operating Systems Security**		
6.1	Security Architecture	2	CO6
6.2	Analysis of Security in Linux/Windows	1	CO6
7	**Database Security**		
7.1	Security Architecture	2	CO6
7.2	Enterprise security	1	CO6
7.3	Database auditing	1	CO6
	TOTAL	36	

Course Designers:

1. Subhashni R rsica@tce.edu

21CB630	ARTIFICIAL INTELLIGENCE

Category	L	T	P	Credit	Terminal Exam Type
PC	3	0	0	3	Theory

Preamble

The course is to understand the methods of creating a synergy between the humans and machines by performing real world intellectual tasks such as decision making, planning, problem solving and like using various algorithms.

Prerequisite

Data Structures and Algorithms.

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Summarize different types of AI environments, transform a given real world problem to state space problem.	10
CO2	Apply the relevant uniform search algorithms and heuristics search strategies based on the given state space.	25
CO3	Implement the local search strategies to solve the given Constraint Satisfaction Problem.	10
CO4	Apply the suitable Adversarial search techniques for the given multi-agent environment.	15
CO5	Utilize propositional logics and probabilistic reasoning to apply knowledge representation for the given certain and uncertain problem respectively.	15
CO6	Construct plan graph using planning techniques for the given state space.	15
CO7	Explain the stages and issues in the development of an expert system.	10

*** Weightage depends on Bloom's Level, number of contact hours

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond		1.1,1.2,1.3,2.1.1
CO2	TPS3	Apply	Value		1.1,1.2,1.3,2.1,2.2.1,4.1,4.3.1
CO3	TPS3	Apply	Value		1.1,1.2,1.3,2.1,2.2,4.1,4.2.1,4.3.1,4.3.2, 4.3.3,4.4
CO4	TPS3	Apply	Value		1.1,1.2,1.3,2.1,2.2,4.1,4.2.1,4.3.1,4.3.2, 4.3.3,4.4
CO5	TPS3	Apply	Value		1.1,1.2,1.3,2.1,2.2,4.1,4.2.1,4.3.1,4.3.2, 4.3.3,4.4
CO6	TPS3	Apply	Value		1.1,1.2,1.3,2.1,2.2,4.1,4.2.1,4.3.1,4.3.2, 4.3.3,4.4
CO7	TPS2	Understand	Respond		1.1,1.2,1.3,2.1.1

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO 1	M	L											L		
CO 2	S	M	L		M	M	L	M	L			S	M	L	M
CO 3	S	M	L		M	M	L	S	L			S	M	L	M
CO 4	S	M	L		M	M	L	M	L			S	M	L	M
CO 5	S	M	L		L	M	L	M	L			S	M	L	M
CO 6	S	M	L		M	M	L	M	L			S	M	L	M
CO 7	M	L											L		

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	**Continuous Assessment Tests**		**Assignment**		**Terminal Examination**
	1	2	1	2	
Remember	30	20	-	-	20
Understand	30	20	30	30	20
Apply	40	60	70	70	60
Analyse	0	0	-	-	-
Evaluate	0	0	-	-	-
Create	0	0	-	-	-

Assessment Pattern: Psychomotor

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

Sample Questions for Course Outcome Assessment**

** (2 to 3 at the cognitive level of course outcome)

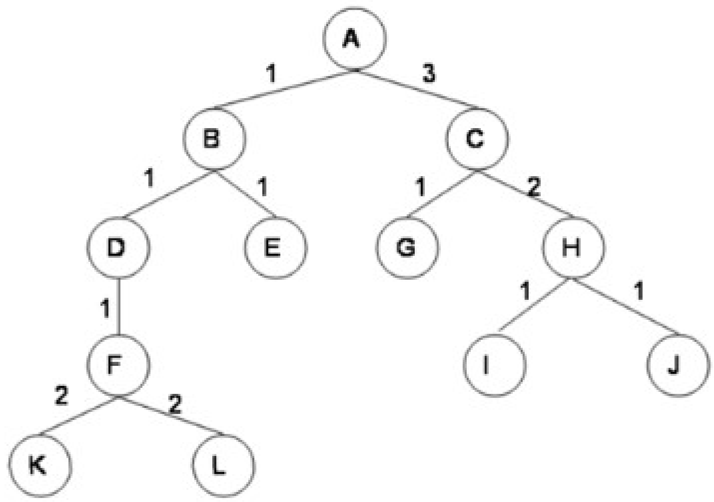
Course Outcome 1(CO1):

1. List the various types of agents and it’s characteristics.

2. Describe in brief an autonomous vehicle as an intelligent agent. Give a **PEAS** specification for the task environment.
3. The water jug problem can be stated as follows: you are given two jugs of capacities litres and 3 litres. You also have a pump that can be used to fill either jug with water, and you can empty the contents of either jug at any time. Your goal is to get exactly 2 litres of water in the 4 litre jug. Formulate this problem as a state-space search describing the state, move-generator and the goal checker.

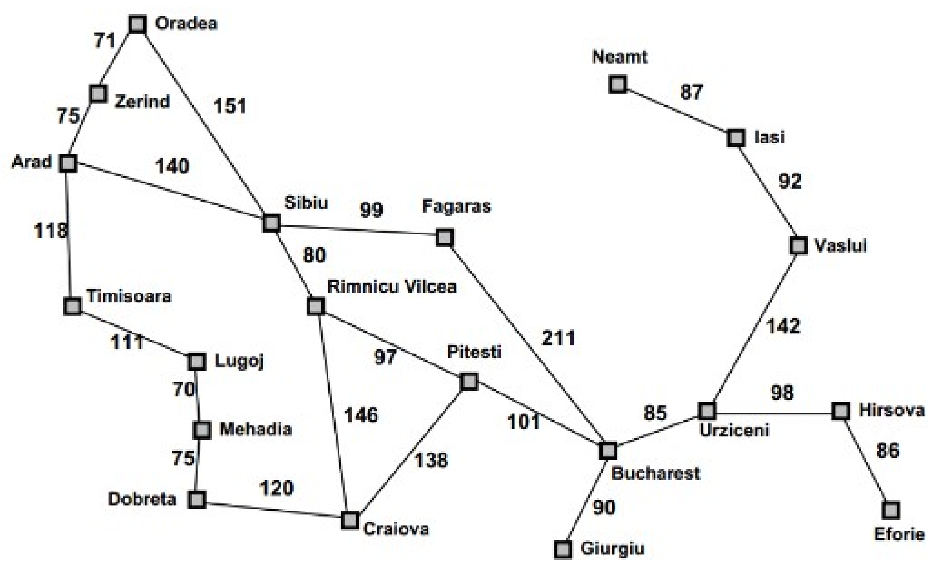
Course Outcome 2(CO2):

1. Define the state space of the N-queen problem.
2. Consider the tree shown below. The numbers on the arcs are the arc lengths. Assume that the nodes are expanded in alphabetical order when no other order is specified by the search, and that the goal is state G. No visited or expanded lists are used.What order would the states be expanded by each type of Uninformed search? Stop when you expand G.



3. Apply heuristic search, Greedy best first search for the given problem to reach Bucharest.

Romania with step costs in km



Straight–line distance to Bucharest

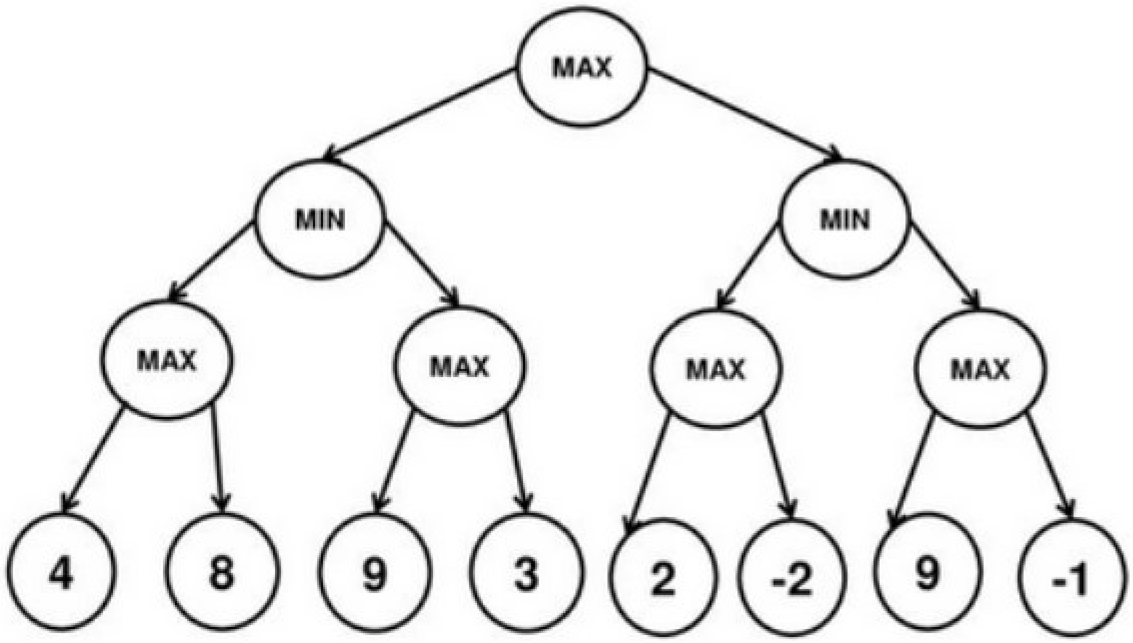
Arad	366
Bucharest	0
Craiova	160
Dobreta	242
Eforie	161
Fagaras	178
Giurgiu	77
Hirsova	151
Iasi	226
Lugoj	244
Mehadia	241
Neamt	234
Oradea	380
Pitesti	98
Rimnicu Vilcea	193
Sibiu	253
Timisoara	329
Urziceni	80
Vaslui	199
Zerind	374

Course Outcome 3(CO3):

1. Consider assigning colors to a checkerboard so that squares that are adjacent vertically or horizontally do not have the same color. We know that this can be done with only two colors, say red (R) and black (B). We will limit our discussion to five squares on a 3x3 board, numbered as follows and If in the initial state (all variables have domains { R, B }), we assign variable 1 to R and do forward checking, what are the resulting domains of the other variables?

```
1 | 2 | 3
-----------
4 | 5 |
-----------
  |   |
```

2. Consider the CSP with
   Variables = A,B, C
   Domains = {1,2,3,4}
   Constraints = A<B, B<C
   Using the Arc Consistency Algorithm, determine the new domains for A,B and C when the algorithm terminates with all consistent arcs.
3. Find the value returned to the root node (i) without alpha-beta pruning and (ii) alpha-beta pruning.

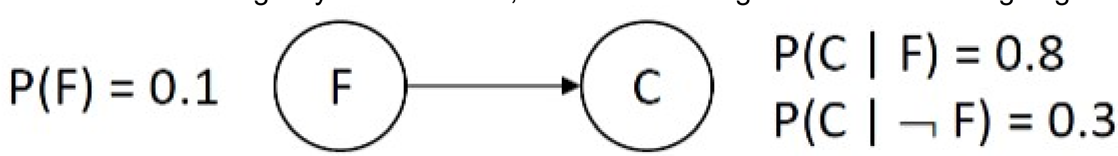


Course Outcome 4 (CO4):

1. Apply FOL and check which of the following sentences are valid, unsatisfiable, or neither.
a. Smoke ⇒ Smoke
b. Smoke ⇒ Fire
c. Smoke ∨ Fire ∨ ¬ Fire
d. (Smoke ⇒ Fire) ⇒ (¬Smoke ⇒ ¬Fire)
e. (Smoke ⇒ Fire) ⇒ (Smoke ∧ Heat ⇒ Fire)

2. Apply First Order Logic and Encode the following sentences:
a. Jack owns a dog;
b. Every dog owner is an animal lover
c. No animal lover kills an animal
d. Either Jack or Curiosity killed the cat, who is named Tuna
e. Did Curiosity kill the cat?

3. Consider the following Bayesian network, where F = having the flu and C =coughing:



a. Write down the joint probability table specified by the Bayesian network.
b. Are C and F independent in the Bayesian network of Part a?

Course Outcome 5 (CO5):

1. Write the PDDL description of an air cargo transportation planning problem.

2. Consider the following problem - There are two locations C1 and C2, and two containers L1 and L2. If the ship is in the same location as a container, and the ship is empty, the ship can hold the container, as a result of this action, the container is on the ship and the ship is no longer empty. If the ship is in location x, it can move to location y, as a result of this action, the ship is in

location y. If the ship has a container on it, and is in location x, then it can unload, and the effect of the action is that the container is in location x and the ship is empty. In the initial state, both containers and the ship are in L1 and the ship is empty. The goal is to have container C2 in L2. Define the problem as a planning problem. Specify the predicates, objects, initial state, goal specification and the action schemas.

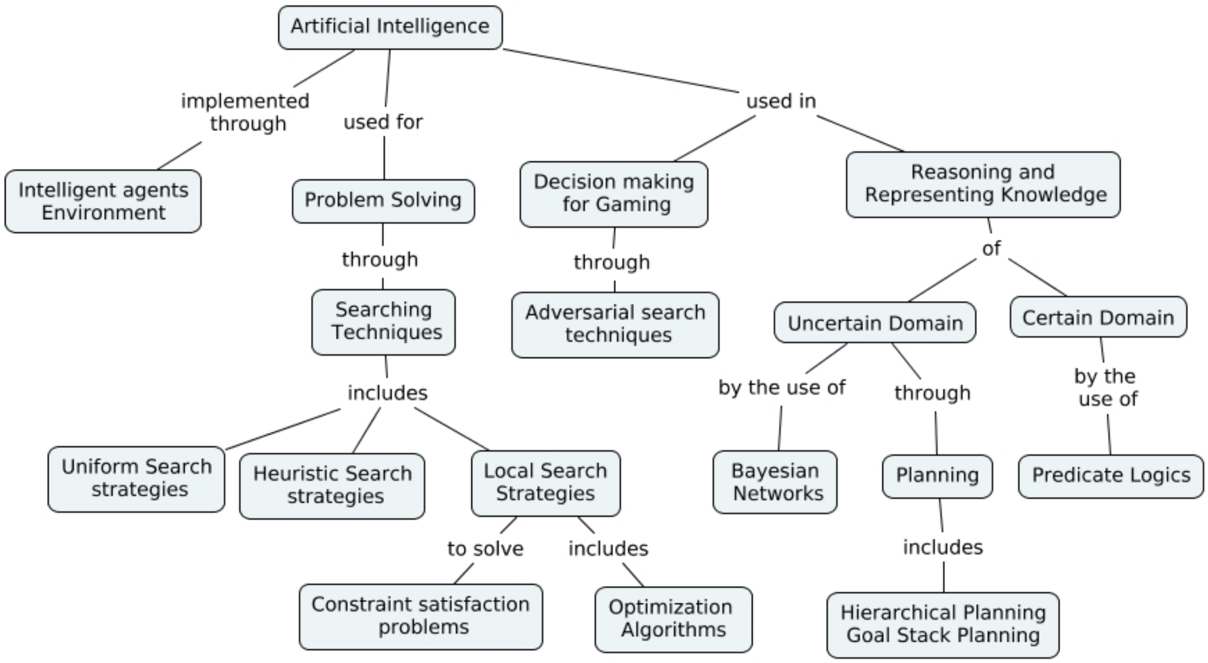
3. The following table of actions describe a planning problem for determining the steps in starting a car. The initial and final states are also indicated. Apply the partial-order planning algorithm to draw the final partial order plan clearly showing the causal links (including the subgoals that they achieve) and ordering links.

Action	Pre-condition	Effects
Turn-Key	$\neg$ Accelerator $\wedge$ $\neg$ Ignition	Ignition
Press-Clutch	$\neg$ Clutch	Clutch
Release-Clutch	Clutch	$\neg$ Clutch
Press-Accl	$\neg$ Accelerator	Accelerator
Release-Accl	Accelerator	$\neg$ Accelerator
Set-Gear	Clutch	Gear-Set
Engage-Gear	Clutch $\wedge$ Gear-Set $\wedge$ $\neg$ Accelerator $\wedge$ Ignition	Gear-Engaged $\wedge$ $\neg$Clutch
START	$\neg$ Clutch $\wedge$ $\neg$ Accelerator $\wedge$ $\neg$ Ignition	
FINISH	Gear-Engaged $\wedge$ $\neg$Clutch $\wedge$ Accelerator $\wedge$ Ignition	

Course Outcome 6(CO6):

1. Describe various components of Expert System Shell.
2. Differentiate the conventional System and an Expert System.
3. Explain the strategies used by Inference Engine for acquiring knowledge from the KB.

Concept Map



Syllabus

Introduction, Overview of Artificial intelligence: Problems of AI, AI technique, Tic - Tac - Toe problem. Intelligent Agents, Agents & environment, nature of environment, structure of agents, goal based agents, utility based agents, learning agents.

Problem Solving: Defining the problem as state space search, production system, problem characteristics, issues in the design of search programs.

Search techniques: Problem solving agents, searching for solutions; uniform search strategies: breadth first search, depth first search, depth limited search, bidirectional search, comparing uniform search strategies. Heuristic search strategies Greedy best-first search, A* search, AO* search, memory bounded heuristic search: local search algorithms & optimization problems: Hill climbing search, simulated annealing search, local beam search.

Constraint satisfaction problems: Local search for constraint satisfaction problems. Adversarial search, Games, optimal decisions & strategies in games, the minimax search procedure, alpha-beta pruning, additional refinements, iterative deepening.

Knowledge & reasoning: Knowledge representation issues, representation & mapping, approaches to knowledge representation. Predicate logic, representing simple fact in logic, representing instant & ISA relationship, computable functions & predicates, resolution, natural deduction. Representing knowledge using rules, Procedural verses declarative knowledge, logic programming, forward verses backward reasoning, matching, control knowledge.

Probabilistic reasoning: Representing knowledge in an uncertain domain, the semantics of Bayesian networks, Dempster-Shafer theory, Planning Overview, components of a planning system, Goal stack planning, Hierarchical planning, other planning techniques.

Expert Systems: Representing and using domain knowledge, expert system shells, and knowledge acquisition.

Learning Resources

Text Book :

1. Stuart J. Russell and Peter Norvig, *"Artificial Intelligence: A Modern Approach"* , 4th edition, Pearson, 2020.
2. Elaine Rich, Kevin Knight and Shivashankar B Nair, *"Artificial Intelligence"*, Third Edition, McGraw Hill Education India, 2010.

Reference Book :

1. Dan W Patterson, *"Introduction To Artificial Intelligence And Expert Systems Online"*,2nd Edition, Prentice-Hall of India,2001.
2. Kaushik, Saroj , "*Logic and Prolog Programming"*, New Age International,2002.
3. Joseph C. Giarratano, Gary D. Riley, *"Expert Systems: Principles and Programming"*, 4th Edition,2005.

Online Resources :

1. https://cse.iitkgp.ac.in/~pallab/course/2022/autumn%202022/Artificial%20Intelligence%20autumn%202022/index.html
2. https://www.ics.uci.edu/~rickl/courses/cs-171/cs171-lecture-slides/

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1.	**Introduction, Overview of Artificial intelligence**		
1.1	Problems of AI, AI technique, Tic - Tac - Toe problem.	1	CO1
1.2	Intelligent Agents, Agents & environment, nature of environment, structure of agents, goal based agents, utility based agents, learning agents.	2	CO1
2.	**Problem Solving, Problems, Problem Space & search**		
2.1	Defining the problem as state space search, production system, problem characteristics, issues in the design of search programs. **Search techniques:** Problem solving agents, searching for solutions; uniform search strategies: breadth first search, depth first search,	2	CO2
2.2	Depth limited search, bidirectional search, comparing uniform search strategies.	2	CO2
2.3	Heuristic search strategies : Greedy best-first search	1	CO2
2.4	A* search and AO* search	2	CO2
2.5	Memory bounded heuristic search: local search algorithms & optimization problems: Hill climbing search	2	CO2
2.6	Simulated annealing search, local beam search.	1	CO2
3.	**Constraint satisfaction problems**		
3.1	Local search for constraint satisfaction problems.	4	CO3

3.2	Adversarial search, Games, optimal decisions & strategies in games	3	CO4
3.3	The minimax search procedure, alpha-beta pruning, additional refinements, iterative deepening.	3	CO4
4.	**Knowledge & reasoning**		
4.1	Knowledge representation issues, representation & mapping, approaches to knowledge representation. Predicate logic, representing simple fact in logic, Representing instant & ISA relationship, computable functions & predicates,	1	CO5
4.2	Resolution, natural deduction Representing knowledge using rules, Procedural verses declarative knowledge,	1	CO5
4.3	Logic programming, forward verses backward reasoning, matching, control knowledge.	1	CO5
5.	**Probabilistic reasoning**		
5.1	Representing knowledge in an uncertain domain, the semantics of Bayesian networks,	2	CO5
5.2	Dempster-Shafer theory	1	CO5
5.3	Planning Overview, components of a planning system, Goal stack planning,	2	CO6
5.4	Hierarchical planning, other planning techniques	3	CO6
6.	**Expert Systems**		
6.1	Representing and using domain knowledge	1	CO7
6.2	Expert system shells, and knowledge acquisition.	1	CO7
	Total Hours	36	

Course Designers:

1. Dr.A.Malini amcse@tce.edu
2. Ms.M.Mahalakshmi mmica@tce.edu

21CB640	FINANCIAL & COST ACCOUNTING

Category	L	T	P	Credit	Terminal exam type
HSS	2	0	0	2	Theory

Preamble

Accounting is a science which provides all the data by recording, classifying, summarizing and interpreting the various transactions taking place in an organization and thereby helps an engineer in taking vital decisions in an effective manner. Finance is an allied but a separate field relying on accounting and enables engineers in taking useful financial and cost related decisions by providing well defined concepts, tools and techniques

Prerequisite

NIL

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage in %
CO1	Describe the basic concepts accounting	10
CO2	Interpret the concept of accounting process.	10
CO3	Prepare the financial statements and analyse, interpret the statements	25
CO4	Prepare the cash flow and fund flow Statement	15
CO5	Prepare cost sheet, marginal cost and various types of budgets.,	25
CO6	Prepare the company accounts and annual reports.	15

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Value	Guided response	1.1, 2.3.4, 2.4.6, 2.4.7, 2.5.1
CO2	TPS3	Understand	Value	Mechanism	1.1, 1.2, 2.1.3, 2.1.4, 2.1.5, 2.3, 2.4.3, 2.4.6, 2.4.7
CO3	TPS3	Apply	Value	Mechanism	1.1, 1.2, 2.1.3, 2.1.4, 2.1.5, 2.3, 2.4.3, 2.4.6, 2.4.7
CO4	TPS4	Apply	Value	Mechanism	1.1, 1.2, 2.1, 2.3.2, 2.4.6, 2.4.7, 3.2.3, 4.1.1, 4.1.6, 4.6
CO5	TPS3	Apply	Value	Mechanism	1.1, 1.2, 2.1, 2.4.3, 2.4.4, 2.5.4, 4.1.1, 4.2.1, 4.2.4, 4.3.2, 4.4.6, 4.5.5, 4.6.1
CO6	TPS3	Apply	Value	Mechanism	1.1, 1.2, 2.1.3, 2.1.4, 2.1.5, 2.3, 2.4.3, 2.4.6, 2.4.7

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	M	L	-	-	-	-	-	M	-	M	S	S	-	-	-
CO2	M	L	-	-	-	-	-	M	S	M	S	S	-	-	-
CO3	S	M	L	-	-	-	-	S	S	S	S	S	-	-	L
CO4	S	M	L	-	L	M	M	S	S	M	S	M	-	-	-

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

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive levels	Continuous Assessment Tests		Assignments		Terminal examination
	1	2	1	2	
Remember	20	20	-	-	20
Understand	30	30	-	-	20
Apply	50	50	100	100	60
Analyse					
Evaluate					
Create					

Assessment Pattern: Psychomotor

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

Sample Questions for Course Outcome Assessment**

Course Outcome 1(CO1):

1. Define accounting.
2. Explain the accounting concepts and conventions
3. Explain the process of accounting cycle.

Course Outcome 2(CO2):

1.Define Journalising.

2.Define ledger.

3. Explain the methods of preparation of trial balance.

Course Outcome 3(CO3):

1. Prepare Trading, Profit and Loss Account and Balance Sheet from the following

S.NO	PARTICULARS	Debit balances (in Rs)	Credit balances(in Rs)
1	Capital		300000
2	Bank	15000	
3	Plant and machinery	40000	
4	Land and building	60000	
5	Debtors	20000	
6	Creditors		40000

7	Cash	70000	
8	Purchases and sales	35000	50000
9	Purchase returns and sales returns	7000	4000
10	Bills receivable	3000	
11	Bills payable		5000
12	Wages	40000	
13	Salaries	30000	
14	Discount		4000
15	Stock on Jan 2017	10000	
16	Furniture	7000	
17	Carriage inwards	5000	
18	Carriage outwards	6000	
19	Advertising	10000	
20	Travelling expense	3000	
21	Loans		60000
22	Vans	100000	
23	Telephone	2000	
	Total	463000	463000

2.From the following particulars, prepare comparative balance sheet of Malar Ltd as on 31st March 2017 and 31st March 2018.

Particulars	31st March 2017	31st March 2018
I EQUITY AND LIABILITIES 1. Shareholders' fund a) Share capital b) Reserves and surplus 2. Non-current liabilities Long-term borrowings 3. Current liabilities Trade payables	 2,00,000 50,000 30,000 20,000	 2,50,000 50,000 60,000 60,000
Total	**3,00,000**	**4,20,000**
II ASSETS 1. Non-current assets a) Fixed assets b) Non - current investments 2. Current assets a)Inventories b) Cash and cash equivalents	 1,00,000 50,000 75,000 75,000	 1,50,000 75,000 1,50,000 45,000
Total	**3,00,000**	**4,20,000**

3. Make a statement of Trend Analysis (2019 as base) from the comparative financial statements. Income Statement of Logesh (P) Ltd.

Income Statement

Particulars	2016	2017	2018	2019
Sales	300	310	350	450
Cost of Goods Sold	150	170	180	190
Gross Profit	150	140	170	260
Operating	70	75	75	80

Expenses				
Operating Profit	80	65	95	180

Balance sheet

Particulars	**2016**	**2017**	**2018**	**2019**
Current Assets	70	80	90	90
Fixed Assets	150	70	180	170
Total Assets	220	250	270	260
Current Liabilities	50	55	60	60
Long Term Liabilities & Capital	170	195	210	200
Total Liabilities	220	250	270	260

Course Outcome 4(CO4):

1.From the following balance sheet of Ram & Co Prepare a statement of changes in working capital

Liabilities	1998	1999	**Assets**	1998	1999
Share Capital	150	170	Land & Building	145	170
Debentures	20	30	Machinery	30	20
Reserves & Surplus	35	45	Furniture	40	50
Loans	40	20	Debtors	45	35
Creditors	60	70	Stock	35	45
Bills Payable	20	15	Cash	30	30
Total	**325**	**350**	**Total**	**325**	**350**

2.From the following balance sheets prepare cash flow statement.

Liabilities	1998	1999	**Assets**	1998	1999
Sundry Creditors	2000	3000	Cash	1000	2000
Bills Payable	5000	2000	Debtors	2,500	3000
Share capital	16,000	20,000	Stock	3000	2,500
P & L a/c	4000	5000	Bills receivable	2000	3,500
			Furniture	4000	5,000
			Land & Building	14,500	14,000
Total	**27,000**	**30,000**	**Total**	**27,000**	**30,000**

Additional information

1.There were no sale of fixed assets.

3.From the following balance sheets prepare cash flow statement.

Liabilities	01.01.98	31.12.98	**Assets**	01.01.98	31.12.98

Share capital	60,000	80,000	Land	20,000	25,000
Loans	25,000	20,000	Machinery	25,000	20,000
Creditors	13,000	15,000	Stock	30,000	35,000
Bills Payable	4,000	5,000	Debtors	25,000	35,000
P & L a/c	8,000	10,000	Cash	10,000	15,000
Total	**1,10,000**	**1,30,000**	**Total**	**1,10,000**	**1,30,000**

Course Outcome 5(CO5):

1. Prepare cost sheet in the book of Vimi from the following particulars.
   Opening stock: - Raw material = Rs 5,000
   Finished goods = Rs 4,000
   Closing stock: - Raw material = Rs 4,000
   Finished goods = Rs 5,000

   Raw material purchased = Rs 50,000
   Wages paid to laboures = Rs 20,000
   Chargeable expenses = Rs 2,000
   Rent and Taxes = Rs 7,400
   Power = Rs 3,000
   Experimental expenses = Rs 600
   Sale of wastage of material = Rs 200
   Office management salary = Rs 4,000
   Office printing & stationery = Rs 200
   Salaries to salesman = Rs 2,000
   Commission to traveling agents = Rs 1,000
   Sales = Rs 1, 00,000
2. Calculate the cost sheet from the following details given below for the month of October 2019.Total production during the period was 786 units. Identify the sales value and the cost per unit of the product.

Particulars	**Rs**
Raw materials on 1.10.2019	3200
Raw materials on 30.10.2019	1800
Work in Progress on 1.10.2019	2800
Work in Progress on 30.10.2019	2500
Finished goods on 1.10.2019 (Rs 3600)	120 units
Finished goods on 30.10.2019	145 units
Materials Purchased	5000
Direct wages	3000
Direct expenses	2000
Factory expenses	1500
Office and administrative expenses	1800
Selling and distribution expenses	1500
Charge profit 15% on sales	

3. From the forecast of income and expenditure prepare a cash budget for the months from April to June 2019.

Month	Sales	Purchases	Wages	Office	Selling

	Rs	Rs	Rs	expenses Rs	expenses Rs
Feb	70,000	45,000	4,500	2,700	1,800
Mar	72,000	43,000	4,700	3,000	2,000
Apr	75,000	44,000	4,900	2,900	2,200
May	71,000	40,000	5,000	3,000	2,100
Jun	70,000	42,000	5,000	2,800	1,900

- Plant worth Rs25, 000 purchased in June. 40% payable immediately and the remaining in two equal installments in subsequent months.
- Advance tax payable in April Rs 4500
- Period of credit allowed
  - By suppliers 2 months
  - To customer 1 month
- Dividend payable Rs 7000 in June
- Delay in payment of wages and office expenses 1 month and selling expenses 1 month.
  Expected cash balance on 1st April Rs 30,000
  Machinery expected to sell on May is Rs 20,000

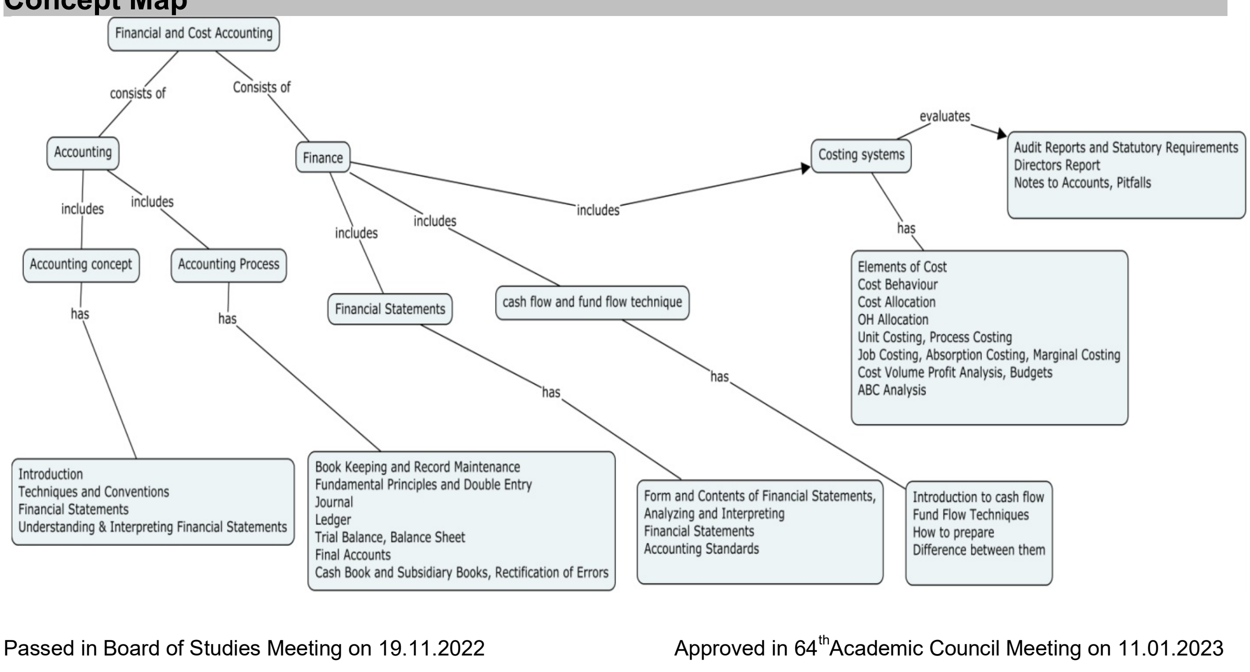
Course Outcome 6 (CO6):

1.ABC Ltd company issued 25,000 shares at Rs 10 per share payable Rs 3 on application, Rs 4 on allotment Rs 3 on first and final call. The public subscribed for 24,000 shares. The directors allotted all the 24,000 shares and received the money duly. Pass the necessary journal entry.

2.Gaja Ltd issued 40,000 shares of ₹ 10 each to the public payable ₹ 2 on the application, ₹ 5 on the allotment, and ₹ 3 on the first and final call. Applications were received for 50,000 shares. The Directors decided to allot 40,000 shares on a pro-rata basis and a surplus of application money was utilized for allotment. Pass journal entries assuming that the amounts due were received.

3.A company forfeited 200 shares of ₹ 10 each fully called up for non – payment of the first call of ₹ 2/- per share and final call of ₹ 3 per share. 120 of these shares were reissued at ₹ 6/- per share fully paid up. Give the necessary entries.

Concept Map



Syllabus

Accounting Concept: Introduction, Techniques and Conventions, Financial Statements- Understanding & Interpreting Financial Statements, **Accounting Process:** Book Keeping and Record Maintenance, Fundamental Principles and Double Entry, Journal, Ledger, Trial Balance, Balance Sheet, Final Accounts, Cash Book and Subsidiary Books, Rectification of Errors. **Financial Statements:** Form and Contents of Financial Statements, Analyzing and Interpreting Financial Statements, Accounting Standards. **Cash Flow and Fund Flow Techniques:** Introduction, How to prepare, Difference between them. **Costing Systems:** Elements of Cost, Cost Behaviour, Cost Allocation, OH Allocation, Unit Costing, Process Costing, Job Costing, Absorption Costing, Marginal Costing, Cost Volume Profit Analysis, Budgets, ABC Analysis. **Company Accounts and Annual Reports:** Audit Reports and Statutory Requirements, Directors Report, Notes to Accounts, Pitfalls

Learning Resources

1. Robert N Anthony, David Hawkins, Kenneth Marchant, "Accounting: Texts and Cases", McGraw-Hill 2017
2. S P. Jain and K L Narang ,"Corporate Accounting" 9th edition, Kalyani Publishers, New India, 2019.
3. M.C.Shukla,T.S.Grewal,"AdvancedAccounts"- S. Chand & company Ltd.,19th edition ,2017 Reprint, 2010.
4. Prasanna Chandra, "Financial Management-Theory and practice"seventh Reprint,Tata McGraw-Hill publishing company Limited,2010.
5. P.S.BoopathiManickam "Financial and Management Accounting" PSG publications 2009.
6. Michael C .Ehrhardt and Eugene F . Brigham, "Financial Management: Theory and Practice - thirteenth edition" South-Western cengage learning, 2011
7. Paramasivan.C, Subramanian.T, "Financial management" New Age international Publishers, 2014.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1.	**Accounting Process (4)**		
1.1	Introduction	1	CO1
1.2	Techniques and Conventions	1	CO1
1.3	Financial Statements	1	CO1
1.4	Understanding & Interpreting Financial Statements	1	CO1
2.	**Accounting Concept (5)**		
2.1	Book Keeping and Record Maintenance	1	CO2
2.2	Fundamental Principles and Double Entry	1	CO2
2.3	Journal	1	CO2
2.4	Ledger		CO2
2.5	Trial Balance, Balance Sheet	1	CO2
2.6	Final Accounts		CO2
2.7	Cash Book and Subsidiary Books, Rectification of Errors	1	CO2
3.	**Financial Statements (4)**		
3.1	Form and Contents of Financial Statements,	1	CO3
3.2	Analyzing and Interpreting	1	CO3
3.3	Financial Statements	1	CO3
3.4	Accounting Standards	1	CO3
4.	**Cash Flow and Fund Flow Techniques (4)**		

4.1	Introduction to cash flow	1	CO4
4.2	Fund Flow Techniques	1	CO4
4.3	How to prepare	1	CO4
4.4	Difference between them	1	CO4
5	**Costing Systems (4)**		
5.1	Elements of Cost	1	CO5
5.2	Cost Behaviour		CO5
5.3	Cost Allocation	1	CO5
5.4	OH Allocation		CO5
5.5	Unit Costing, Process Costing	1	CO5
5.6	Job Costing, Absorption Costing, Marginal Costing		CO5
5.7	Cost Volume Profit Analysis, Budgets	1	CO5
5.8	ABC Analysis		CO5
6	**Company Accounts and Annual Reports (3)**		
6.1	Audit Reports and Statutory Requirements	1	CO6
6.2	Directors Report	1	CO6
6.3	Notes to Accounts, Pitfalls	1	CO6
			Total: 24 hours

Course Designers:

1. Mr.S.Rajkumar srmech@tce.edu
2. Mr.V.Janakiraman vjncse@tce.edu

21CB650	BUSINESS COMMUNICATION & VALUE SCIENCE– IV

Category	L	T	P	Credit	Terminal Exam Type
Project	2	0	0	2	Fully Internal

Preamble

This course aims at enhancing students' corporate communication, developing workplace etiquette, accomplishing time management and stress management techniques. It helps students become emotionally intelligent and learn problem solving skills in personal and professional lives. It creates awareness on the value of corporate social responsibility.

Prerequisite

BasicKnowledgeofverbal and writtenEnglish

CourseOutcomes

On thesuccessfulcompletionofthecoursestudentswillbeableto

CO Number	CourseOutcomeStatement	Weightage in %
CO1	Demonstrate Effective Communication in Business Correspondence.	20
CO2	HandleEmotional Intelligence and Conflict Management in both personal and professional lives	15
CO3	Demonstrate Public Speaking skill in real-life scenario	20
CO4	Practice the best Time Management Techniques	15
CO5	Acquirethe best practices to Manage Stress.	10
CO6	Relate the importance of Corporate Social Responsibility	20

COMappingwithCDIOCurriculumFramework

CO#	TCE ProficiencyScale	LearningDomainLevel			CDIO CurricularComponents (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Apply	Value	Perception	2.4,2.5,3.1
CO2	TPS2	Apply	Respond	Perception	2.4,2.5,3.2.6
CO3	TPS3	Apply	Respond	Perception	3.1,3.1.6
CO4	TPS2	Apply	Respond	Perception	3.1.6,3.2
CO5	TPS3	Apply	Respond	Guided Response	3.2.1,3.2.3,3.3.1
CO6	TPS6	Apply	Respond	Create (Project)	3.1.6,3.2

MappingwithProgrammeOutcomesandProgrammeSpecificOutcomes

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

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

S-Strong;M-Medium;L-Low

AssessmentPattern:CognitiveDomain

No CAT willbeconducted.
Summative - No Paper based Examination.
Activity Based Evaluation will be done by the Internal and External Examiners

Internal Examination:

Model Test	**CO1&2**	**APPLY**	**20**
Quiz	**CO4&5**	**APPLY**	**10**

External Examination: (External Evaluation is done by the Industry people)

Aptitude Test	**CO1&2**	**APPLY**	**20**		
Speaking	**CO3**	**APPLY**	**10**		
Project & Review	**CO6**	**APPLY**	**30**		
			R1	**R2**	**Final Review & Submission**
			10	**10**	**10**
		Total	**100**		

AssessmentPattern:Psychomotor

PsychomotorSkill	**Mini project/Assignment/PracticalComponent**
Perception	
Set	
GuidedResponse	Project
Mechanism	
ComplexOvertResponses	
Adaptation	
Origination	

SampleQuestionsforCourseOutcomeAssessment**

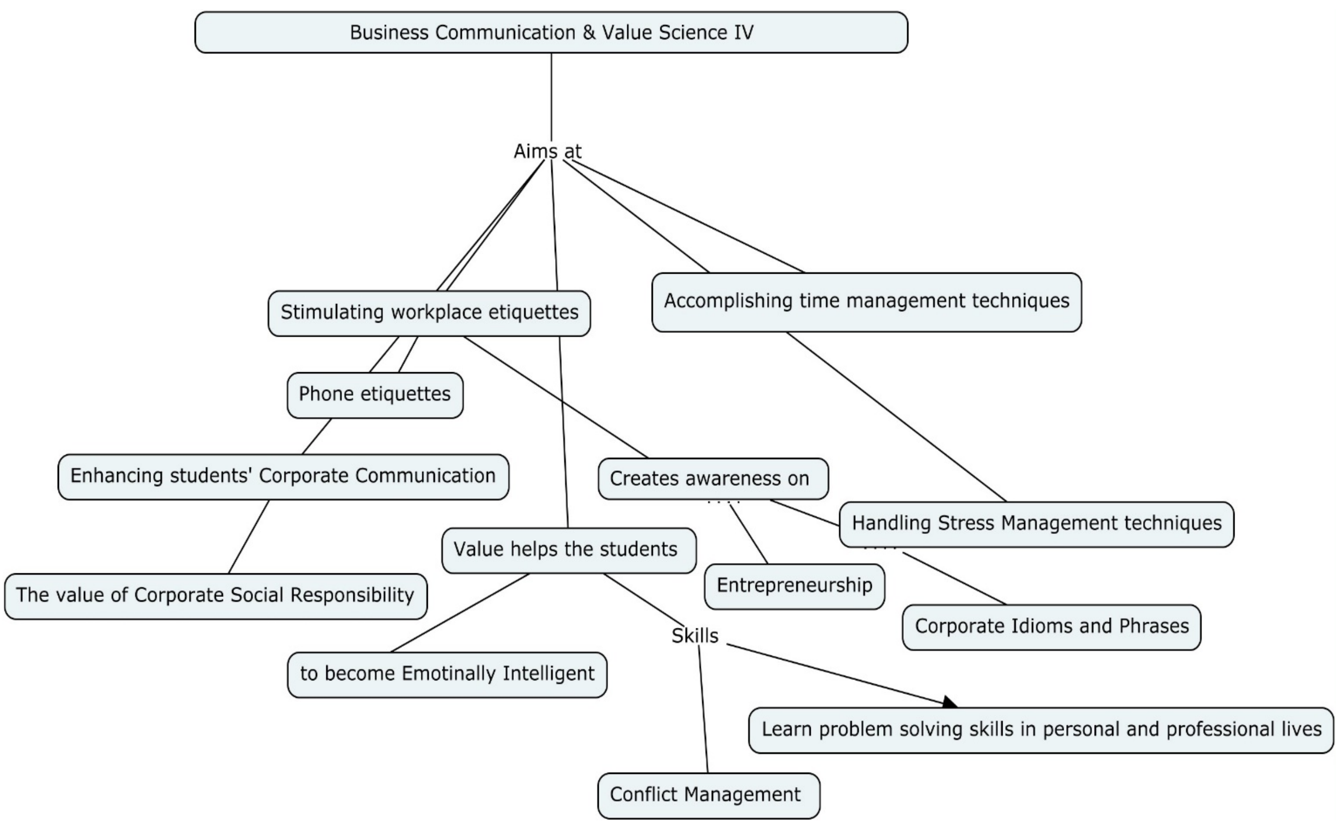
CourseOutcome1 (CO1):(20marks)

A. Write Business Letters

B. Interpretation of Graphics
C. Frame sentences using business Idioms and Phrases
D. Quiz on Phone etiquettes

CourseOutcome2 (CO2):(20marks) Quiz/Questionnaire
Emotional Intelligence/ Intelligence Quotient (IQ)/ Emotional Quotient (EQ)& Conflict Management
CourseOutcome**3(CO3):(10 Marks) Speaking Activity**
Public Speaking – Real life scenario and Entrepreneurship
CourseOutcome4(CO4):(10 marks) **Listening Activity**
TED Talks - Time management and Etiquettes
Course**Outcome4(CO5):(10 Marks) Case Study**
Case Study on Stress Management
Course Outcome 6 (CO6): (30) Project + Review
Startup related project and its review will be based on -
1. Topic selection 2. Preparation (synopsis) 3. Full project submission

ConceptMap



Syllabus

Principles of Communicative writing and Corporate Etiquettes
Identify the key aspects of communicative Writing - Business Letters, Writing Proposals - startups, Graphical interpretation, Business Idioms and Corporate terms, Features of Corporate

etiquettes, Cellphone and telephone etiquettes.

Emotional Intelligence and Conflict Management
Difference between Emotional Quotient and Intelligence Quotient, Importance of Emotional Intelligence in personal and professional lives, Meaning and Definition of Conflict, Reasons of Conflict, impacts of Conflicts, Tips to Manage Conflicts.

Public Speaking Skills and Time Management Skill
Public Speaking at your workplace, Best practices of public speaking in real life scenarios, Extempore, Listening - Ted-Talk videos

Time and Stress Management Skills
Time Management for better life style, Basic practices to Manage Stress, 4As of Stress Management, Relaxation Techniques.

Corporate Social Responsibility
Attributes needed to function and grow in a corporate environment, Ubuntu story, Attributes and Qualities required for Work - Resilience, Flexibility, Strategic Thinking and Planning, Resolving Conflicts and Decision Making.

LearningResources

TextBooks:	
	ThearenoprescribedtextsforSemester1–therewillbehandoutsand referencelinksshared.
Reference Books:	
1	Emotional Intelligence: Why it Can Matter More Than IQ by Daniel Goleman
2	Putting Emotional Intelligence to Work by Ryback David
3	How to Develop Self Confidence and Improve Public Speaking - Time - Tested Methods of Persuasion by Dale Carnegie
4	TED Talks: The official TED guide to public speaking: Tips and tricks for giving unforgettable speeches and presentations
Web References:	
1	**https://www.tata.com/about-us/tata-group-our-heritage**
2	**https://economictimes.indiatimes.com/tata-success-story-is-based-on-humanityphilanthropy-and-ethics/articleshow/41766592.cms**
OnlineResources:	
1	https://youtu.be/reu8rzD6ZAE
2	https://youtu.be/Wx9v_J34Fyo
3	https://youtu.be/F2hc2FLOdhI

4	https://youtu.be/wHGqp8lz36c
5	https://youtu.be/hxS5He3KVEM
6	https://youtu.be/nMPqsjuXDmE

Course Contents and Lecture Schedule

ModuleNo.	Topic	No. ofHours	CourseOutcome
1.1	Identify the key aspects of communicative Writing	1	CO1
1.2	Business Letters	1	CO1
1.3	Writing Proposals – Start ups	1	CO1
1.4	Graphical Interpretation	1	CO1
1.5	Business Idioms and Corporate Terms	1	CO1
1.6	Features of Corporate Etiquettes and Phone Etiquettes	1	CO1
2.1	Difference between Emotional Quotient and Intelligence Quotient	2	CO2
2.2	Importance of Emotional Intelligence in Personal and Professional lives	1	CO2
2.3	Meaning and Definition of Conflict, Reasons of Conflict, impacts of Conflicts, Tips to Manage Conflicts	1	CO2
3.1	Public Speaking at your Workplace	3	CO3
3.2	Best practices of Public Speaking in Real Life Scenarios	2	CO3
3.3	Extempore	1	CO3
3.4	Listening - Ted-Talk videos	2 (LAB)	CO3
4.1	Time Management for better life style	1	CO4
4.2	Basic Practices to Manage Stress, 4As of Stress Management	1	CO5
4.3	Relaxation Techniques	1	CO5
5.1	Attributes needed to function and grow in a Corporate Environment, Ubuntu story	1	CO6
5.2	Attributes and Qualities required for Work - Resilience, Flexibility, Strategic Thinking and Planning, Resolving Conflicts and Decision Making	2	CO6
	TOTAL	24	

CourseDesigners:

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21CB660	COMPUTER NETWORKS LAB

Category	L	T	P	Credit	Terminal Exam Type
PC	0	0	4	2	Practical

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

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Configuration of networking components and installingdevice driversand build aLocal AreaNetwork.	10
CO2	Implement client server communication using socketprogramming.	15
CO3	Implement Sliding window protocol and stop and wait protocol.	15
CO4	ImplementFiletransfer, Remote Method Invocation.	15
CO5	Develop a DNS client server to resolve the given host name or IP address.	20
CO6	SimulateanetworktopologyusingNS3.	25

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO#	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value	Mechanism	1.2,3.2.3,4.5.1
CO2	TPS3	Apply	Value	Mechanism	1.2,3.2.3,4.5.1,4.5.3
CO3	TPS3	Apply	Value	Mechanism	1.2,3.2.3,4.5.1,4.5.3
CO4	TPS3	Apply	Value	Mechanism	1.2,3.2.3,4.5.1,4.5.3
CO5	TPS3	Apply	Value	Mechanism	1.2,3.2.3,4.5.1,4.5.3
CO6	TPS3	Apply	Value	Mechanism	1.2,2.1.2,3.2.3,4.5.1,4.5.3

Mapping with Programme Outcomes and Programme Specific Outcomes

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

S- Strong; M-Medium; L-Low

AssessmentPattern: Cognitive Domain

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

AssessmentPattern: Psychomotor

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

List of Experiments/Activities with CO Mapping

Module No.	Topic	No.of Sessions	Course Outcome
	Implementation of system administration and network administration	2	CO1
	Implementation of socket programming and client server model using UDP and TCP	4	CO2
	Implementation of Sliding window protocol and stop and wait protocol	2	CO3
	Simulate PING and TRACEROUTE commands	2	CO3
	Applications using TCP Sockets like File transfer Remote command execution Chat Concurrent server	4	CO4
	Create a socket for HTTP for webpage upload and download	2	CO5
	Implementation of Subnetting Applications DNS SNMP	2	CO5
	Simulation of any one of routing protocol using NS3	2	C06
	Implement Network File Transfer Application using PUTTY	2	C06
	Perform a case study about ETTERCAP (NETWORK SECURITY TOOL).	2	C06
	Total	24	

Course Designers:

1. Mrs.P.Suganthi psica@tce.edu

21CB670	INFORMATION SECURITY LAB

Category	L	T	P	Credit	Terminal Exam type
PC	0	0	2	1	Practical

Preamble

The objective of an information security lab is to protect information from unauthorized release and ensure that the appropriate level of confidentiality is preserved. It has three fundamental objectives, namely confidentiality, integrity, and availability.Students will get hands-on experience on password cracking and authentication, computer vulnerability scan and network security monitoring (intrusion detection).

Prerequisite

NIL

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Implementation of authentication methods in Unix/Linux systems by using passwords.	25
CO2	Implementation of vulnerabilities in database security and multi factor authentication in Unix/Linux systems.	15
CO3	Demonstrate file systems access control policy in Unix/ Linux systems.	10
CO4	Apply hashing algorithm for encryption and data integrity.	15
CO5	Identify the interfaces of the Wireshark application and perform network analysis.	20
CO6	Demonstrate network intrusion detection system using network security tool.	10

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value	-	1.2,1.3,2.2,4.3
CO2	TPS3	Apply	Value	-	1.2,2.2,2.3,4.2,4.3
CO3	TPS3	Apply	Value	-	1.2,1.3,4.3,4.4,4.5
CO4	TPS3	Apply	Value	-	1.2,1.3,4.2,4.3
CO5	TPS3	Apply	Value	-	1.2,1.3,4.2,4.3,4.4,4.5,4.6
CO6	TPS3	Apply	Value	-	1.2,1.3,4.2,4.3,4.4,4.5,4.6

Mapping with Programme Outcomes and Programme Specific Outcomes

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

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

S- Strong; M-Medium; L-Low

AssessmentPattern: 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	No. of sessions	Course Outcome
1	Manage user identityof Unix/Linux systems in groups and depict administrator policies for adding/deleting user accounts.	1	CO1
2	Create, edit and manage passwords and expiration limits by Viewing group level password policies.	1	CO1
3	Implementation of standard password manager for adding and retrieving the passwords from store using GPG key.	1	CO1
4	Apply software vulnerabilities such as SQL injection and provide solutions for prevention and detection.	1	CO2
5	Apply two-factor authentication for SSH In Linux/Unix systems.	1	CO2
6	Implementation of file permission/access modes and change it using symbolic method and absolute form.	1	CO3
7	Implementation of SHA-I algorithm and MD5 algorithm for generating hashed passwords.	2	CO4
8	Study the steps for installing Wireshark, the packet-sniffing tool for performing Network analysis.	1	CO5
9	Implementations of the various wireshark filter and perform malware traffic analysis.	2	CO5
10	Apply snort tool fornetwork intrusion detection.	1	CO6
	TOTAL	12	

Learning Resources

1. https://access.redhat.com/products
2. https://www.wireshark.org/docs/wsug_html/
3. David Wheeler, “*Secure Programming HOWTO*”, 7th Edition, 2015.

Course Designers:

1. Subhashni R rsica@tce.edu

21CB680	Artificial Intelligence Lab

Category	L	T	P	Credit	Terminal Exam type
PC	0	0	2	1	Practical

Preamble

The experiments are designed to provide problem-solving abilities that can be applied to a variety of real-world issues. Students can discover how Artificial Intelligence algorithms can reason, interact, apply knowledge, and learn.

Prerequisite

Basic knowledge of programming language like python,c or c++

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Develop solutions using relevant uninformed search strategies to solve the given state space problem.	15
CO2	Construct a solution using suitable heuristic searching algorithms for the given problem statement	15
CO3	Implement a suitable optimization algorithm for the real-world problem.	15
CO4	Apply an adversarial search strategy for the given gaming environment and the CSP problem.	25
CO5	Construct a planning graph to solve the considered real world problem.	15
CO6	Apply various probabilistic decision-making algorithms on considering a real time dataset for evaluation.	15

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value		1.2, 2.3.2,3.2.3, 4.4.3, 4.5.3
CO2	TPS3	Apply	Value		1.2, 2.3.2,3.2.3, 4.4.3, 4.5.3
CO3	TPS3	Apply	Value		1.2, 2.3.2,3.2.3, 4.4.3, 4.5.3
CO4	TPS3	Apply	Value		1.2, 2.3.2,3.2.3, 4.4.3, 4.5.3
CO5	TPS3	Apply	Value		1.2, 2.3.2,3.2.3, 4.4.3, 4.5.3
CO6	TPS3	Apply	Value		1.2, 2.3.2,3.2.3, 4.4.3, 4.5.3

Mapping with Programme Outcomes and Programme Specific Outcomes

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

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

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

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

Assessment Pattern: Psychomotor

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

List of Experiments/Activities with CO Mapping

S.No	Name of the Experiment	No. of sessions	Course Outcome
1.	Implement a solution for the Tic-Tac-Toe problem with O and X	1	CO1
2.	Implement an uninform searching strategy to detect a cycle and the strongly connected components in a directed graph using BFS and DFS respectively.	1	CO1
3.	Implement a program to find the shortest path between the source and the destination node using A* and AO* heuristic searching algorithms.	1	CO2
4.	Implement a Greedy Heuristic solution for the travelling salesman problem.	1	CO2
5.	Implement an Optimization Algorithm, Hill Climbing algorithm for the N-Queen Problem.	1	CO3
6.	Implement a program to solve the crypt arithmetic puzzle, a CSP problem using Backtracking.	2	CO4
7.	Implement the adversarial search MinMax algorithm with and without alpha beta pruning for a two-player gaming environment.	1	CO4
8.	Implement a program to solve the Block World Problem using goal stack planning.	1	CO5
9.	Implement Bayesian Belief Network for a given large dataset	1	C06
10.	Implement a k-means clustering algorithm for given data set	1	C06
11.	Implement Decision Tree for any considered application of decision making.	1	C06
	Total	12	

Learning Resources

1. Stuart Russell and Peter Norvig. "*Artificial Intelligence: A Modern Approach*", 4th Edition, Prentice Hall, 2020.

2. Deepak Khemani. “*A First Course in Artificial Intelligence”*, McGraw Hill Education ,2013.

Course Designers

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CURRICULUM AND DETAILED SYLLABI

FOR

B.TECH DEGREE (Computer Science and Business Systems) PROGRAMME

SEVENTH AND EIGHTH SEMESTER

FOR THE STUDENTS ADMITTED FROM THE

ACADEMIC YEAR 2021 – 2022 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
(A Govt. Aided, ISO 9001:2008 certified Autonomous Institution affiliated to Anna University)
B.Tech Degree (Computer Science and Business Systems) Programme
COURSES OF STUDY
(For the candidates admitted from 2021 – 2022 onwards)

SEVENTH SEMESTER

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	No.of Hours / Week			Credits
				L	T	P	
THEORY COURSES							
1	21CB710	Service Operations Management	BS	3	0	0	3
2	21CBPX0	Program Elective - V	PE	2	0	0	2
3	21CBPX0	Program Elective – VI	PE	2	0	0	2
4	21CBPX0	Program Elective – VII	PE	3	1	0	4
5	21CBPX0	Program Elective - VIII	PE	3	0	0	3
6	21CBPX0	Program Elective - IX	PE	3	1	0	4
7	21CBPX0	Program Elective - X	PE	2	0	2	3
THEORY CUM PRACTICAL COURSES							
8	21CB720	IT Workshop	ES	2	0	2	3
			TOTAL	**20**	**2**	**4**	**24**

EIGHTH SEMESTER

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	No.of Hours / Week			Credits
				L	T	P	
PRACTICAL COURSES							
1	21CB810	Project	Project	0	0	12	6
			TOTAL	**0**	**0**	**12**	**6**

BS : Basic Sciences
PE : Program Elective
ES : Engineering Sciences
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
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B.Tech Degree (Computer Science and Business Systems) Programme
SCHEME OF EXAMINATIONS
(For the candidates admitted from 2021 – 2022 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	21CB710	Service Operations Management	3	40	60	100	27	50
THEORY CUM PRACTICAL COURSES								
2	21CB720	IT Workshop	3	50	50	100	22.5	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
PRACTICAL								
1	21CB810	Project	-	40	60	100	27	50

21CB710	Service Operations Management	Category	L	T	P	Credit	Terminal Exam Type
		BS	3	0	0	3	Theory

Preamble

The objective of the course is to understand the growing significance and impact of services on the growth and economy and the scientific ways to run the operations so as to optimize the business and brand returns. The main concern of Operations Management is to convert the materials into goods and services efficiently. This course would help the students understand service Operations Management which comprises planning, implementing, and also supervising the production of goods and management.

Prerequisite

Fundamentals of Management, Operations Research

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Understand the services and service operations management concepts.	15
CO2	Improve services from Goods-Dominant logic to Service-Dominant logic by adding values.	15
CO3	Develop a new service and generate a blueprint for service delivery system.	15
CO4	Apply the principles, tools and techniques of service design such as Huff's retail model, thinking model.	20
CO5	To demonstrate the strategies for service supply relationship of goods and after sales service.	25
CO6	Implement the service operation strategies on any service organization around with the perspective of: nature, classification, design and quality of service.	10

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond		1.2,1.3,2.2,2.3,2.5.4,4.2
CO2	TPS3	Apply	Value		1.2,2.1,2.2,4.1,4.2
CO3	TPS3	Apply	Value		1.2, 2.1.2,4.4,4.5,4.6
CO4	TPS3	Apply	Value		1.2,2.3,4.2,4.3,4.4,4.5,4.6
CO5	TPS3	Apply	Value		1.2,2.1,2.3,4.5
CO6	TPS3	Apply	Value		1.2,2.1,2.5,3.1.5,4.3,4.5,4.6

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	M	L	L	L				L				M	M		L
CO2	S	M	M	L				L				M	M		L
CO3	S	M	M		L			L				M	M		L
CO4	S	S	M		M			L				M	M	L	L
CO5	S	M	M					L				M	M		L
CO6	S	S	M		M			L				M	M	L	L

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests		Assignment		Terminal Examination
	1	2	1	2	
Remember	15	15			20
Understand	15	20	50	50	40
Apply	20	15	50	50	40
Analyse					
Evaluate					
Create					

Sample Questions for Course Outcome Assessment**

** (2 to 3 at the cognitive level of course outcome)

Course Outcome 1(CO1):

1. Illustrate how the type of work he or she does influences a person's lifestyle. For example, contrast a farmer, a factory worker, and a school teacher.
2. Determine if the service sector is currently expanding or contracting based upon the Non-Manufacturing Index (NMI) found at the ISM Report on Business on the Institute of Supply Management.
3. Is it possible for an economy to be based entirely on services, analyse?

Course Outcome 2(CO2):

1. Critique the "Distinctive Characteristics of Service Operations" by arguing that the characteristics of customer participation, simultaneity, perishability, intangibility, and heterogeneity may apply to goods as well.
2. Illustrate the "distinctive characteristics of service operations" for a service with which you are familiar.
3. Could firms in the "world-class service delivery" stage of competitiveness be described as "learning organizations"?

Course Outcome 3(CO3):

1. Give an example of a service in which isolation of the technical core would be inappropriate.
2. Prepare a service blueprint for Golfsmith.
3. What generic approach to service system design is illustrated by Commuter Cleaning, and what competitive advantages does this design offer?

Course Outcome 4 (CO4):

1. Will Amazon continue to be successful against "click-and mortar" competitors, such as Barnes & Noble? Is Amazon.com a model for the future of retailing?
2. What features of the 7-Eleven Japan distribution system illustrate the "Value Net Integrator" e-business model?
3. Illustrate the four components in the cost of quality for a service of your choice.

Course Outcome 5 (CO5):

1. The CRAFT program is an example of a heuristic programming approach to problem solving. Why might CRAFT not find the optimal solution to a layout problem?
2. The architect for the new undergraduate library is interested in a floor plan that would be viewed as convenient by users. Based on survey data from the old library, student movements between different areas in hundreds of trips per month are noted in the flow matrix below. Prepare a good initial rectangular layout that minimizes total flow distance between nonadjacent areas; then use operations sequence analysis to improve the layout.

Library Area	**A**	**B**	**C**	**D**	**E**	**F**
A Reserve Room	—	5	9	3	7	1
B Reference Room	3	—	8	2	6	2
C Copy Room	1	1	—	7	2	3
D Stacks	2	2	10	—	2	5
E Periodical Room	1	2	6	3	—	2
F Computer Room	1	1	1	4	2	—

3. Passengers arriving at an airport departure gate must first wait for their row to be called before proceeding to the gate to have their boarding pass authenticated. If the boarding pass does not match the departing flight, the passenger is directed to the appropriate gate. A passenger attempting to carry on an excessively large bag is directed to check the luggage piece and return. Passengers with the proper boarding pass and appropriate sized carry-on are allowed to enter the jet way and board the plane. Draw a process flow diagram of the departure gate process. How might this process be improved to avoid delays?

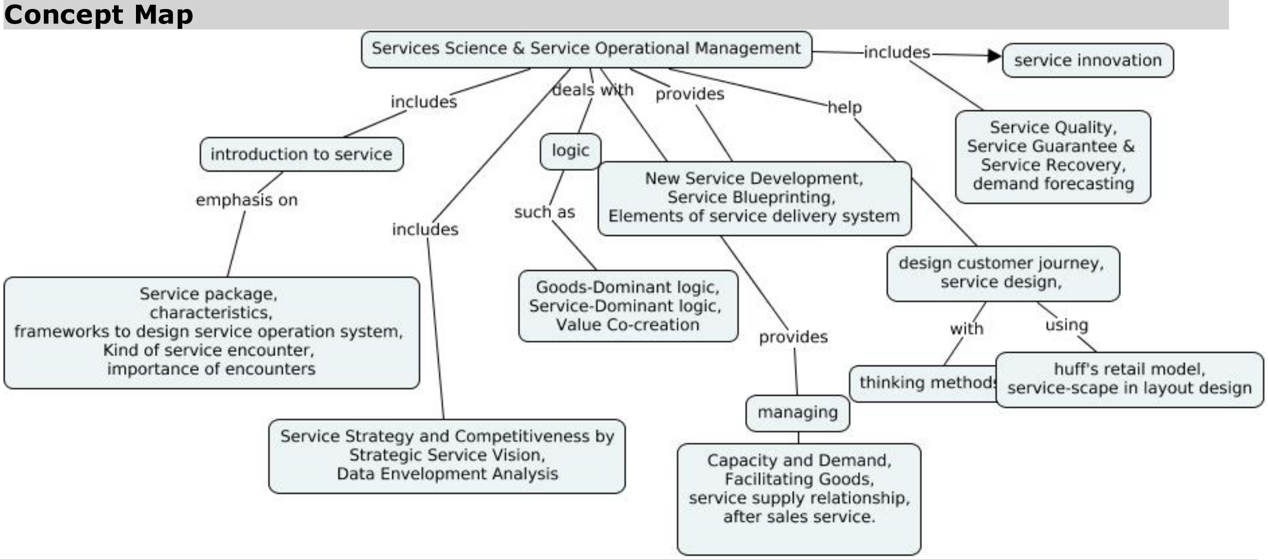
Course Outcome 6(CO6):

1. Sunset Airlines is reviewing its check-in procedures in anticipation of its "two for the price of one" fare promotion. Presently, a single clerk spends an average of 3 minutes per passenger checking luggage and issuing boarding passes. Service times have a negative exponential distribution, and passenger arrivals are Poisson distributed, with an anticipated mean of 15 per hour during flight operations. What is the probability that an arriving passenger will be served immediately without waiting?
2. Sea Dock, a private firm, operates an unloading facility in the Gulf of Mexico for super tankers delivering crude oil for refineries in the Port Arthur area of Texas. Records show that, on average, 2 tankers arrive per day, with a Poisson distribution. Super tankers are unloaded one at a time on a first-come, first-served (FCFS) basis. Unloading requires approximately 8 hours of a 24-hour working day, and unloading times have a negative exponential distribution.
    a. Sea Dock has provided mooring space for 3 tankers. Is this sufficient to meet the U.S. Coast Guard requirement that at least 19 of 20 arrivals should find mooring space available?
    b. Sea Dock can increase its unloading capacity to a rate of 4 ships per day through additional labour at a cost of $480 per day. Considering the

$1,000- per-day demurrage fee charged to Sea Dock for keeping a super tanker idle (this includes unloading time as well as time spent waiting in queue), should management consider this expansion opportunity?

3. A resort hotel is planning to install a computerized inventory system to manage the complementary guest toilet items such as soap and shampoo. The daily usage rate for bars of soap appears to be distributed normally, with mean 16 and standard deviation 3. Once an order is placed, it takes a full week before delivery is made. The effort to place an order and receive the shipment is approximately one hour's time for a staff person who is paid $10 per hour. The opportunity cost of capital is 20 percent per year. A bar of soap is valued at approximately $0.25. The hotel is concerned about stockouts of such a basic item and, thus, desires a 94 percent service level. Recommend an order quantity (*Q*) and reorder point (*r*) for a continuous review system.

Concept Map



Syllabus

Introduction: Introduction to service operations, Role of service in economy and society, Introduction to Indian service sector. Nature of Services and Service Encounters: Differences between services and operations, Service package, characteristics, various frameworks to design service operation system, Kind of service encounter, importance of encounters

Service-Dominant Logic: From Goods-Dominant logic to Service-Dominant logic, Value Co-creation. Service Strategy and Competitiveness: Development of Strategic Service Vision (SSV), Data Envelopment Analysis

New Service Development: NSD cycle, Service Blueprinting, Elements of service delivery system.

Service Design: Customer Journey and Service Design, Design Thinking methods to aid Service Design. Locating facilities and designing their layout: models of facility locations (Huff's retail model), Role of service-scape in layout design. Service Quality: SERVQUAL, Walk through Audit, Dimensions of Service quality & other quality tools

Service Guarantee & Service Recovery: Provide Service guarantee and recover from Service failure. Forecasting Demand for Services: A review of different types of forecasting methods for demand forecasting. Managing Capacity and Demand: Strategies for matching capacity and demand, Psychology of waiting, Application of various tools used in managing waiting line in services. Managing Facilitating Goods: Review of inventory models, Role of inventory in services. Managing service supply relationship: Understanding the supply chain/hub of service, Strategies for managing suppliers of service. Vehicle Routing Problem: Managing after sales service, Understanding services that involve transportation of people and vehicle, Techniques for optimizing vehicle routes

Service Innovation: Services Productivity, Need for Services Innovation.
Case Study:
Case 1: Choose any service organization around and present it from the perspective of: nature of service, classification of service, blueprint or service design analysis, service quality, and any additional perspective you would like to add.
Case 2: Choose any latest research paper in services and explain your understanding and feedback on the same.

Learning Resources

TEXTBOOK:

1. Fitzsimmons & Fitzsimmons, Service Management: Operations, Strategy, Information Technology, McGraw Hill publications,7th edition,2019.

REFERENCE BOOK:

1. Reason, Ben, and Lovlie, Lavrans, Service Design for Business: A Practical Guide to Optimizing the Customer Experience, Pan Macmillan India, 2016.
2. Wilson, A., Zeithaml, V. A., Bitner, M. J., & Gremler, D. D. *Services marketing: Integrating customer focus across the firm*. McGraw Hill,2012
3. Lovelock, C.*Services Marketing, 7/e*. Pearson Education India,2011
4. Chesbrough. H, Open services innovation: Rethinking your business to grow and compete in a new era. John Wiley & Sons, 2010.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1	**Introduction**		
1.1	Introduction to the course, Introduction to service operations	1	CO1
1.2	Role of service in economy and society, Introduction to Indian service sector	2	CO1
1.3	**Nature of Services and Service Encounters:** Differences between services and operations, Service package, characteristics	2	CO1
1.4	various frameworks to design service operation system, Kind of service encounter, importance of encounters	1	CO1
2	**Service-Dominant Logic:**		
2.1	From Goods-Dominant logic to Service-Dominant logic, Value Co-creation	2	CO2

2.2	**Service Strategy and Competitiveness:** Development of Strategic Service Vision (SSV)	2	CO2
2.3	Data Envelopment Analysis	1	CO2
3	**New Service Development**:		
3.1	NSD cycle	2	CO3
3.2	Service Blueprinting	2	CO3
3.3	Elements of service delivery system	1	CO3
4	**Service Design:**		
4.1	Customer Journey and Service Design	1	CO4
4.2	Design Thinking methods to aid Service Design	1	CO4
4.3	**Locating facilities and designing their layout:** models of facility locations (Huff's retail model)	2	CO4
4.4	Role of service-scape in layout design	1	CO4
4.5	**Service Quality:** SERVQUAL, Walk through Audit	1	CO4
4.6	Dimensions of Service quality & other quality tools	1	CO4
5	**Service Guarantee & Service Recovery:**		
5.1	Provide Service guarantee and recover from Service failure	1	CO5
5.2	**Forecasting Demand for Services**: A review of different types of forecasting methods for demand forecasting.	1	CO5
5.3	**Managing Capacity and Demand**: Strategies for matching capacity and demand, Psychology of waiting	1	CO5
5.4	Application of various tools used in managing waiting line in services.	1	CO5
5.5	**Managing Facilitating Goods**: Review of inventory models, Role of inventory in services	1	CO5
5.6	**Managing service supply relationship:** Understanding the supply chain/hub of service, Strategies for managing suppliers of service	1	CO5
5.7	**Vehicle Routing Problem:** Managing after sales service, Understanding services that involve transportation of people and vehicle	2	CO5
5.8	Techniques for optimizing vehicle routes	1	CO5
6	**Service Innovation:**		
6.1	Services Productivity, Need for Services Innovation	1	CO6
6.2	**Case Study:** **CASE 1:** Choose any service organization around and present it from the perspective of: nature of service, classification of service, blueprint or service design analysis, service quality, and any additional perspective you would like to add. **CASE 2:** Choose any latest research paper in services and explain your understanding and feedback on the same.	3	CO6
	TOTAL	**36**	

Course Designers:

1. Subhashni.R rsica@tce.edu

21CB720	IT WORKSHOP

Category	L	T	P	Credit	Terminal Exam Type
ES	2	0	2	3	Theory

Preamble

This course enables the students to become familiar with the MATLAB/SCILAB software that helps them to solve application problems. It integrates computation, visualization and programming environment. It helps the students to conduct numerical experiments and to tackle realistic and more complicated mathematical problems.

Prerequisite

NIL

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Explain the fundamental features of MATLAB for problem solving.	10
CO2	Perform the basic mathematical operations as well as matrix generation and array representations.	15
CO3	Draw the graphs, plot multiple data, perform line styles and change colors using the plotting features.	20
CO4	Develop scripting programs to build an interactive computational environment.	20
CO5	Demonstrate control flow and operators using loops and structures.	20
CO6	Solve the problems by debugging the code interactively in M-files.	15

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond		1.2,2.1.5,2.2.3,2.5.1,3.2.3, 4.5.3
CO2	TPS2	Understand	Respond		1.2,2.1.5,2.2.3,2.5.1,3.2.3, 4.5.3
CO3	TPS3	Apply	Value		1.2,2.1.5,2.2.3,2.5.1,3.2.3, 4.5.3
CO4	TPS3	Apply	Value		1.2,2.1.5,2.2.3,2.5.1,3.2.3, 4.5.3
CO5	TPS3	Apply	Value		1.2,2.1.5,2.2.3,2.5.1,3.2.3, 4.5.3
CO6	TPS3	Apply	Value		1.2,2.1.5,2.2.3,2.5.1,3.2.3, 4.5.3

Mapping with Programme Outcomes and Programme Specific Outcomes

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

CO 1	M	L	L	L		L		L			L	L	L	L	L
CO 2	M	L	L	L		L		L			L	L	L	L	L
CO 3	S	M	L	L		L		L			L	L	M	L	L
CO 4	S	M	L	L		L		L			L	L	M	L	L
CO 5	S	M	L	L		L		L			L	L	M	L	L
CO 6	S	M	L	L		L		L			L	L	M	L	L

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Test		Model Examination	Terminal Examination
	I	II		
Remember	40	20		20
Understand	40	20		30
Apply	20	60	100	50
Analyse				
Evaluate				
Create				

Assessment Pattern: Psychomotor

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

Sample Questions for Course Outcome Assessment**

Course Outcome 1(CO1):

1. Write fundamental programs in MATLAB, creating variables and mathematical functions.
2. Brief about the history of MATLAB its strengths and weaknesses.
3. Find the precedence of operators and perform basic algebraic operations.

Course Outcome 2(CO2):

1. Write a program to perform matrix operations and array operations
2. Write a program to solve the system of linear equations.
3. Perform SVD for the given data.

Course Outcome 3(CO3):

1. Program the fundamentals concepts of basic Plotting consisting of simple and multiple data sets in one plot.

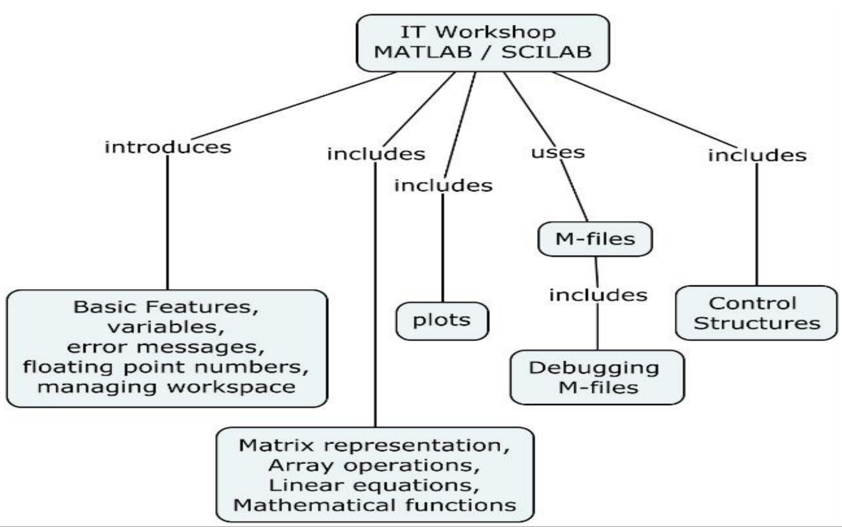
2. Write a program to plot the function sin (x) on the interval [0, 2π].
3. Plot three related functions of x: y1 = 2 cos(x), y2 = cos(x), and y3 = 0.5 ∗ cos(x), in the interval $0 \le x \le 2\pi$.

Course Outcome 4(CO4):
1. Write a program to perform Input –output Arguments in M-Scirpt files using functions.
2. Write a function file that converts temperature in degrees Fahrenheit (◦F) to degrees Centigrade (◦C). Use input and fprintf commands to display a mix of text and numbers. Recall the conversion formulation, C = 5/9 ∗ (F − 32).
3. Write a user-defined MATLAB function, with two input and two output arguments that determines the height in centimeters (cm) and mass in kilograms (kg)of a person from his height in inches (in.) and weight in pounds (lb). (a) Determine in SI units the height and mass of a 5 ft.15 in. person who weight 180 lb. (b) Determine your own height and weight in SI units.

Course Outcome 5(CO5):
1. Write a program to find the quadratic roots
2. Develop a matlab coding for solving simultaneous equations consisting of three variables and there by finding the variables.
3. Explain the control structures that cause specific group of instructions to be repeated for a fixed no of times or until the specified condition is met.

Course Outcome 6(CO6):
1. Explain the debugging process.
2. Create breakpoints and test with a help of a simple MATLAB program
3. What is the use the debugging process and debugging M-files.

Concept Map



Syllabus

Introduction to MATLAB

History, basic features, strengths and weaknesses, good programming practices and plan your code *Working with variables, workspace and miscellaneous commands:* Creating MATLAB variables, overwriting variable, error messages, making corrections, controlling the hierarchy of operations or precedence, controlling the appearance of floating point number, managing the workspace, keeping track of your work session, entering multiple statements per line, miscellaneous commands.

Matrix, array and basic mathematical functions
Matrix generation, entering a vector, entering a matrix, matrix indexing, colon operator, linear spacing, creating a sub-matrix, dimension, matrix operations and functions matrix generators, special matrices, array and array operations, solving linear equations, other mathematical functions.
Basic plotting
Overview, creating simple plots, adding titles, axis labels, and annotations, multiple data sets in one plot, specifying line styles and colours
Introduction to programming
Introduction, M-File Scripts, script side-effects, M-File functions, anatomy of a M-File function, input and output arguments, input to a script file, output commands
Control flow and operators
``if ... end'' structure, relational and logical operators, ``for ... end'' loop, ``while ... end'' loop, other flow structures, operator precedence, saving output to a file
Debugging M-files
Debugging process, preparing for debugging, setting breakpoints, running with breakpoints, examining values, correcting and ending debugging, correcting an M-file

Learning Resources

Text Books:
1. 'Digital Image Processing using MATLAB', Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, McGraw Hill Education; 2nd edition, 2017.
2. 'MATLAB: A Practical Introduction to Programming and Problem Solving', Stormy Attaway, Butterworth-Heinemann; 5th edition, 2018.

Reference Link:
1. Experiments with MATLAB, Cleve Moler, 2011, https://www.mathworks.com/content/dam/mathworks/mathworks-dot-com/moler/exm/ book.pdf

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1	**Introduction to MATLAB**		
1.1	History, basic features, strengths and weaknesses, good programming practices and plan your code *Working with variables, workspace and miscellaneous commands:* Creating MATLAB variables, overwriting variable	1	CO1
1.2	Error messages, making corrections, controlling the hierarchy of operations or precedence, controlling the appearance of floating point number	1	CO1
1.3	Managing the workspace, keeping track of your work session, entering multiple statements per line, miscellaneous commands,	1	CO1
2	**Matrix, array and basic mathematical functions**		
2.1	Matrix generation, entering a vector, entering a matrix, matrix indexing, colon operator, linear spacing	1	CO2
2.2	creating a sub-matrix, dimension, matrix operations	1	CO2
2.3	functions matrix generators, special matrices, array and array operations	1	CO2

2.4	solving linear equations, other mathematical functions.	1	CO2
3	**Basic plotting**		
3.1	Overview, creating simple plots, adding titles, axis labels, and annotations	2	CO3
3.2	multiple data sets in one plot, specifying line styles and colours	2	CO3
4	**Introduction to programming**		
4.1	Introduction, M-File Scripts, script side-effects	1	CO4
4.2	M-File functions,	1	CO4
4.3	anatomy of a M-File function, input and output arguments,	2	CO4
4.4	input to a script file, output commands	1	CO4
5	**Control flow and operators**		
5.1	``if ... end" structure, relational and logical operators,	2	CO5
5.2	``for ... end" loop, ``while ... end" loop,	1	CO5
5.3	other flow structures, operator precedence, saving output to a file	2	CO5
6	**Debugging M-files**		
6.1	Debugging process, preparing for debugging	1	CO6
6.2	setting breakpoints, running with breakpoints	1	CO6
6.3	examining values, correcting and ending debugging, correcting an M-file	1	CO6
	SUBTOTAL	**24**	
Expt. No.	**Laboratory Exercises**	**No. of hours**	**Course Outcome**
1	Introduction to MATLAB: Programs using mathematical and relational expressions and the operators.	2	CO1
2	Introduction to MATLAB Programming: Programs on input and output.	2	CO1
3	Vectors and Matrices: Programs using array operations and matrix operations (such as matrix multiplication).	2	CO2
4	Data Structures: Cell Arrays and Structures: Experiments based on two main data structures: cell arrays and structures	2	CO2
5	Visualization by plotting data and adding features	2	CO3
6	Experiments based on Advanced Plotting Techniques.	2	CO3
7	MATLAB Programs: More experiments based on scripts and user-defined functions	2	CO4
8	Experiments based on Advanced Functions.	2	CO4
9	Selection Statements: Experiments on if statements, with else and elseif clauses and switch statements.	2	CO5
10	Loop Statements and Vectorizing Code: Programs based on the concepts of counted (for) and conditional (while) loops.	2	CO5
11	Experiments based on Debugging and breakpoints	2	CO6
12	Examining the M-files	2	CO6
	SUBTOTAL	**24**	
	TOTAL	**48**	

Course Designer:

1. Mrs. J. Felicia Lilian jflcse@tce.edu

CURRICULUM AND DETAILED SYLLABI

FOR

B.TECH DEGREE (Computer Science and Business Systems) PROGRAMME

PROGRAMME ELECTIVES

FOR THE STUDENTS ADMITTED FROM THE

ACADEMIC YEAR 2020 – 2021 ONWARDS

THIAGARAJAR COLLEGE OF ENGINEERING

(A Government Aided ISO 9001-2008 Certified

Autonomous Institution affiliated to Anna University)

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20CBPB0	Cloud, Microservices & Application

Category	L	T	P	Credit	Terminal Exam Type
PSE	2	0	2	3	Theory

Preamble

This course intends to introduce students to the fundamentals of developing application on cloud, specifically public clouds such as AWS, AZURE and Google. Apply Micro services principles to specific business requirements to build a scalable & performing solution.

Prerequisite

NIL

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Explain the key technologies of delivery and deployment models of cloud	15
CO2	Acquire the various cloud components to guide the applications of public cloud	15
CO3	Develop and design an application using various tools in cloud environment	20
CO4	Deploy the cloud micro services using native cloud tools	25
CO5	Maximize scalability in micro services-based applications using Devops	15
CO6	Analyze the issues of cloud such as security, monitoring etc	10

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	-	1.2, 4.3.2
CO2	TPS3	Apply	Value	-	1.2, 2.1.2, 3.2.3, 4.5.3
CO3	TPS3	Apply	Value	-	1.2, 2.1.2, 3.2.3, 4.3.2
CO4	TPS3	Apply	Value	-	1.2, 2.1.2, 3.2.3, 4.5.3
CO5	TPS3	Apply	Value	-	1.2, 2.1.2, 3.2.3, 4.5.3
CO6	TPS3	Apply	Value	-	1.2, 2.1.2, 3.2.3, 4.5.3

Mapping with Programme Outcomes and Programme Specific Outcomes

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

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive levels	Continuous Assessment Tests			Practical	Terminal examination
	1	2	3		
Remember	20	10	10		10
Understand	20	30	30		30
Apply	60	60	60	100	60
Analyse					
Evaluate					
Create					

Sample Questions for Course Outcome Assessment**

Course Outcome 1(CO1):

1. Name the essential characteristics of cloud computing.
2. Elaborate the most important advantages of cloud technologies for social networking application
3. Explain in detail about cloud service models.

Course Outcome 2(CO2):

1. Explain the services provided by the Amazon infrastructure cloud from a user perspective.
2. How to deploy a web application in a Google App Engine? Explain.
3. Give an overview of Open Stack Services.

Course Outcome 3(CO3):

1. Identify when to use cloud application and explain how architecture affects the performance.
2. Deploy cloud application with user interface that to be used on a smart phone.
3. Adapt suitable data component for E-Governance applications.
4. Design an interface for rural development system using suitable cloud platform.

Course Outcome 4 (CO4):

1. Assume that a company ABC wants to offer services such as starting a policy and payment of policy on a service oriented architecture over the cloud. Explain the implementation details of this scenario.
2. Consider online shop with separate micro services for user-accounts, product-catalogue order-processing and shopping carts, setting up micro services system using spring boot and spring cloud.
3. To compare and contrast micro service implementations. Setting up micro services for NETFLIX play lists using spring boot.

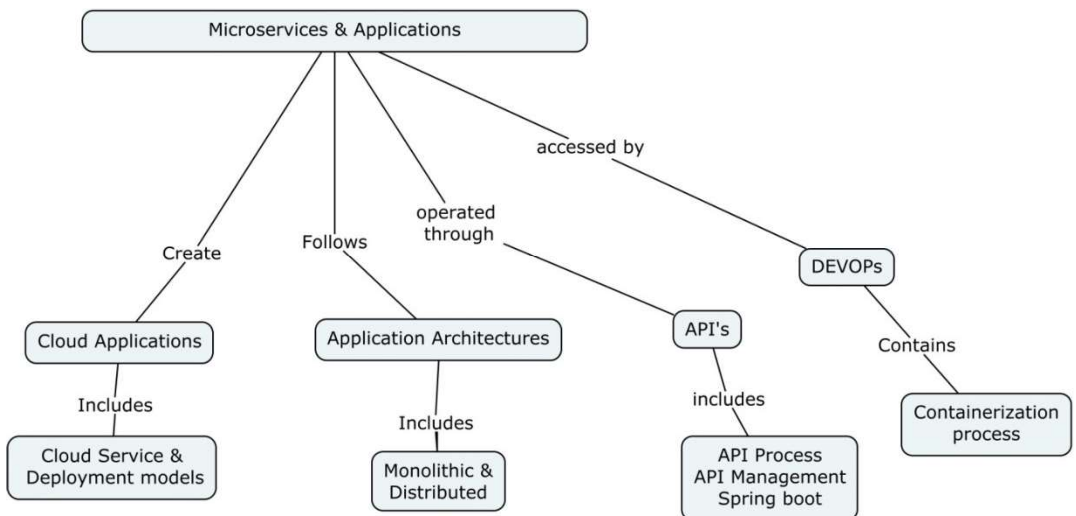
Course Outcome 5 (CO5):

1. Explain with a use case where DevOps can be used in industry / real life.
2. Explain the use of Git commands. In Git, how do you revert a commit that has already been pushed and made public?

3. Explain your understanding and expertise on both the software development side and the technical operations side of an organization you have worked with in the past?

Course Outcome 6(CO6):
1. Analyze the various cloud computing tools to improve security through automation.
2. Explain IBM application services for cloud security.
3. How to secure your data for transport in cloud?

Concept Map



Syllabus

Cloud Fundamentals: Introduction, Cloud Service Components, Cloud Service / Deployment models, Application of Cloud computing
Cloud components: Guiding Principle with respect to utilization, security, pricing and the applications of cloud, public cloud platforms overview and their usage
Application Architectures: Monolithic & distributed, Micro service fundamental and design approach, Cloud native applications – 12 Factors App
Application Integration process, Apification process, API fundamental, Micro service, API management, Spring boot, fundamental and design of micro service, API tools, Developer portal, Applications of micro services and APIFICATION.
Devops: Fundamentals, Tools and applications, containerization process and application.
Advanced topics: Python refresher, use cases, cloud security and monitoring tools
Laboratory:
- Choose a real life example of Business application that you have used and apply these technologies and concepts to solution it.
- Cloud Architecture Design
- Microservice Architecture Design
- API development use case and deployment
- Microservice development and deployment
- Devops tools usages for automation in development / Testing / Deployment
- AWS features use cases – ex, Lambda Functions
- Azure features use cases
- GCP Features use cases

- Creating an API and API Documentation
- Cloud scaling

Learning Resources

1. Rittinghouse, John W., and James F. Ransome, “Cloud Computing: Implementation, Management and Security”, CRC Press, 2017.
2. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, “Mastering Cloud Computing”, Tata Mcgraw Hill, 2013.
3. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing - A Practical Approach”, Tata Mcgraw Hill, 2009.Online courses
4. https://onlinecourses.nptel.ac.in › noc21_cs14 › preview

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1.	**Fundamentals (4)**		
1.1	Cloud fundamentals	1	CO1
1.2	Cloud service components	1	CO1
1.3	Cloud service / deployment models	1	CO1
1.4	Applications of cloud computing	1	CO1
2.	**Components of cloud (4)**		
2.1	Cloud components	1	CO2
2.2	Guiding Principle with respect to utilization	1	CO2
2.3	Guiding Principle with respect to security and pricing	1	CO2
2.3	Public Cloud Platforms overview and their usage	1	CO2
3.	**Cloud Architectures (5)**		
3.1	Application architectures	1	CO3
3.2	Monolithic & Distributed architecture	1	CO3
3.3	Micro service fundamentals and design approach	1	CO3
3.4	Cloud Native applications	1	CO3
3.5	12 Factors App	1	CO3
4.	**Application Integrated Process and Apification (6)**		
4.1	Application Integrated Process	1	CO4
4.2	Apification Process	1	CO4
4.3	API fundamentals	1	CO4
	Microservice, API management		
	Spring boot	1	
	fundamental and design of micro service		
4.4	API Tools	2	CO4
4.5	Developer portal		CO4
4.6	Applications of Micro service and APIFICATION		CO4
5.	**Devops (3)**		
5.1	Devops Fundamentals	1	CO5
5.2	Tools and applications	1	CO5
5.3	Containerization Process, Applications of Devops	1	CO5
6.	**Advanced topics (2)**		
6.1	Python – Refresher, use cases	1	CO6
6.2	Cloud security, Monitoring tools	1	CO6

		24	
Laboratory			
Module No.	**Topic**	**No. of Hours**	**Course Outcome**
1	Cloud Architecture Design	2	CO2
2	Microservice Architecture Design	3	CO2
3	API development use case and deployment	2	CO3
4	Microservice development and deployment	2	CO2
5	Devops Tools usages for automation in development / Testing / Deployment	4	CO5
6	AWS features use cases	2	CO6
7	Azure features use cases	2	CO6
8	GCP Features use cases	2	CO3
9	Creating an API and API Documentation	3	CO4
10	Cloud scaling	2	CO4
		24	
	Total hours	**48**	

Course Designers:

1. Dr.A.Malini amcse@tce.edu
2. Mr.V.Janakiraman vjncse@tce.edu

20CBPC0	MACHINE LEARNING

Category	L	T	P	Credit	Terminal Exam Type
PSE	2	0	2	3	Theory

Preamble

This course introduces the fundamentals of machine learning to the students and it also enables them to understand the classification, regression and clustering algorithms to apply them to various real-time problems. The course also guides them in finding the correct evaluation metrics to quantify the efficiency of the algorithm.

Prerequisite

NIL

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Understand the basics of machine learning and their need using WEKA and R	10
CO2	Familiarize with various classification algorithms and evaluation metric to apply them for various problems	20
CO3	Interpret the significance of using Support Vector Machines and Hidden Markov Models	20
CO4	Apply the regression algorithms for various applications	15
CO5	Apply the association rule mining and expectation – maximization algorithms	15
CO6	Apply the clustering algorithms with clear understanding in detecting anomalies and outliers.	20

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	-	1.1, 1.2, 1.3, 2.1.1
CO2	TPS3	Apply	Value	-	1.3, 2.1.1, 2.1.1, 2.1.2
CO3	TPS3	Apply	Value	-	1.3, 2.1.1, 2.1.2, 2.4.6, 4.5.1, 4.5.3
CO4	TPS3	Apply	Value	-	1.3, 2.1.1, 2.1.2, 2.4.6, 4.5.1, 4.5.3
CO5	TPS3	Apply	Value	-	1.3, 2.1.1, 2.1.2, 2.4.6, 4.5.1, 4.5.3
CO6	TPS3	Apply	Value	-	1.3, 2.1.1, 2.1.2, 2.4.6, 4.5.1, 4.5.3

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO 1	PO2	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	M	L	-	-	M	-	-	-	-	L	-	L	L	-	L
CO2	S	M	L	-	L	-	-	-	-	L	-	L	L	-	-
CO3	S	M	L	-	M	-	-	-	-	L	-	L	L	-	L
CO4	S	M	L	L	M	L	-	-	-	L	-	L	M	-	L
CO5	S	M	L	L	M	-	-	-	-	L	-	L	M	-	L
CO6	S	M	L	L	M	L	-	-	-	L	-	L	M	-	L

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Practical	Terminal Examination
	1	2	3		
Remember	30	20	20		20
Understand	30	40	40		20
Apply	40	40	40	100	60
Analyse	-	-	-	-	-
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Assessment Pattern: Psychomotor

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

Sample Questions for Course Outcome Assessment**

** (2 to 3 at the cognitive level of course outcome)

Course Outcome 1(CO1):
1. Explain the terms in Machine Learning. Discuss why Machine Learning is important.
2. Discuss the issues in Machine Learning
3. "When the feature space is larger, overfitting is less likely", Justify the statement.

Course Outcome 2(CO2):
1. Define (i) Prior Probability (ii) Conditional Probability (iii) Posterior Probability. What are the relevance and features of Bayesian theorem? Explain the practical difficulties of the Bayesian theorem.
2. Explain Naïve Bayes Classifier with an Example.

3. List the issues in Decision Tree Learning. Interpret the algorithm with respect to overfitting the data

Course Outcome 3(CO3):
1. Explain the concept of Viterbi algorithm and its role using hidden markov model.
2. A hypothetical SVM model has the following values of lagrange multipliers α and support vectors: Suppose that the linear kernel is used. Compute the output y of this SVM model when the input feature vector is (0.3, 0.8, 0.6).

α	**Support Vector**	**y**
1	(1,-1,1)	+1
0.5	(0,2,-1)	-1
1	(-1,0,2)	-1

3. What are the basic problems in HMM? Derive the solutions to the problems using forward, viterbi, and baum-welch algorithms?

Course Outcome 4 (CO4):
1. The sales of the company for each year is shown below

X(year)	2018	2019	2020	2021
Y(sales improved in %)	12	19	30	35

   a) Find the regression line y = ax+b
   b) Predict the sales in 2020 based on the regression obtained.
2. In logistic regression, what do you mean by loss and prediction functions. Explain with the help of co-variance and posterior distribution functions.
3. Fit the logistic regression model for the given dataset {(-,1,-5)), (+,(5,-1)), (+,(3,3)), (+,(-1,5)), (-,(-5,2)), (-,(-2,-2))}

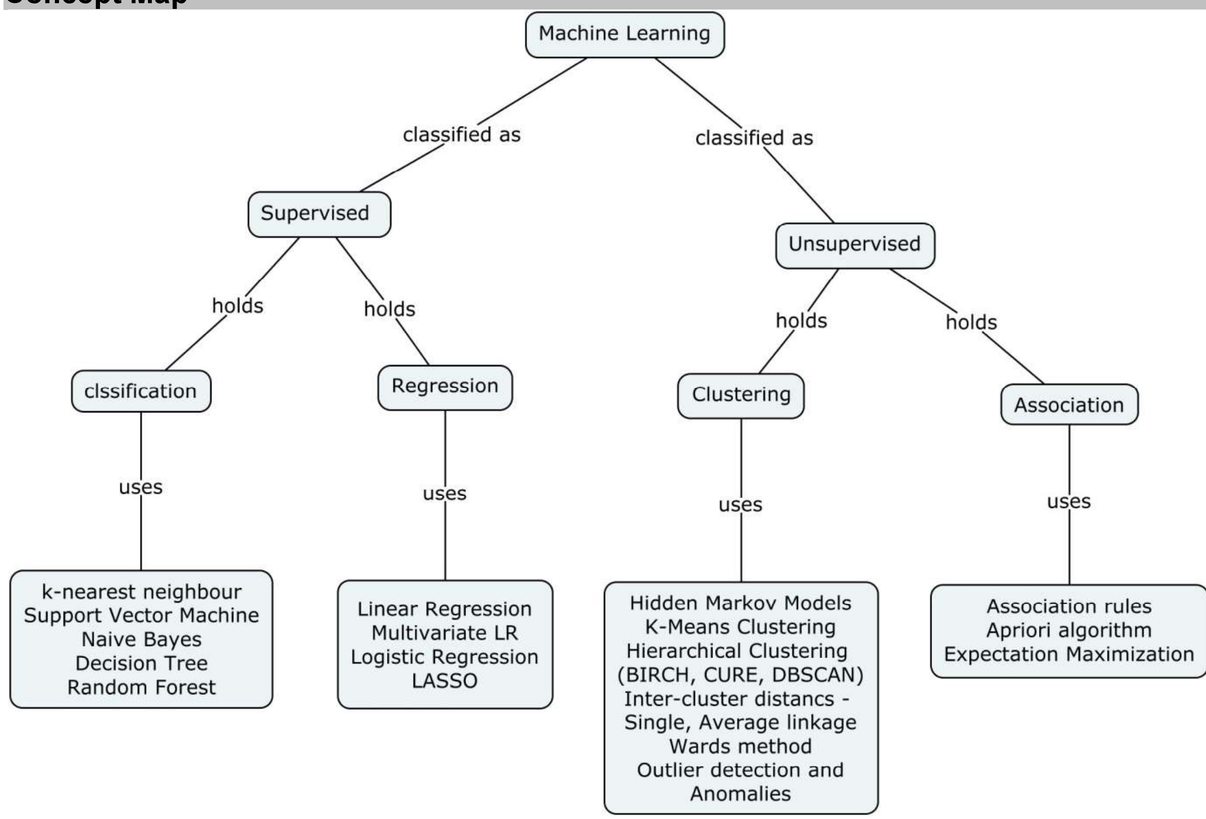
Course Outcome 5 (CO5):
1. What is the need of Association Rule Mining? Mention the roles of support and confidence in Association Rule Mining.
2. Now you want to learn your friend's transition model, based on this utterance. Zero pseudocounts. Since there's missing data, you must use the EM algorithm. Show the results of one step of the EM algorithm, where the previous question was the first E-step. So just do an M-step and show the resulting parameters. For this question, don't bother with START and END transitions. Use zero pseudocounts.
3. At first, you guess that your friend was generating words from this bigram LM: p(hi|hi) = 0.7 p(yo|hi) = 0.3 p(hi|yo) = 0.5 p(yo|yo) = 0.5 Given these parameters, what is the posterior probability of whether the missing word is "hi" or "yo"?

Course Outcome 6(CO6):
1. We are given the following four data points in two dimension: X1 = (2, 2), X2 = (8, 6), X3 = (6, 8), X4 = (2, 4). We want to cluster the data points into two clusters C1 and C2 using the K-Means algorithm. Manhattan distance is used for clustering. To initialize the algorithm we consider C1 = {X1, X3}, and C2 = {X2, X4}. After two iteration of the K-Means algorithm, the cluster memberships are – C1={X1,X4} and C2={X2, X3}
2. We would like to cluster the natural numbers from 1 to 1024 into two clusters using hierarchical agglomerative clustering. We will use Euclidean distance as our distance

measure. We break ties by merging the clusters in which the lowest natural number resides. For example, if the distance between clusters A and B is the same as the distance between clusters C and D, we would choose A and B as the next clusters to merge if min{A, B} < min{C, D} , where {A, B} are the set of natural numbers assigned to clusters A and B. For each of the clustering methods mentioned below, specify the number of elements assigned to each of the two clusters obtained by cutting the dendogram at the root for Single, Complete and Average Linkage

3. How is Entropy used as a Clustering Validation Measure?

Concept Map



Syllabus

Introduction to Machine Learning (ML); Relationship between ML and human learning; A quick survey of major models of how machines learn; Example applications of ML. Introduction to WEKA and R. **Classification**: Supervised Learning; Feature engineering; Training and testing classifier models; Cross-validation; Model evaluation (precision, recall, F1-mesure, accuracy, area under curve); Statistical decision theory; Naive Bayes classification; Bayesian networks; Decision Tree and Random Forests; k-Nearest neighbor classification; **Support Vector Machines**; Artificial neural networks including backpropagation; Applications of classifications; Ensembles of classifiers including bagging and boosting. **Hidden Markov Models (HMM)** with Viterbi algorithms; Sequence classification; Conditional random fields; **Regression**: Multi-variable regression; Model evaluation; Least squares regression; Regularization; LASSO; Applications of regression. **Association rule mining** algorithms including apriori. Expectation-

Maximization(EM) algorithm for unsupervised learning. **Clustering**: average linkage; Ward's algorithm; Minimum spanning tree clustering; K-nearest neighbors clustering; BIRCH; CURE; DBSCAN Anomaly and outlier detection methods.

Lab Sessions:

(1) Introduction to WEKA and R
(2) Classification of some public domain datasets in UCI ML repository

Mini projects in the Lab:

(1) Implementation of one clustering algorithm
(2) Implementation of one anomaly detection algorithms
(3) Implementation of EM algorithm for some specific problem

Learning Resources

Text Books:

1. R.O. Duda, P.E. Hart, D.G. Stork, Pattern Classification, 2/e, Wiley, 2001.
2. C. Bishop, Pattern Recognition and Machine Learning, Springer, 2007.
3. E. Alpaydin, Introduction to Machine Learning, 3/e, Prentice-Hall, 2014.
4. A. Rostamizadeh, A. Talwalkar, M. Mohri, Foundations of Machine Learning, MIT Press.
5. Webb, Statistical Pattern Recognition, 3/e, Wiley, 2011

Course Contents and Lecture Schedule

THEORY COMPONENT			
Module No.	**Topic**	**No. of Hours**	**Course Outcome**
1.	**Introduction to Machine Learning**		
1.1	Relationship between ML and human learning	1	CO1
1.2	Example applications of ML	1	CO1
1.3	Introduction to WEKA and R	1	CO1
2.	**Classification**		
2.1	Supervised Learning: Feature engineering; Training and testing classifier models	1	CO2
2.3	Cross-validation; Model evaluation (precision, recall, F1-mesure, accuracy, area under curve)	1	CO2
2.4	Statistical decision; Naive Bayes classification; Bayesian networks	1	CO2
2.6	Decision Tree and Random Forests; k-Nearest neighbor classification	1	CO2
3	**Support Vector Machines**		
3.1	Artificial neural networks including backpropagation	1	CO3
3.2	Applications of classifications; Ensembles of classifiers including bagging and boosting	1	CO3
3.3	**Hidden Markov Models** (HMM) with Viterbi algorithms	2	CO3
3.4	Sequence classification using HMM; Conditional random fields	1	CO3
4	**Regression**		

4.1	Multi-variable regression	1	CO4
4.2	Model evaluation; Least squares regression	1	CO4
4.3	Regularization; LASSO; Applications of regression	1	CO4
5	**Association rule mining**		
5.1	Association rule mining algorithms including apriori	3	CO5
5.2	Expectation-Maximization (EM) algorithm for unsupervised learning	2	CO5
6	**Clustering**		
6.1	average linkage; Ward's algorithm	1	CO6
6.2	Minimum spanning tree clustering; K-nearest neighbors clustering	1	CO6
6.3	BIRCH; CURE; DBSCAN Anomaly and outlier detection methods	2	CO6
	TOTAL	**24**	
PRACTICAL COMPONENT			
Module No.	**Topic**	**No. of Hours**	**Course Outcome**
1	Introduction to WEKA and R	**2**	CO1
2	Classification of some public domain datasets in UCI ML repository	**6**	CO2
3	Implementation of SVM	**4**	CO3
4	Implementation of regression algorithm	**4**	CO4
5	Implementation of EM algorithm for some specific problem	**2**	CO5
6	Implementation of Clustering algorithm	**4**	CO6
7	Implementation of anomaly detection algorithms	**2**	CO6
	TOTAL	**24**	
	TOTAL HOURS	**48**	

Course Designers:

1. Dr. P Chitra pccse@tce.edu
2. Mrs. J. Felicia Lilian jflcse@tce.edu

20CBPD0	MODERN WEB APPLICATIONS

Category	L	T	P	Credit	Terminal Exam Type
PSE	3	0	2	4	Theory

Preamble

This course covers the design, implementation, and testing of web-based applications including related software, database and interfaces. The students will learn about mark-up languages, scripting languages, interactive graphics and databases. It also covers social, ethical and security issues arising from the web and social software. The concepts will be illustrated with appropriate examples and tools.

Prerequisite

NIL

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage in %
CO1	Demonstrate the basic principles of web components and understand the standards required for the development of web environment.	10
CO2	Apply the design tools and styles to develop web pages using mark-up language HTML and CSS	15
CO3	Illustrate the scripting language and apply them to develop high quality dynamic web client application	20
CO4	Use the interchange language XML to develop web applications for distributed environment	15
CO5	Construct dynamic web pages by applying the validation and verification conditions using PHP	20
CO6	Apply server side languages using My-SQL & PHP platforms for manipulating data in a web application	20

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	-	1.1,1.2,4.3.2
CO2	TPS3	Apply	Value	-	1.2, 2.1.1,2.1.2,3.2.3,4.3.2
CO3	TPS3	Apply	Value	-	1.2, 2.1.2, 3.2.3,4.3.2
CO4	TPS3	Apply	Value	-	1.2, 2.1.2, 3.2.3,4.5.3
CO5	TPS3	Apply	Value	-	1.2, 2.1.2,2.4.3,3.2.3,4.5.3
CO6	TPS3	Apply	Value	-	1.2, 2.1.2,2.4.6,3.2.3,4.5.3

Mapping with Programme Outcomes and Programme Specific Outcomes

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

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

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive levels	Continuous Assessment Tests			Practical	Terminal examination
	1	2	3		
Remember	20	20	20		20
Understand	30	30	30		30
Apply	50	50	50	100	50
Analyse					
Evaluate					
Create					

Assessment Pattern: Psychomotor

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

Sample Questions for Course Outcome Assessment**

Course Outcome 1(CO1):

1. Explain web browser architecture.
2. List out the types of web pages.
3. List out the Characteristics of web applications

Course Outcome 2(CO2):

1. Create HTML forms for ticket booking system.
2. Write a CSS Rule to change colour of all elements containing attribute class = "green move" to green and shift them down to 25 pixels and right 15 pixels?
3. Write a HTML program to insert "India Map" and fix the hot spots in the map.

Course Outcome 3(CO3):

1. Write a client server application using JSP to get radius sent by browser and find area of circle
2. Develop three tier application for online registration of a course using JSP.
3. Develop client server application using JSP for calculating factorial of a number which is sent from client.
4. Write a Java Script to get input from the user in XHTML and convert to lowercase and uppercase?

Course Outcome 4 (CO4):

1. Write an XML and DTD for Storing Recipes.
2. Construct the book's XML document using cascading style sheets
3. Illustrate the principles of XSLT

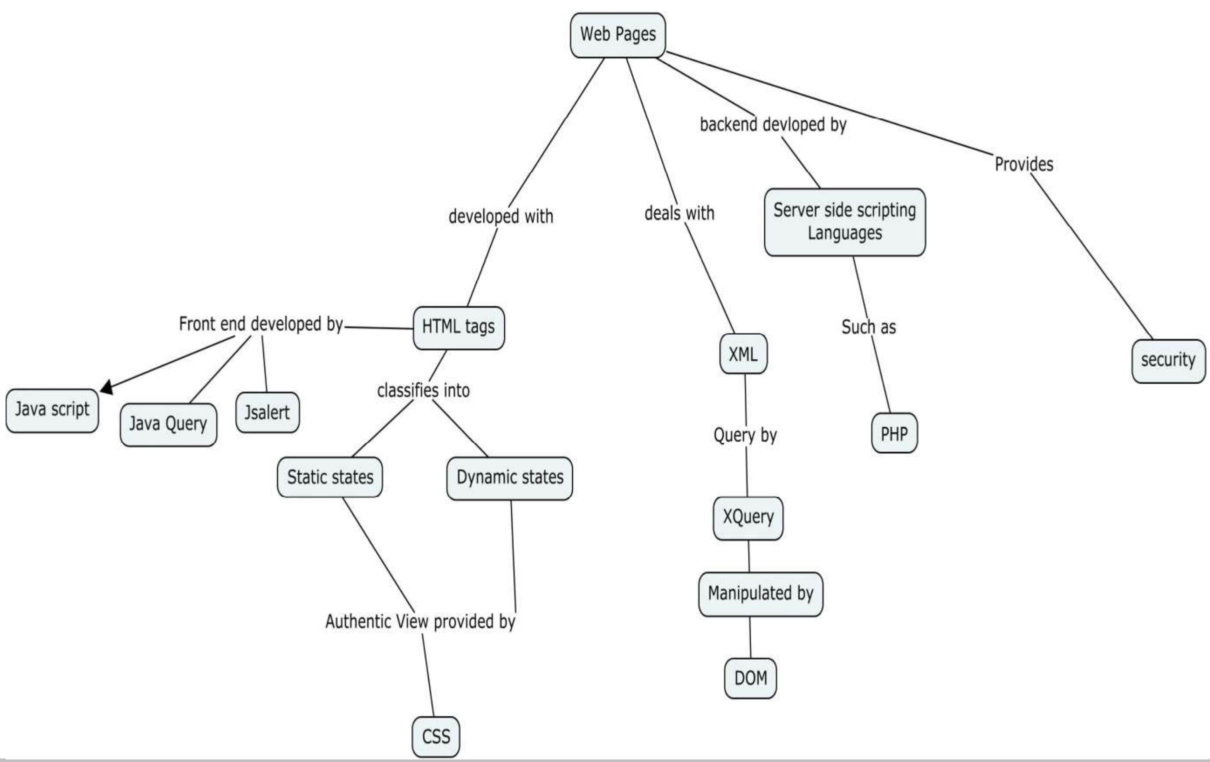
Course Outcome 5 (CO5):

1. Model the database for Employee Details System and do the following queries using PHP.
    a. Insert a new employee into the database.
    b. Delete the 2nd record for the particular employee.
    c. Make search provision.
    d. Provide view for the whole table.
2. Create dynamic web application for College Management system using PHP.
    a. Perform the following task by using jQuery UI
    b. Click Toggle colors
    c. Click Add a New Box
3. Write a PHP program to retrieve the HTML Form information by using POST command

Course Outcome 6(CO6):

1. Create cookie information to identify the visitors for the web pages.
2. Construct 2 user id's and password and write these to cookies. Read the information entered in the Login form and authenticate with the values (user id and passwords) available in the cookies and check the validity of the user.
3. Identify different types of attacks in web security.

Concept Map



Syllabus

Introduction to Internet & World Wide Web:–History of the Internet & World- Wide Web, Web Browsers, –Web Servers, Uniform Resource Locator, Tools and Web Programming Languages. Web Standards, Categories of Web Applications, Characteristics of Web Applications, Tiered Architecture

Hypertext Mark Up Language (HTML) Revision: Basic HTML page, Text Formatting, Table, Headers, Linking, Images, List, Meta Elements

Cascading Style Sheets (CSS) Revision: Inline, Internal and External Style Sheet, Bootstrap-CSS Text , CSS forms , CSS components drop down .

Java Script: Introduction to Java Scripts, Objects in Java Script, Dynamic HTML with Java Script, Bootstrap- JS Alert, JS Button, JS popover

Extensible Markup Language (XML): Introduction, Structuring Data, Document Type Definition, XML Vocabularies, Document Object Model DOM) with Java Script, Extensible Style sheet Language Transforms (XSL)

Writing Basic PHP Programs : Creating PHP Programs, Numbers and Strings, Literals and Variables, Operators and Functions

Form & PHP: Creating Form Controls, Using Values Returned From, Forms Using PHP

PHP Database Connectivity: Connecting to MySQL Server, Selecting Databases, Checking for Errors, Closing the MySQL Server Connection

Manipulating Data in MySQL Using PHP: Inserting, Viewing Updating and Deleting Records, Manipulating joined tables. **User Authentication:** Creating Session, Authorization Level

Learning Resources

1. Deitel P.J., Deitel H.M and Deitel A (2012) Internet and World wide web : How to program, fifth edition, Pearson Prentice Hall.
2. HTML & CSS: Design and Build Websites, Jon Duckett, John Wiley and sons.
3. Naramore E., Gerner J., Scouarnec Y.L., et al., (2005) Beginning PHP5, Apache, MySQL Web Development: Programmer to Programmer, John Wiley & Sons Inc.
4. SebestaR.W.(2014)ProgrammingtheWorldWideWeb,8thedition,Pearson.
5. PressmanR.andLoweD.(2008)Web Engineering: apractitioner's approach, FirstEdition, Mc GrawHill
6. Kappel G., et al. (2006) Web Engineering: The Discipline of systematic Development of Web Applications, First Edition, John Wiley & Sons.
7. SuhW.(2005) Web Engineering: Principles and Techniques, Idea GroupInc.
8. UllmanL (2016) PHP for the Web:Visual Quick Start Guide, Fifth Edition, Peach pit Press

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1.	**Introduction to Internet & World Wide Web (3)**		
1.1	History of the Internet & World- Wide Web, Web Browsers, Web Servers	2	CO1
1.2	Uniform Resource Locator, Tools and Web Programming Languages. Web Standards, Categories of Web Applications	1	CO1
1.3	Characteristics of Web Applications, Tiered Architecture	1	CO1
2	**Hypertext Mark Up Language (4)**		
2.1	Basic HTML page, Text Formatting, Table, Headers, Linking, Images, List, Meta Elements	2	CO2
3	**Cascading Style Sheets(CSS) Revision**		

3.1	Inline, Internal and External Style Sheet Bootstrap-CSS Text	2	CO2
3.2	CSS forms , CSS components drop down	1	CO2
4	**Java Script (3)**		
4.1	Introduction to Java Scripts, Objects in Java Script	2	CO3
4.2	Dynamic HTML with Java Script, Bootstrap- JS Alert	3	CO3
4.3	JS Button, JS popover	2	CO3
5	**Extensible Markup Language(XML) (3)**		
5.1	Introduction, Structuring Data	1	CO4
5.2	Document Type Definition, XML Vocabularies,	2	CO4
5.3	Document Object Model (DOM)with Java Script	2	CO4
5.4	Extensible Style sheet Language Transforms(XSL)		CO4
6	**Writing Basic PHP Programs, Form & PHP, PHP Database Connectivity (6)**		
6.1	Creating PHP Programs	2	CO5
6.2	Numbers and Strings		CO5
6.3	Literals and Variables	2	CO5
6.4	Operators and Functions		CO5
6.5	Creating Form Controls, Using Values Returned From, Forms Using PHP	2	CO5
6.6	Connecting to MySQL Server, Selecting Databases, Checking for Errors, Closing the MySQL Server Connection	2	CO5
7	**Manipulating Data in MySQL Using PHP, User Authentication (5)**		
7.1	Inserting, Viewing, Updating and Deleting Records,	3	CO6
7.2	Manipulating joined tables	2	CO6
7.3	Creating Session, Authorization Level	2	CO6
	Total	**36**	

Laboratory

Module No.	Topic	No. of Hours	Course Outcome
1	Basic HTML tags and its use	2	CO1
2	Design the following static web pages for your application a) Home page b) Login Page c) Catalogue Page	2	CO2
3	Design the following static web pages for your application a) Cart page b) Registration page	2	CO2
4	Write a Java script to perform validation and verification of forms for your application	6	CO3

5	Develop an XML file by using all the XML components for the application that you have designed.	4	CO4
6	Write Program in PHP to demonstrate basics of PHP and convert all the previous forms that are developed for your application to PHP forms. Make sure that you establish database connection using MySQL.	2	CO5
7	Write a program in PHP to perform CRUD (Create, Insert, Update, Delete operations) and also design a page that can upload & display image in PHP	2	CO5
8	Write a PHP code to connect the database and extract data from the tables and display them.	2	CO6
9	Work on any case study.	2	CO6
	Total	24	
Total Hours		**60**	

Course Designers:

1. Mrs. J. Felicia Lilian jflcse@tce.edu
2. Mr. V. Janakiraman vjncse@tce.edu

CURRICULUM AND DETAILED SYLLABI

FOR

B.TECH DEGREE (Computer Science and Business Systems) PROGRAMME

PROGRAMME ELECTIVES

FOR THE STUDENTS ADMITTED FROM THE

ACADEMIC YEAR 2021 – 2022 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
(A Govt. Aided, ISO 9001:2008 certified Autonomous Institution affiliated to Anna University)
B.Tech Degree (Computer Science and Business Systems) Programme
PROGRAMME ELECTIVES
(For the candidates admitted from 2021 – 2022onwards)

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	No.of Hours / Week			Credits
				L	T	P	
THEORY COURSES							
1	21CBPE0	Data Mining and Analytics	PSE	3	1	0	4
THEORY CUM PRACTICAL COURSES							
2	21CBPF0	IoT System Design	PEES	2	0	2	3

PSE : Program Specific Elective
PEES : Program specific Elective for Expanded Scope
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
(A Govt. Aided, ISO 9001:2008 certified Autonomous Institution affiliated to Anna University)
B.Tech Degree (Computer Science and Business Systems) Programme
PROGRAMME ELECTIVES
(For the candidates admitted from 2021 – 2022 onwards)

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	21CBPE0	Data Mining and Analytics	3	40	60	100	27	50
THEORY CUM PRACTICAL COURSES								
2	21CBPF0	IoT System Design	3	50	50	100	22.5	50

21CBPE0	DATA MINING AND ANALYTICS

Category	L	T	P	Credit	Terminal exam type
PSE	3	1	0	4	Theory

Preamble

The course provides an emphasis on data processing techniques, rule mining, classification, clustering and in the development of prediction models. It facilitates the student by interpreting the real world problems by examining with appropriate mining tools. Also provides an in-depth knowledge on managing, handling and analysing structured or unstructured data.

Prerequisite

NIL

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage in %
CO1	Describe the fundamental concepts of data mining	15
CO2	Apply appropriate data pre-processing techniques for the given dataset.	15
CO3	Interpret and apply data-mining techniques such as association rule mining, classification and prediction for given scenario.	20
CO4	Apply descriptive modelling using linear regression analysis and perform various tests using forecasting models for categorical data.	15
CO5	Implement linear and non linear model for solving real world data.	20
CO6	Apply time series analysis and prescriptive analytics methods for solving the real world problems	15

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	-	1.2,2.3.1,2.3.2
CO2	TPS3	Apply	Value	Mechanism	1.2, 2.2, 2.3.1, 2.3.2, 3.1.4, 3.1.5
CO3	TPS3	Apply	Value	Mechanism	1.2, 2.3.1, 2.3.2, 2.3.3, 4.4.1, 4.5.3, 4.5.5
CO4	TPS4	Apply	Organize	Complex overt Responses	1.3,2.2.3,2.2.4
CO5	TPS4	Apply	Organize	Complex overt Responses	1.3,2.2.3,2.2.4
CO6	TPS3	Apply	Value	Mechanism	1.2, 2.3.1, 2.3.2, 2.3.3, 4.4.1, 4.5.3, 4.5.5

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	L											L		
CO2	S	M	L										M		
CO3	S	M	L		L							L	M	L	L

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

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive levels	Continuous Assessment Tests		Assignments		Terminal examination
	1	2	1	2	
Remember	20	20			10
Understand	20	20	30	30	20
Apply	60	60	70	70	70
Analyse					
Evaluate					
Create					

Assessment Pattern: Psychomotor

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

Sample Questions for Course Outcome Assessment**

Course Outcome 1(CO1):

1. Discuss the Issues and challenges in Data Mining.
2. Describe different types of data and give an example for each.
3. Explain various stages of KDD.

Course Outcome 2(CO2):

1. Suppose that the data for analysis includes the attribute age. The age values for the data tuples are 75, 63, 55, 47, 77, 48, 63, 54, 60, 38, and 54.
   a. Find the mean, median and mid-range of the data.
   b. Can you find (roughly) the first quartile (Q1) and the third quartile (Q3) of the data?
   c. What is the mode of the data? Comment on the data"s modality (i.e., bimodal, trimodal, etc.).
   d. Show a boxplot of the data. e. How is a quantile-quantile plot different from a quantile plot?
2. Normalize 23, -23, 27, 39, 41, 47, 50, 52, 54, 60 using the decimal scaling method.
3. Suppose a group of 12 sales price records has been stored as follows: 5, 10, 11, 13, 15, 35, 50, 55, 72, 92, 204, 215. Partition them into 3 bins by equal width binning

Course Outcome 3(CO3):

1. Illustrate the significance of candidate set generation step of level wise algorithm.
2. For the given database find all the frequent item sets using Apriori method and list all the strong association rules that match the metarule

$$\forall x \in \text{transaction},\ buys(X,item1) \wedge buys(X,item2) \Rightarrow buys(X,item3).$$

TID	Items bought
100	{f, a, c, d, g, i, m, p}
200	{a, b, c, f, l, m, o}
300	{b, f, h, j, o, w}
400	{b, c, k, s, p}
500	{a, f, c, e, l, p, m, n}

Minimum Support = 30%

Minimum Confidence = 70%

3. For the given database, using the Apriori algorithm finds all the Strong association rules which is used for deciding the profit level of the company. Assume the min support=30% and min confidence=70%

S.NO	Age	Credit rating
1.	25	Fair
2.	29	Excellent
3.	35	Fair
4.	42	Excellent
5.	47	Fair
6.	49	Excellent

Course Outcome 4 (CO4):

Consider the assumptions of linearity for a curvature using various plots. Scatter plot of residuals versus the fitted values• Scatter plot for residuals versus each predictor•The plot for residuals versus the predictor suggests that there is a non-linear relationship.

1. Identify the type of regression analysis model that suits best for the above problem
2. Differentiate Hierarchical and non-hierarchical segmentation models with an illustrative example.
3. Elaborate the algorithmic steps of the regression model.
4. Consider there are about 1000 tuples of record with binary class labels. Out of 1000 data tuples 580 belongs to class A and 420 data tuples belongs to class B. The data records have been trained and tested over Neural Network algorithm. The confusion matrix shows that out of 1000 tuples of records only 620 records has been correctly classified by the classifier which then corresponds 341 of class A and 279 of class B.

Calculate the following:

- Classification Accuracy
- Error Rate
- Sensitivity
- Specificity
- Precision

Course Outcome 5 (CO5):

1. Apply the following data for non-parametric maximum likelihood estimator for the variable S(t). Incorporate the concepts of censoring and no censoring with respect to the total number of individuals dj, for an event to occur. Suppose there are 10 customers of a certain type who were tracked over a a period of time to determine how many have churned, censored and at risk t(nt). out of 10 customers at the beginning of the study, the following conditions holds with respect to the time of the event S(t):

Time	Customers at risk $t(n_j)$	Customers churned $t(d_j)$	Customers censored at t
0	10	0	0
3	?	1	1
6	?	1	0
9	?	0	1
12	?	3	0
15	?	1	1
18	?	0	1

(i) Derive the KM estimator for S(t).

(ii) Find the total number of customers who are at risk at the end of the time period, say 18.

2. Relate the concept of product limit estimator for s(t) with censoring for churn prediction with 10 individuals and compute the following for the data provided: (i) Examine when the customers churn. (ii) Interpret the data when customers make next purchase. (iii) Solve for s(t) when customers are in default state

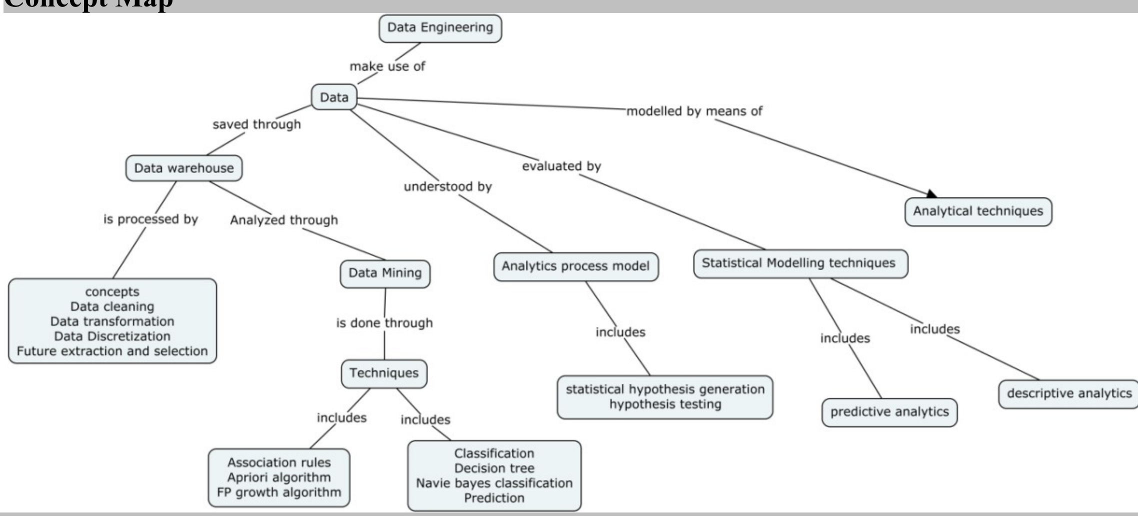
Customer	Time of churn	Churn or censored
C1	6	Churn
C2	3	Censored
C3	12	Churn
C4	15	Censored
C5	18	Censored
C6	12	Churn

Course Outcome 6(CO6):

1. Consider a set of unstructured textual data given for analysis. Summarize the sub tasks and components in which a text analysis process must contain. Make use of tagging and annotation for the textual data analysis process.
2. Consider the logical view of a document from a full text to a set of index terms and compute the following for text processing: (a) Parts of speech tagging (b) Tokenization (c) Stemming
3. Produce the pseudo code for computing tokenization, stemming using any text processing language for the below.

I love this movie! It's sweet, but with satirical humor. The dialogue is great and the adventure scenes are fun… It manages to be whimsical and romantic while laughing at the conventions of the fairy tale genre. I would recommend it to just about anyone. I've seen it several times, and I'm always happy to see it again whenever I have a friend who hasn't seen it yet!

Concept Map



Syllabus

Introduction and Knowledge Representation

Introduction - Related technologies - Machine Learning, DBMS, OLAP, Statistics, Stages of the Data Mining Process, Data Mining Techniques, Knowledge Representation Methods, Task relevant data, Background knowledge, Representing input data and output knowledge, Visualization techniques, Applications.

Data Pre-processing

Data pre-processing: Data cleaning, Data transformation, Data reduction, Discretization and generating concept hierarchies. Attribute-oriented analysis: Attribute generalization, Attribute relevance, Class comparison, Statistical measures

Data Mining Methods

Association rules: Motivation and terminology, Basic idea: item sets, Generating item sets and rules efficiently, Correlation analysis. Classification: Basic learning/mining tasks, Inferring rudimentary rules: 1R, algorithm, Decision trees, covering rules. Prediction: The prediction task, Statistical (Bayesian) classification, Bayesian networks, Instance based methods (nearest neighbor), linear models.

Descriptive analytics: Data Modeling, Trend Analysis, Simple Linear Regression Analysis

Forecasting models: Heuristic methods, predictive modeling and pattern discovery, Logistic Regression: Logit transform, ML estimation, Tests of hypotheses, Wald test, LR test, score test, test for overall regression, multiple logistic regression, forward, backward method, interpretation of parameters, relation with categorical data analysis. Interpreting Regression Models, Implementing Predictive Models

Linear Models and Non Linear Model

Introduction to linear model - Link functions such as Poisson, binomial, inverse binomial, inverse Gaussian, Gamma.

Introduction to Non Linear Regression (NLS) - Linearization transforms, their uses & limitations, examination of non-linearity, initial estimates, iterative procedures for NLS, grid search, steepest descent. Introduction to semiparametric regression models, additive regression models. Introduction to nonparametric regression methods

Time Series Analysis: Auto - Covariance, Auto-correlation and their properties. Exploratory time series analysis, Test for trend and seasonality, Exponential and moving average smoothing, Holt – Winter smoothing, forecasting based on smoothing.

Linear time series models: Autoregressive, Moving Average, Autoregressive Moving Average and Autoregressive Integrated Moving Average models; Estimation of ARIMA models such as Yule-Walker estimation for AR Processes, Maximum likelihood and least squares estimation for ARIMA Processes, Forecasting using ARIMA models.

Prescriptive Analytics: Mathematical optimization, Networks modeling-Multi-objective optimization-Stochastic modelling.

Learning Resources

1. Jiawei Han and MichelineKamber, "Data Mining: Concepts and Techniques", 3rd Edition, Morgan Kaufmann Publishers, 2010.
2. LiorRokach and OdedMaimon, "Data Mining and Knowledge Discovery Handbook", 2nd edition Springer, 2010
3. Trevor Hastie and Robert Tibshirani and Friedman, "The Elements of Statistical Learning: Data Mining, Inference, and Prediction", 2nd edition, Springer, 2017
4. George E. P. Box, Gwilym M. Jenkins, Gregory C. Reinsel, Greta M. Ljung "Time Series Analysis: Forecasting and Control", 5th edition Wiley, 2015
5. https://nptel.ac.in/courses/106/105/106105174/ - Data Mining by Prof. PabitraMitra, IIT Kharagpur.
6. https://www.edx.org/learn/data-analysis
7. https://www.coursera.org/browse/data-science/data-analysis

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1.	**Introduction and KnowledgeRepresentation (6)**		
1.1	Introduction - Related technologies	1	CO1

1.2	Machine Learning, DBMS, OLAP, Statistics	1	CO1
1.3	Stages of the Data Mining Process, Data Mining Techniques	1	CO1
1.4	Knowledge Representation Methods, Task relevant data, Background knowledge	1	CO1
1.5	Representing input data and output knowledge, Visualization techniques, Applications	1	CO1
1.6	**Case Study:** Study about WEKA tool and WEKA explorer	1	CO1
2.	**Data Pre-processing (7)**		
2.1	Data cleaning, Data transformation, Data reduction	1	CO2
2.2	Attribute generalization	1	CO2
2.3	Attribute relevance	1	CO2
2.4	Class comparison,	1	CO2
2.5	Statistical measures	1	CO2
2.6	**Case study:** Perform data pre-processing techniques for real world data sets (Weather / Medical / banking)	2	CO2
3.	**DATA MINING METHODS (9)**		
3.1	Association rules: Motivation and terminology	1	CO3
3.2	Basic idea: item sets, Generating item sets and rules efficiently	1	CO3
3.3	Correlation analysis	1	CO3
3.4	Classification: Basic learning/mining tasks	1	CO3
3.5	Inferring rudimentary rules: 1R, algorithm		CO3
3.6	Decision trees, covering rules	1	CO3
3.7	The prediction task, Statistical (Bayesian) classification	1	CO3
3.8	Bayesian networks		CO3
3.9	Instance-based methods (nearest neighbour), linear models	1	CO3
3.10	**Case study 1:** Frequent item sets mining using Apriori and FP growth algorithm	1	CO3
3.11	**Case study 2:** Classification- Implement Decision Tree, Naïve Bayesian Classifier, NN classifier and SVM.	1	CO3
4.	**Descriptive Analytics and Forecasting models (8)**		
4.1	Data Modeling, Trend Analysis, Simple Linear Regression Analysis	1	CO4
4.2	Forecasting models: Heuristic methods, predictive modeling and pattern discovery	1	CO4
4.3	Logistic Regression: Logit transform, ML estimation, Tests of hypotheses, Wald test, LR test, score test, test for overall regression	2	CO4
4.4	multiple logistic regression, forward, backward method, interpretation of parameters, relation with categorical data analysis	2	CO4
4.5	Interpreting Regression Models, Implementing Predictive Models	1	CO4

4.6	**Case study:** Statistical model using a sample dataset – pre-processing, hypothesis building, model fitting, model validation and interpretation of results.	1	CO4
5	**Linear and Non-linear Models (10)**		
5.1	Introduction to Linear model	1	CO5
5.2	Generalized Linear model: link functions such as Poisson, binomial, inverse binomial, inverse Gaussian, Gamma.	1	CO5
5.3	Linearization transforms, their uses & limitations, examination of non-linearity, initial estimates.	2	CO5
5.4	iterative procedures for NLS Grid search, steepest descent methods	2	CO5
5.5	Introduction to semi-parametric regression models, additive regression models. Introduction to nonparametric regression method	2	CO5
5.6	**Case study1:** Linear regression technique for statistical model building.	2	CO5
6	**Time Series Analysis (8)**		
6.1	Auto - Covariance, Auto-correlation and their properties. Exploratory time series analysis, Test for trend and seasonality	1	CO6
6.2	Exponential and moving average smoothing, Holt – Winter smoothing, forecasting based on smoothing	1	CO6
6.3	Autoregressive, Moving Average, Autoregressive Moving Average and Autoregressive Integrated Moving Average models	1	CO6
6.4	Estimation of ARMA models such as Yule-Walker estimation for AR Processes	1	CO6
6.5	Maximum likelihood and least squares estimation for ARMA Processes, Forecasting using ARIMA models	1	CO6
6.6	Mathematical optimization		CO6
6.7	Networks modeling-Multi-objective optimization-Stochastic modelling	1	CO6
6.8	Decision and Risk analysis, Decision trees.		CO6
6.9	**Case Study 1**:Perform forecasting using any time series data with help of ARIMA model	2	CO6
Total: 48 hours			

Course Designers:

1. Dr.P.Chitra pccse@tce.edu
2. Mr.V.Janakiraman vjncse@tce.edu

21CBPF0	IoT System Design

Category	L	T	P	Credit	Terminal Exam Type
PEES	2	0	2	3	Theory

Preamble

The course will enable the students to understand the basic concepts of IoT with its use cases and applications. It helps the students to identify the technologies to make the things to communicate through the internet that interacts with the real world. It also gives an overview of designing the prototype and connecting with appropriate tools to store data for future analysis.

Prerequisite

NIL

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Understand the basic concepts of IoT, its building blocks, and use cases in industry domain.	10
CO2	Apply the IoT architecture to connectthe data,and process them for various applications.	10
CO3	Analyze the domain specific IoT sensors for data acquisition by satisfying the requirement.	10
CO4	Use an appropriate network protocol to connect the IoT architecture for transmitting data.	10
CO5	Employ the security and privacy mechanism to leverage communication with data.	10
CO6	Apply data analytics techniques over time series data for analyzing its characteristics.	10
CO7	Develop an IoT application to perform data acquisition through sensors and R Pi camera.	20
CO8	Build a cloud environment to store the acquired data using the network protocols.	20

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond		1.2,2.1.5,2.2.3,2.5.1,3.2.3, 4.5.3
CO2	TPS3	Apply	Value		1.2,2.1.5,2.2.3,2.5.1,3.2.3, 4.5.3
CO3	TPS3	Apply	Value		1.2,2.1.5,2.2.3,2.5.1,3.2.3, 4.5.3
CO4	TPS3	Apply	Value		1.2,2.1.5,2.2.3,2.5.1,3.2.3, 4.5.3
CO5	TPS3	Apply	Value		1.2,2.1.5,2.2.3,2.5.1,3.2.3, 4.5.3
CO6	TPS3	Apply	Value		1.2,2.1.5,2.2.3,2.5.1,3.2.3, 4.5.3
CO7	TPS4	Analyze	Organize		1.2,2.1.5,2.2.3,2.5.1, 3.1, 3.2.3, 4.5.1, 4.5.3
CO8	TPS4	Analyze	Organize		1.2,2.1.5,2.2.3,2.5.1, 3.1, 3.2.3, 4.5.1, 4.5.3

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	L	L		L		L			L	L	L	L	L
CO2	S	M	L	L		L		L			L	L	M	L	L
CO3	S	M	L	L		L		L			L	L	M	L	L
CO4	S	M	L	L		L		L			L	L	M	L	L
CO5	S	M	L	L		L		L			L	L	M	L	L
CO6	S	M	L	L		L		L			L	L	M	L	L
CO7	S	S	M	L		L		L			L	L	S	L	L
CO8	S	S	M	L		L		L			L	L	S	L	L

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests		Practical	Terminal Examination
	1	2		
Remember	30	20	-	20
Understand	30	30	-	40
Apply	40	50	100	40
Analyse				
Evaluate				
Create				

Assessment Pattern: Psychomotor

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

Course Level Assessment Questions CO7 & CO8 are assessed through Mini-Project.
Mini-project Details

- **Team formation (Team size: 3)**
- **Problem Identification – real world problems focused on societal and environment need**
- **Identification of appropriate components needed to build the microcontroller board**
- **Assemble the components and program the board**
- **Test the board with sample input**

Sample Questions for Course Outcome Assessment**

Course Outcome 1(CO1):

1. Discuss in detail about the Evolution of Internet of Things
2. What do you know about Customer IoT? Compare customer IoT with Industrial Internet.
3. Consider a smart irrigation system and discuss.

Course Outcome 2(CO2):
1. Draw a neat sketch and label the IoT architecture.
2. Illustrate the implementation of edge analytics on wearable devices.
3. Explain in detail about the flow of data in an centralized alarm system through IoT devices.

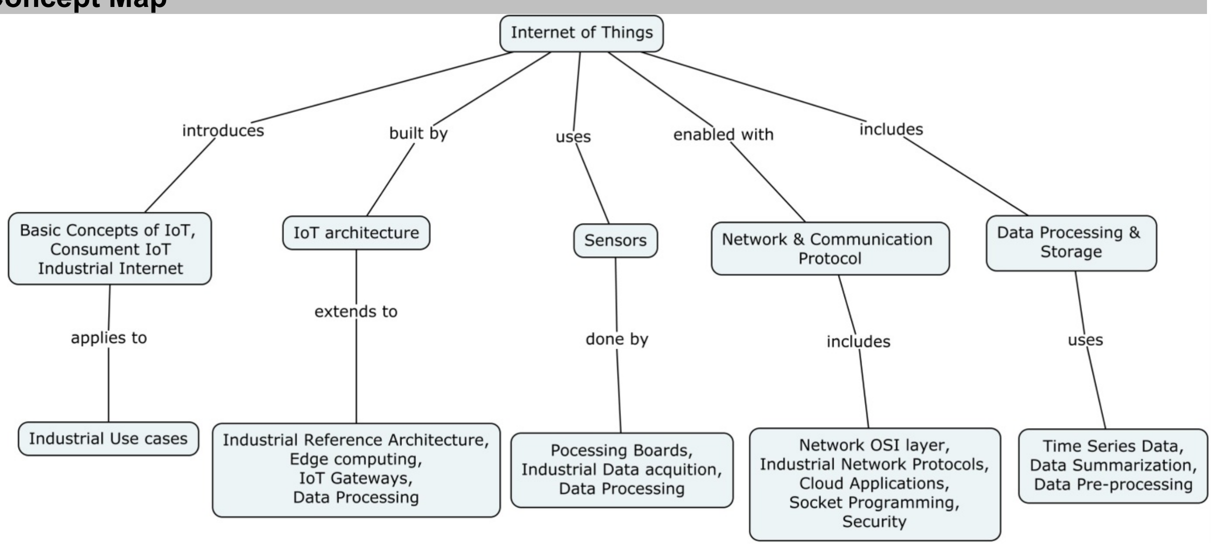
Course Outcome 3(CO3):
1. Explain the interfacing of sensors and actuators to the controllers.
2. Write a program to calculate the humidity in a particular place.
3. Illustrate on the use of sensors and transducers in an Industrial Application.

Course Outcome 4 (CO4):
1. Discuss on the network layers in respective to IoT levels.
2. Discuss on the protocols used for IoT in an commercial environment.
3. Construct an alternate design for using 801.2 Wi-Fi communications for distributed communication over the sensor nodes.

Course Outcome 5 (CO5):
1. Discuss on MQTT, CoAP as IoT protocols for resource-constrained devices?
2. Construct Secure Development of IoT applications.
3. Explain how the connection is established with a microcontroller such as Bluetooth and USB

Course Outcome 6(CO6):
1. Develop an IoT application to solve anomaly detection issue
2. Discuss about the role, features and characteristics of a Time Series Data.
3. Explain in detail on how to handle noisy and missing data to produce an effective environment.

Concept Map



Syllabus

Introduction to IoT and Use cases: Understanding basic concepts of IoT, Consumer IoTvs Industrial Internet, Fundamental building blocks, Use Cases of IoT in various industry domains,

Architecture: IoT reference architectures, Industrial Internet Reference Architecture, Edge Computing, IoT Gateways, Data Ingestion and Data Processing Pipelines, Data Stream Processing

Sensors and Industrial Systems: Introduction to sensors and transducers, integrating sensors to sensor processing boards, introduction to industrial data acquisition systems, industrial control systems and their functions

Networking and Communication for IoT: Recap of OSI 7 layer architecture and mapping to IoT architecture, Introduction to proximity networking technologies (ZigBee, Bluetooth, Serial Communication), Industrial network protocols (Modbus, CANbus), Communicating with cloud applications (web services, REST, TCP/IP and UDP/IP sockets, MQTT, WebSockets, protocols. Message encoding (JSON, Protocol Buffers)

IoT Data Processing and Storage: Time Series Data and their characteristics, time series databases, basic time series analytics, data summarization and sketching, dealing with noisy and missing data, anomaly and outlier detection,

Students can write as an assignment on any 2 topics listed below:

a. **IoT Applications**
   - Smart Cities
   - Connected Vehicles and Telematics
   - Smart Grids
   - Smart Homes

b. **IoT data visualization**

c. **Survey of cloud based IoT platforms**

d. **Low power wide area networks for IoT**

e. **IoT device management**

f. **Survey of chips, embedded modules and development boards for IoT devices**

g. **Embedded and real-time operating systems for IoT**

h. **IoT Security**
   - Security risks in IoT
   - Securing IoT endpoint devices and secure communication protocols for IoT
   - Security and Privacy of IoT data

Module No.	Topic	No. of Hours	Course Outcome
1	**Introduction to IoT and Use cases**:		
1.1	Understanding basic concepts of IoT,	**1**	CO1
1.2	Consumer IoTvs Industrial Internet,	**1**	CO1
1.3	Fundamental building blocks,	**1**	CO1
1.4	Use Cases of IoT in various industry domains,	**1**	CO1
2	**Architecture**		
2.1	IoT reference architectures,	**1**	CO2
2.2	Industrial Internet Reference Architecture,		CO2
2.3	Edge Computing,	**1**	CO2
2.4	IoT Gateways,	**1**	CO2
2.5	Data Ingestion and Data Processing Pipelines,	**1**	CO2
2.6	Data Stream Processing		CO2
3	**Sensors and Industrial Systems:**		

3.1	Introduction to sensors and transducers,	**1**	CO3
3.2	integrating sensors to sensor processing boards,	**1**	CO3
3.3	introduction to industrial data acquisition systems,	**1**	CO3
3.4	industrial control systems and their functions	**1**	CO3
4	**Networking for IoT:**		
4.1	Recap of OSI 7 layer architecture and mapping to IoT architecture,	**1**	CO4
4.2	Introduction to proximity networking technologies (ZigBee, Bluetooth, Serial Communication),	**2**	CO4
4.3	Industrial network protocols (Modbus, CANbus),	**1**	CO4
5	**Communication for IoT**		
5.1	Communicating with cloud applications (web services, REST, TCP/IP and UDP/IP)	**2**	CO5
5.2	sockets, MQTT, WebSockets, protocols.	**1**	CO5
5.3	Message encoding (JSON, Protocol Buffers)	**1**	CO5
6	**IoT Data Processing and Storage:**		
6.1	Time Series Data and their characteristics,	**1**	CO6
6.2	time series databases,	**1**	CO6
6.3	basic time series analytics,		CO6
6.4	data summarization and sketching,	**1**	CO6
6.5	dealing with noisy and missing data, anomaly and outlier detection,	**1**	CO6
	TOTAL	**24**	
Exp. No.	**Laboratory Exercises**	**No. Of Sessions**	**Course Outcome**
1	Setting up the Arduino Development Environment, connecting analog sensors to an Arduino Boarding and reading analog sensor data	**1**	CO7
2	Digital Input and Output reading using and Arduino board and Arduino Development Environment	**1**	CO7
3	Integrate an Arduino Board to a Raspberry Pi computer and send sensor data from Arduino to the R Pi	**1**	CO7
4	Setup Python on the R Pi and run sample R Pi programs on the R Pi. Read the data from Arduino using Python language	**1**	CO7
5	Connect a R Pi Camera module to the Raspberry Pi and using Python programming capture still images and video	**1**	CO7
6	Develop a mobile application to view the images captured by the R Pi camera	**1**	CO7
7	Set up TCP/IP socket server on a PC. Send a message from the R Pi to the PC using socket communication	**2**	CO8
8	Set up a MQTT broker on the PC. Send data from R Pi to PC using MQTT protocol. Receive data from PC to R Pi using MQTT protocol	**1**	CO8

9	Connect LED lights to an Arduino. Connect the Arduino to the R Pi. Send Message from PC to R Pi via MQTT protocol. On receipt of the message, toggle the LED lights on the Arduino	**1**	CO8
10	Set up an account in a cloud service (such as Google / AWS or Azure). Set up a simple Http server using a language of your choice. Push the image captured from the R Pi camera to this web service. On receiving the image, store the image in a database or file	**2**	CO8
	SUB TOTAL	**12**	
	TOTAL	**48Hrs**	

Learning Resources

Text Books:

1. Olivier Hersent, David Boswarthick and Omar Elloumi, "The Internet of Things: Key Applications and Protocols", Second Edition, Wiley Publisher, 2012.
2. ArshdeepBahga, Vijay Madisetti, "Internet of Things: A Hands on Approach", Universities Press, First Edition, 2015.
3. RajkumarBuyya, Amir VahidDastjerdi, "Internet of Things Principles and Paradigms", Elsevier, First edition, 2016.

Reference Books:

1. Samuel Greengard, "The Internet of Things (The MIT Press Essential Knowledge series)", MIT Press, 2015.
2. CharalamposDoukas, "Building Internet of Things with the Arduino", CreateSpace Independent Publishing Platform , 2012.
3. Ben Fry, "Visualizing Data-Exploring and Explaining Data with the Processing Environment", O'Reilly Media, 2007.
4. Andrew K Dennis , "Raspberry Pi Computer Architecture Essentials", 2016.
5. M. Banzi, "Getting Started with Arduino", O Reilly Media, 2009.

Links:

1. Industrial Internet Reference Architecture - http://www.iiconsortium.org/IIRA.htm
2. World Economic Forum Report on Industrial Internet of Things - https://www.weforum.org/reports/industrial-internet-things
3. 50 Sensor Applications for a Smarter World - http://www.libelium.com/resources/top_50_iot_sensor_applications_ranking/
4. GSMA IoT Security Guidelines & Assessment - https://www.gsma.com/iot/future-iot-networks/iot-security-guidelines/

Course Designers:

1. Mrs.Felicila Lilian jflcse@tce.edu

CURRICULUM AND DETAILED SYLLABI

FOR

B.TECH DEGREE (Computer Science and Business Systems) PROGRAMME

PROGRAMME ELECTIVES

FOR THE STUDENTS ADMITTED FROM THE

ACADEMIC YEAR 2021 – 2022 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
(A Govt. Aided, ISO 9001:2008 certified Autonomous Institution affiliated to Anna University)
B.Tech Degree (Computer Science and Business Systems) Programme
PROGRAMME ELECTIVES
(For the candidates admitted from 2021 – 2022 onwards)

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	No.of Hours / Week			Credits
				L	T	P	
THEORY COURSES							
1	21CBPG0	Financial Management	PSE	2	0	0	2
2	21CBPH0	Human Resource Management	PSE	2	0	0	2
3	21CBPJ0	IT Project Management	PSE	3	1	0	4
4	21CBPK0	Large scale systems	PSE	3	0	0	3
5	21CBPL0	Big Data Analytics	PSE	3	0	0	3
6	21CBPM0	Cloud and Distributed Systems	PSE	3	0	0	3
7	21CBRA0	Usability Design of software Applications	PEES	3	0	0	3
8	21CBRB0	Image Processing and Pattern Recognition	PEES	3	1	0	4
9	21CBRC0	Data Visualization	PEES	3	0	0	3
10	21CBRD0	Logistics Management	PEES	3	0	0	3
11	21CBQA0	Data Mining for Business Intelligence	PEES	3	0	0	3

PSE : Program Specific Elective
PEES : Program specific Elective for Expanded Scope

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
(A Govt. Aided, ISO 9001:2008 certified Autonomous Institution affiliated to Anna University)
B.Tech Degree (Computer Science and Business Systems) Programme
SCHEME OF EXAMINATIONS
(For the candidates admitted from 2021 – 2022 onwards)

PROGRAMME ELECTIVES

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	21CBPG0	Financial Management	3	40	60	100	27	50
2	21CBPH0	Human Resource Management	3	40	60	100	27	50
3	21CBPJ0	IT Project Management	3	40	60	100	27	50
4	21CBPK0	Large scale systems	3	40	60	100	27	50
5	21CBPL0	Big Data Analytics	3	40	60	100	27	50
6	21CBPM0	Cloud and Distributed Systems	3	40	60	100	27	50
7	21CBRA0	Usability Design of software Applications	3	40	60	100	27	50
8	21CBRB0	Image Processing and Pattern Recognition	3	40	60	100	27	50
9	21CBRC0	Data Visualization	3	40	60	100	27	50
10	21CBRD0	Logistics Management	3	40	60	100	27	50
11	21CBQA0	Data Mining for Business Intelligence	3	40	60	100	27	50

21CBPG0	FINANCIAL MANAGEMENT

Category	L	T	P	Credit	Terminal exam type
PSE	2	0	0	2	Theory

Preamble

This course is intended to develop skills for the interpretation of business information and the application of financial theory in financing-related decisions. Also, the students will be able to make better portfolio management, dividend decisions, inventory management, and long-term financing decisions.

Prerequisite

NIL

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage in %
CO1	Understand the financial management concepts to make financial decisions.	15
CO2	Apply the cash flow techniques to find the value of firm or industry.	20
CO3	Apply capital asset pricing model to minimize the risk and return.	20
CO4	Apply financial leverage concepts to maximize the wealth of the shareholders	15
CO5	Estimate the effectiveness and efficiency of an organization's operating and cash cycles.	15
CO6	Apply cash and account receivable management techniques to maximize the cost savings	15

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	Guided Response	1.2, 4.3.2
CO2	TPS3	Apply	Value	Mechanism	1.2, 2.1.2, 3.2.3, 4.5.3
CO3	TPS3	Apply	Value	Mechanism	1.2, 2.1.2, 3.2.3, 4.3.2
CO4	TPS3	Apply	Value	Mechanism	1.2, 2.1.2, 3.2.3, 4.5.3
CO5	TPS3	Apply	Value	Mechanism	1.2, 2.1.2, 3.2.3, 4.5.3
CO6	TPS3	Apply	Value	Mechanism	1.2, 2.1.2, 3.2.3, 4.5.3

Mapping with Programme Outcomes and Programme Specific Outcomes

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

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive levels	Continuous Assessment Tests		Assignments		Terminal examination
	1	2	1	2	
Remember	20	10			20
Understand	20	30	30		20
Apply	60	60	70	100	60
Analyse					
Evaluate					
Create					

Assessment Pattern: Psychomotor

Psychomotor Skill	Miniproject /Assignment/Practical Component
Perception	
Set	
Guided Response	30
Mechanism	70
Complex Overt Responses	
Adaptation	
Origination	

Sample Questions for Course Outcome Assessment**

Course Outcome 1(CO1):

1. Explain the various functions of financial management.
2. Define Annuity factor
3. Explain Time value of Money. What is its relevance in financial decision making?

Course Outcome 2(CO2):

1. Calculate the minimum current price needed to make selling the bond the best financial choice?
2. Illustrate the various probability distribution to measures the risk.
3. Consider a portfolio of 300 shares of firm A worth $10/share and 50 shares of firm B worth $40/share. You expect a return of 8% for stock A and a return of 13% for stock B.
   (a) What is the total value of the portfolio, what are the portfolio weights and what is the expected return?
   (b) Suppose firm A's share price goes up to $12 and firm B's share price falls to $36. What is the new value of the portfolio? What return did it earn? After the price change, what are the new portfolio weights?

Course Outcome 3(CO3):

1. On the basis of expected Rate, Standard Deviation, Variance and Coefficient of variation decided which of the following company is best for investment (Single company Risk analysis).

Possible outcomes	Probability	Rate of Return	
		Company G	Company H
Bullish Trend	0.3	50%	25%
Normal Trend	0.4	20%	15%
Bearish Trend	0.3	(10)%	15%

2. FANNIE MAE is one of the famous brands trading in the US market. The government of the US now wants to issue a 20 year fixed semi-annually paying bond for their project. The price of the bond is $1,101.79, and the face value of the bond is $1,000. The coupon rate is 7.5% on the

bond. Based on this information, you are required to calculate the approximate yield to maturity on the bond.

3. You can borrow and lend at the risk-free rate of 8%. The return on the optimal risky portfolio is16%. What investment strategy will provide you with an expected return of 22%?

Course Outcome 4 (CO4):

1. Explain the following: (i) Combined Leverage (ii) Asset Leverage (iii) ROI Leverage
2. The following are the details

Selling price per unit	Rs. 20
Variable cost per unit	Rs. 12
Actual sales	200 units
Installed capacity	300 units

Calculated operating leverage in each of the following two situations. (i) when fixed costs are Rs. 1000 (ii) when fixed costs are Rs. 800.

3. A Ltd. has the following capital structure :

	Rs.
Equity share capital (of Rs. 100 each)	1,00,000
10% Preference share capital (of Rs. 100 each)	2,00,000
10% debentures (of Rs. 100 each)	2,00,000

If EBIT is (i) Rs. 1,00,000 (ii) Rs. 80,000 and (iii) Rs. 1,20,000,
Calculate financial leverage under three situations. Assume 50% tax rate.

Course Outcome 5 (CO5):

1. The following information is available for Swagat Ltd.: (` . '000)

Average stock of raw materials and stores	200
Average WIP inventory	300
Average finished goods inventory	180
Average accounts receivable	300
Average accounts payable	180
Average raw materials and stores purchase on credit and consumed per day	10
Average WIP value of raw materials committed per day	12.5
Average cost of goods sold per day	18
Average sales per day	20

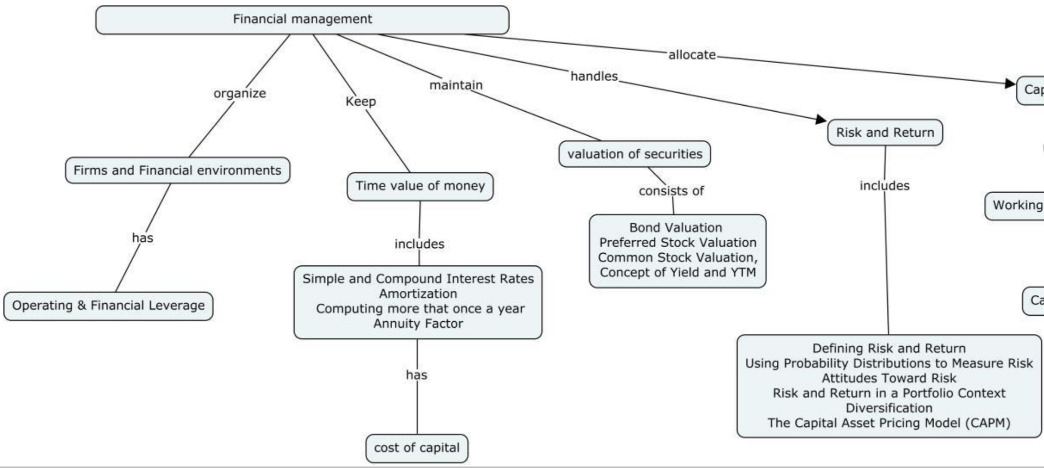
You are require to calculate: (i) Duration of raw material stage (ii) Duration of WIP stage (iii) Duration of Finished goods stage (iv) Duration of accounts receivable stage (v) Duration of accounts payable stage, and (vi) Duration of operating cycle.

2. Illustrate the various determinants of working capital.

Course Outcome 6(CO6):

1. Illustrate the various determinants of cash flows.
2. Illustrate the different methods of cash forecasting.
3. Draw an activity chart that speeds up the process of depositing the cheque in the bank account from the time of receipt?

Concept Map



Syllabus

Introduction: Introduction to Financial Management - Goals of the firm - Financial Environments. **Time Value of Money:** Simple and Compound Interest Rates, Amortization, Computing more than once a year, Annuity Factor.

Capital Budgeting: The Capital Budgeting Concept & Process - An Overview, Generating Investment Project Proposals, Estimating Project, After Tax Incremental Operating Cash Flows, Capital Budgeting Techniques, Project Evaluation and Selection - Alternative Methods

Valuation of Securities: Bond Valuation Preferred Stock Valuation, Common Stock Valuation, Concept of Yield and YTM. **Risk & Return:** Defining Risk and Return, Using Probability Distributions to Measure Risk, Attitudes Toward Risk, Risk and Return in a Portfolio Context, Diversification, The Capital Asset Pricing Model (CAPM)

Operating & Financial Leverage: Operating Leverage, Financial Leverage, Total Leverage, and Indifference Analysis in leverage study. **Cost of Capital:** Concept, Computation of Specific Cost of Capital for Equity - Preference – Debt, Weighted Average Cost of Capital – Factors affecting Cost of Capital

Working Capital Management: Overview, Working Capital Issues, Financing Current Assets (Short Term and Long Term- Mix), Combining Liability Structures and Current Asset Decisions, Estimation of Working Capital.
Cash Management: Motives for holding cash, speeding up Cash Receipts, Slowing Down Cash Payouts, Electronic Commerce, Outsourcing, Cash Balances to maintain, Factoring.
Accounts Receivable Management: Credit & Collection Policies, Analyzing the Credit Applicant, Credit References, Selecting optimum Credit period

Learning Resources:
Text Books:

1. Timothy J. Gallagher, "Financial Management: Principles and Practice 9th Edition", Textbook Media Press, 2022.
2. Shashi K. Gupta, R. K. Sharma, Neeti Gupta," Financial Management Theory and Practice", 9th edition, Kalyani Publishers,2019.

Reference books:

1. Van Horne and Wachowicz, "Fundamentals of Financial Management", Prentice Hall, Pearson education 12th edition, 2016.
2. Srivastava, Misra," Financial Management", 2nd edition Oxford university press

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1.	**Introduction**		
1.1	Introduction to Financial Management	1	CO1
1.2	Goals of the firm - Financial Environments	1	CO1
1.3	**Time Value of Money:** Simple and Compound Interest Rates,	1	CO1
1.4	Amortization, Computing more than once a year, Annuity Factor.	1	CO1
2	**Capital Budgeting**		
2.1	The Capital Budgeting Concept & Process - An Overview, Generating Investment Project Proposals	1	CO2
2.2	Estimating Project, After Tax Incremental Operating Cash Flows	1	CO2
2.3	Capital Budgeting Techniques	1	CO2
2.4	Project Evaluation and Selection - Alternative Methods	1	CO2
3	**Valuation of Securities and Risk & Return**		
3.1	Bond Valuation Preferred Stock Valuation, Common Stock Valuation	1	CO3
3.2	Concept of Yield and YTM	1	CO3
3.3	Defining Risk and Return, Using Probability Distributions to Measure Risk, Attitudes Toward Risk	1	CO3
3.4	Risk and Return in a Portfolio Context, Diversification	1	CO3
3.5	The Capital Asset Pricing Model (CAPM)	1	CO3
4	**Operating & Financial Leverage**		
4.1	Operating Leverage, Financial Leverage, Total Leverage, and Indifference Analysis in leverage study.	1	CO4
4.2	**Cost of Capital:** Concept, Computation of Specific Cost of Capital for Equity	1	CO4
4.3	Preference – Debt, Weighted Average Cost of Capital	1	CO4
4.4	Factors affecting Cost of Capital	1	CO4
5	**Working Capital Management**		
5.1	Overview, Working Capital Issues	1	CO5
5.2	Financing Current Assets (Short Term and Long Term- Mix)	1	CO5
5.3	Combining Liability Structures and Current Asset Decisions, Estimation of Working Capital.	1	CO5
6	**Cash Management**		

6.1	Motives for holding cash, Speeding up Cash Receipts, Slowing Down Cash Payouts,	1	CO6
6.2	Electronic Commerce, Outsourcing, Cash Balances to maintain, Factoring.	1	CO6
6.3	**Accounts Receivable Management:** Credit & Collection Policies, Analyzing the Credit Applicant,	1	CO6
6.4	Credit References, Selecting optimum Credit period.	1	CO6
	Total hours	**24**	

Course Designer:

1. Mr.V.Janakiraman vjncse@tce.edu

21CBPH0	Human Resource Management

Category	L	T	P	Credit	Terminal Exam Type
PSE	2	0	0	2	Theory

Preamble

This course is to understand the basic concepts and importance of Human Resources Management and learn Various Human Resources Applications and Practices. Apply HRM concepts in organisational context and understand how HRM activities lead to performance and sustainability of the organisation.

Prerequisite

NIL

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Explain the basic concepts and importance of Human Resource Management	10
CO2	Select appropriate manpower resources using various activities and functions.	20
CO3	Develop action plans, train and appraise the performance of employees.	15
CO4	Understand the system design of Human Resource Management	15
CO5	Choose the appropriate Business strategies to improve the growth of organization.	20
CO6	Identify the impact of HR activities on different service sectors.	20

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	Guided Response	1.1,4.1
CO2	TPS3	Apply	Value	Mechanism	1.1,2.5,3.1,4.2
CO3	TPS3	Apply	Value	Mechanism	2.5,3.1,4.1,4.2
CO4	TPS2	Understand	Respond	Guided Response	1.1,4.2
CO5	TPS3	Apply	Value	Mechanism	2.5,3.1,4.1,4.2
CO6	TPS3	Apply	Value	Mechanism	2.5,3.1,4.1,4.2

Mapping with Programme Outcomes and Programme Specific Outcomes

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

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

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

Sample Questions for Course Outcome Assessment**

** (2 to 3 at the cognitive level of course outcome)

Course Outcome 1(CO1):
1. What is HRM?
2. What is meant by HR policy?
3. Discuss the impact of culture and technology on Human Resource Practices.
4. Elucidate the factors affecting HR policies.
5. Explain the process of formulating HR Policies and analyze the scope of human resource policies.

Course Outcome 2(CO2):
1. Define recruitment and Staffing.
2. What is meant by HRIS?
3. For a startup small scale restaurant, design the content of HRIS and HR portal. What are the common issues the company would face with respect to employee privacy and suggest ways to overcome it?
4. Identify the functions of Human Resource Information Systems.
5. Determine the various internal factors in the organization which affect the recruitment programme.

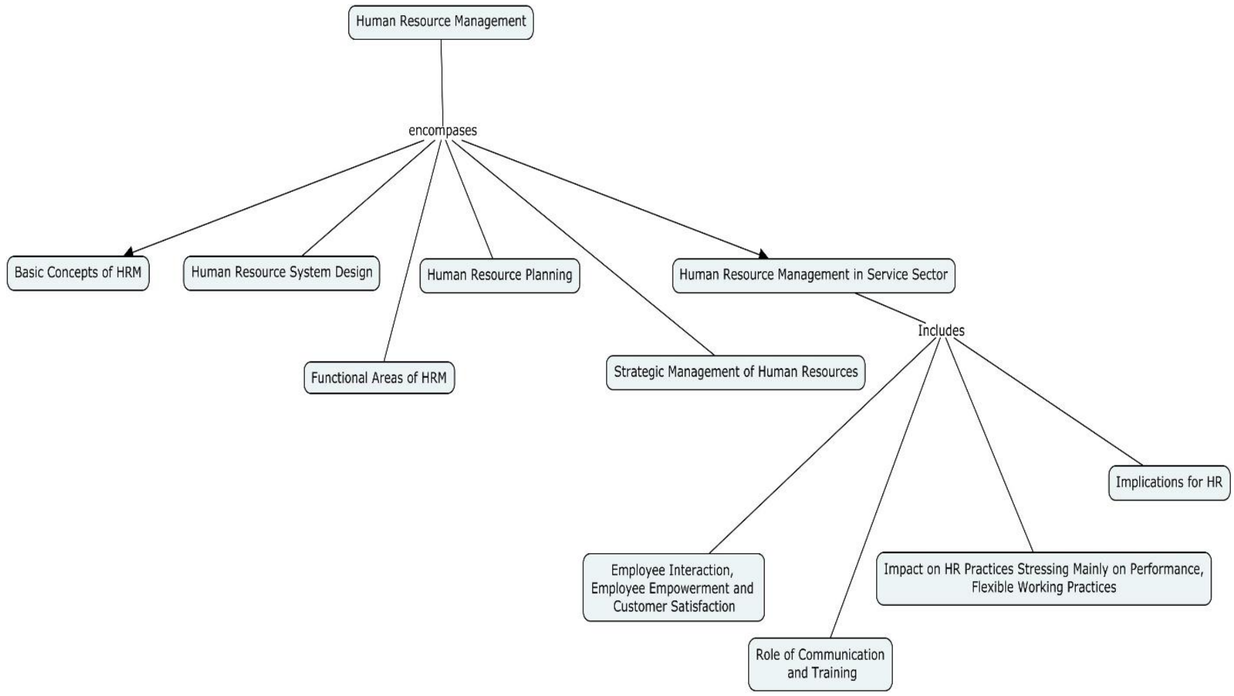
Course Outcome 3 (CO3):
1. Write some of the Major Stumbling blocks in HRP.
2. What is mean by Retention
3. "Human Resource Planning is more than matching demand and supply gaps." Do you Agree?
4. Describe the process of HRP.
5. "Human Resource Planning is a basic business premise & is necessary for organizational effectiveness" please evaluate the statement
6. Discuss the problems in HRP. Explain also how can you plan for Human resources in an effective manner?

Course Outcome 4(CO4):
1. What are the objectives of an HR Audit?
2. Define HR Accounting.
3. Write short note on HR accounting? Discuss the approaches of HR accounting. Also explain how it is different from HR auditing.

Course Outcome 5 (CO5):
1. List the relationship between HR strategy and corporate strategy
2. What are the barriers to strategic HRM?
3. What is strategic capability?
4. What are the various Models of SHRM? Explain In detail
5. Elaborate on the various SHRM challenges faced by an organization with suitable examples.
6. Explain the framework of Strategic HR Management Process

Course Outcome 6 (CO6):
1. How you measure the Customer Satisfaction
2. List the Role of Communication and Training
3. Describe any two theories of motivation which you find the most suitable to motivate the employees of your organization.
4. Identify the Impact on HR Practices Stressing Mainly on Performance

Concept Map



Syllabus

Human Resource Management: Concept and Challenges, HR Philosophy, Policies, Procedures and Practices.
Functional Areas of HRM: recruitment and staffing, benefits, compensation, employee relations, HR compliance, organizational design, training and development, human resource information systems (H.R.I.S.) and payroll.
Human Resource Planning: Demand Forecasting, Action Plans– Retention, Training, Redeployment & Staffing, Succession Planning
Human Resource System Design: HR Profession, and HR Department, Line Management Responsibility in HRM, Measuring HR, Human resources accounting and audit; Human resource information system
Strategic Management of Human Resources: SHRM, relationship between HR strategy and overall corporate strategy, HR as a Factor of Competitive Advantage, Managing Diversity in the Workplace
Human Resource Management in Service Sector- Special considerations for Service Sector including Managing the Customer – Employee Interaction, Employee Empowerment and Customer Satisfaction, Service Failure and Customer Recovery – the Role of Communication and Training, Similarities and Differences in Nature of Work for the Frontline Workers and the Backend, Support Services - Impact on HR Practices Stressing Mainly on Performance, Flexible Working Practices – Implications for HR

Learning Resources

Text Book

1. Dessler G, Varrkey B. "Human Resource Management", 16th edition. Pearson Education India, 2020.

Reference Books

1. Mathis RL, Jackson JH. "Human resource management", 15th edition, Jakarta: Salemba Empat.), 2021.
2. Joseph J. Martocchio, "Human Resource Management", 15th edition, Pearson Education Champaign, 2019.

Online courses

1. https://archive.nptel.ac.in/courses/110/105/110105069/
2. https://www.digimat.in/nptel/courses/video/122105020/

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1.	**Human Resource Management:**		CO1
1.1	Concept and Challenges	1	CO1
1.2	HR Philosophy, Policies	1	CO1
1.3	Procedures and Practices.	1	CO1
3.	**Functional Areas of HRM:**		CO2
3.1	recruitment and staffing, benefits, compensation	1	CO2
3.2	employee relations, HR compliance	1	CO2
3.3	organizational design, training and development	1	CO2
3.4	Human Resource Information Systems (H.R.I.S.) and payroll.	1	CO2
4	**Human Resource Planning:**		CO3
4.1	Demand Forecasting, Action Plans	1	CO3
4.2	Retention, Training	1	CO3
4.3	Redeployment & Staffing	1	CO3
4.5	Succession Planning	1	CO3
2	**Human Resource System Design:**		CO4
2.2	HR Profession and HR Department	1	CO4
2.3	Line Management Responsibility in HRM, Measuring HR	1	CO4
2.4	Human resources accounting and audit	1	CO4
2.5	Human resource information system	1	CO4
5	**Strategic Management of Human Resources:**		CO5
5.1	SHRM	1	CO5
5.2	relationship between HR strategy and overall corporate strategy	1	CO5
5.3	HR as a Factor of Competitive Advantage	1	CO5
5.4	Managing Diversity in the Workplace	1	CO5
6.	**Human Resource Management in Service Sector**		CO6
6.1	Managing the Customer – Employee Interaction, Employee Empowerment and Customer Satisfaction	1	CO6
6.2	Service Failure and Customer Recovery– the Role of Communication and Training	1	CO6
6.3	Similarities and Differences in Nature of Work for the Frontline Workers and the Backend	1	CO6
6.4	Support Services - Impact on HR Practices Stressing Mainly on Performance	1	CO6
6.5	Flexible Working Practices – Implications for HR	1	CO6
	TOTAL	**24**	

Course Designer:

1. Mrs.P.Suganthi psica@tce.edu

21CBPJ0	IT Project Management

Category	L	T	P	Credit	**Terminal Exam Type**
PSE	3	1	0	4	Theory

Preamble

This course develops the competencies and skills for planning, organizing and controlling projects within time and cost targets. Students will also learn agile project management techniques such as Scrum and DevOps.

Prerequisite

-

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Explain the various activities for resource management, risk assessment and project closure	10
CO2	Understand best practices followed in agile project management	10
CO3	Apply appropriate project planning and tracking tools for the given specification	20
CO4	Perform cost benefit analysis for the successful implementation of a project plan	20
CO5	Identify various agile methods to manage software projects effectively	20
CO6	Apply suitable software project management technique for the given scenario	20

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psycho motor	
CO1	TPS2	Understand	Respond		1.2, 2.1.1, 4.1.1, 4.1.2, 4.1.3
CO2	TPS2	Understand	Respond		1.2, 2.1.1, 4.1.1, 4.1.2, 4.1.3
CO3	TPS3	Apply	Value		1.2, 2.1.1, 2.1.3, 2.1.4, 4.1, 4.2, 4.3.1,4.3.4
CO4	TPS3	Apply	Value		1.2, 2.1.1, 2.1.3, 2.1.4, 4.1, 4.2, 4.3.1,4.3.4
CO5	TPS3	Apply	Value		1.2, 2.1.1, 2.1.3, 2.1.4, 4.1, 4.2
CO6	TPS3	Apply	Value		1.2, 2.1.1, 2.1.3, 2.1.4, 2.5, 3.1, 3.2, 3.3, 4.1, 4.2, 4.3.1,4.3.4

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	L			L				M	M	M	L	L	M	
CO2	M	L			L				M	M	M	L	L	M	
CO3	S	M	L		M	L	L	M	S	S	S	M	M	S	M
CO4	S	M	L		M	L	L	M	S	S	S	M	M	S	M
CO5	S	M	L		M	L	L	M	S	S	S	M	M	S	M
CO6	S	M	L		M	L	L	M	S	S	S	M	M	S	M

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests		Assignment/Mini Project		Terminal Examination
	1	2	1	2	
Remember	20	20			20
Understand	40	40			30
Apply	40	40	100	100	50
Analyse					
Evaluate					
Create					

Sample Questions for Course Outcome Assessment**

** (2 to 3 at the cognitive level of course outcome)

Course Outcome 1(CO1):

1. List the software management principles in modern project profile?
2. What is the difference between mitigating a risk and contingency planning?
2. Develop a risk breakdown structure and describe the process involved in Risk management.

Course Outcome 2(CO2):

1. List the benefits of agile modelling.
2. Explain about agile manifesto and principles.
3. Choose an agile methodology which preserves customer values with less work to implement online shopping system.

Course Outcome 3(CO3):

1. Explain the guidelines for estimating times, costs and resources and explain the methods for estimating the project costs by Top Down Approach
2. Explain how organizing projects are deployed within the dedicated project teams. State its pros and cons.
3. Develop a WBS for a project in which you are going to build shopping application. Try to identify all of the major components and provide three levels of detail.

Course Outcome 4 (CO4):

1. What are the causes for variations in project estimates?
2. How will you select a suitable cost estimation model for a given project?
3. Estimate the cost associated with the project using bottom up technique

Course Outcome 5(CO5):

1. Recall about task boards.
2. Explain about project scheduling and tracking using burn down charts.
3. Create backlogs and burn down chart to monitor the progress of the project.

Course Outcome 6 (CO6):

1. Create a customer database for the Modesto league baseball team. Draw a project network Complete the forward and backward pass, compute activity slack, and identify the critical path. How long will this project take? How sensitive is the network schedule? Calculate the free slack and total slack for all noncritical activities.
2. Your roommate is about to submit a scope statement for a spring concert sponsored by the entertainment council at Western Evergreen State University (WESU). WESU is a residential university with over 22,000 students. This will be the first time in six years since WESU sponsored a spring concert. The entertainment council has budgeted $40,000 for the project. The event is to occur on June 5th. Since your roommate knows you are taking a class on project management she has asked you to review her scope statement and make suggestions for improvement. She considers the concert a resume building experience and wants to be as professional as possible. Below is a draft of her scope statement. What suggestions would you make and why?
3. You work for LL Company, which manufactures high-end optical scopes for hunting rifles. LL Company has been the market leader for the past 20 years and has decided to diversify by applying its technology to develop a top-quality binocular. What kind of project management structure would you recommend they use for this project? What information would you like to have to make this

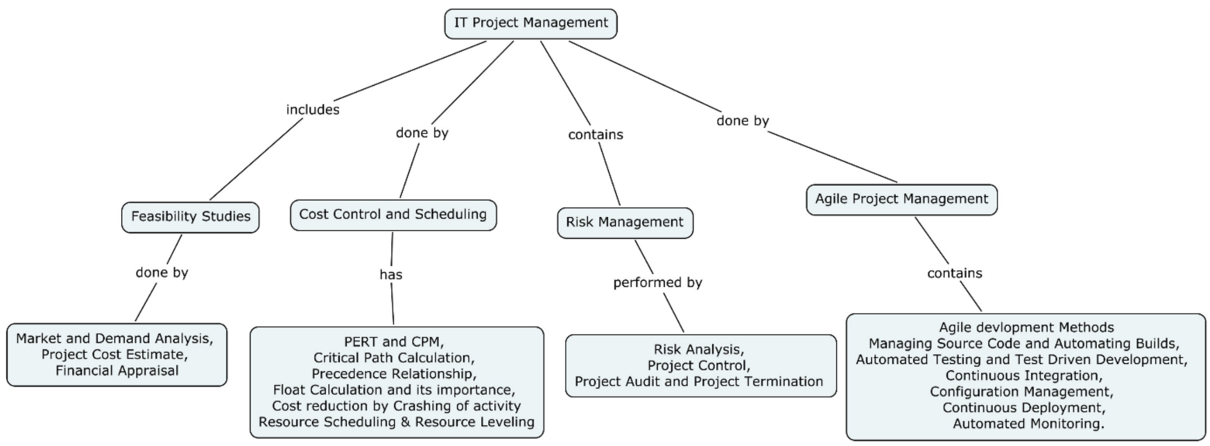
recommendation, and why?

Syllabus

Project Overview and Feasibility Studies- Identification, Market and Demand Analysis, Project Cost Estimate, Financial Appraisal
Project Scheduling: Project Scheduling, Introduction to PERT and CPM, Critical Path Calculation, Precedence Relationship, Difference between PERT and CPM, Float Calculation and its importance, Cost reduction by Crashing of activity.
Cost Control and Scheduling: Project Cost Control (PERT/Cost), Resource Scheduling & Resource Leveling
Project Management Features: Risk Analysis, Project Control, Project Audit and Project Termination
Agile Project Management: Introduction, Agile Principles, Agile methodologies, Relationship between Agile Scrum, Lean, DevOps and IT Service Management (ITIL).
Scrum: Sprint, product backlog, sprint backlog, sprint review, retro perspective, various roles (Roles in Scrum), Best practices of Scrum.
DevOps: Overview and its Components, Containerization Using Docker, Managing Source Code and Automating Builds, Automated Testing and Test Driven Development, Continuous Integration, Configuration Management, Continuous Deployment, Automated Monitoring.
Other Agile Methodologies: Introduction to XP, FDD, DSDM, Crystal

Assignment:
Case studies will be distributed to students beforehand and students should prepare and try to solve these cases before coming to class. Students will be asked submit and present their understanding of the cases and solutions before the class.

Concept Map



Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1	**Project Overview and Feasibility Studies**		
1.1	Identification, Market and Demand Analysis,	1	CO1
1.2	Project Cost Estimate	2	CO3
1.3	Financial Appraisal	1	CO1
2	**Project Scheduling**		
2.1	Introduction to PERT and CPM	1	CO3
2.2	Critical Path Calculation, Precedence Relationship	2	CO3
2.3	Difference between PERT and CPM, Float Calculation and its importance,	1	CO3
2.4	Cost reduction by Crashing of activity	2	CO3
3	**Cost Control and Scheduling**		
3.1	Project Cost Control (PERT/Cost)	2	CO4
3.2	Resource Scheduling & Resource Leveling	2	CO4

Module No.	**Topic**	No. of Hours	Course Outcome
4	**Project Management Features**		
4.1	Risk Analysis	2	CO1
4.2	Project Control	1	CO1
4.3	Project Audit and Project Termination	1	CO1
5	**Agile Project Management**		
5.1	Agile Principles, Agile methodologies	1	CO2
5.2	Relationship between Agile Scrum	1	CO2
5.3	Lean software development	1	CO2
5.4	DevOps and IT Service Management (ITIL)	1	CO5
6	**Agile Methodologies**		
6.1	Extreme Programing	1	CO2
6.2	FDD, DSDM, Crystal	2	CO2
7	**Scrum**		
7.1	Sprint, product backlog, sprint backlog, sprint review, retro perspective	2	CO5
7.2	Roles in Scrum	1	CO5
7.3	Best practices of Scrum	1	CO5
8	**DevOps**		
8.1	Overview and its Components	1	CO2
8.2	Containerization Using Docker	2	CO2
8.3	Managing Source Code and Automating Builds	1	CO5
8.4	Automated Testing and Test Driven Development	1	CO5
8.5	Continuous Integration, Configuration Management	1	CO5
8.6	Continuous Deployment, Automated Monitoring	1	CO5
	Case Study		
1	Students should solve the case studies and present their understanding of the cases and solutions before the class. Collect functional and non-functional requirements for the chosen problem	4	CO6
2	Estimate the effort, development time and resources	2	CO6
3	Create a schedule to organize the tasks, deliverables and milestones of a project on a timeline.	4	CO6
4	Prepare RMMM plan	2	CO6
	Total Hours	48	

Learning Resources:

1. Warburton. R &Kanabar. V, The Art and Science of Project Management, RW Press, RI, Second Edition, 2016.
2. 2. Bob Hughes, Mike Cotterell, Software Project Management, Tata McGraw Hill, Third Edition, 2011.
3. Mike Cohn, "Succeeding with Agile: Software Development Using Scrum", Pearson Addison-Wesley Professional, 1st Edition, 2015.
4. Roman Pichler, "Agile Product Management with Scrum", Addison-Wesley publisher, 1st Edition, 2011.
5. Ken Schwaber, "Agile Project Management with Scrum (Microsoft Professional)", Microsoft Press US publisher, 1st Edition, 2014.

Course Designers:

1. Dr. A. Malini amcse@tce.edu

21CBPK0	LARGE SCALE SYSTEMS

Category	L	T	P	Credit	Terminal Exam Type
PSE	3	0	0	3	Theory

Preamble

This course is to understand the architecture and fundamentals of large scale distributed computing and various scheduling algorithms for resource management. Identify the special requirements for Fault Tolerance in modern large scale systems and apply the appropriate monitoring Tools for control and optimization of large scale system.

Prerequisite

NIL

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Explain the architecture and fundamentals of large scale distributed computing.	20
CO2	Analyze various high performance communication methods in large scale distributed computing.	15
CO3	Apply the appropriate scheduling algorithm for Resource Managements	20
CO4	Apply the appropriate monitoring Tools for control and optimize Large scale system using control monitoring Tools.	20
CO5	Understand the special requirements for Fault Tolerance in modern large scale distributed systems.	10
CO6	Develop the Secure Application using appropriate development tools and framework.	15

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	Guided Response	1.1,4.1
CO2	TPS3	Apply	Value	Mechanism	2.5,3.1,4.1,4.2
CO3	TPS3	Apply	Value	Mechanism	1.1,2.5,3.1,4.2
CO4	TPS3	Apply	Value	Mechanism	2.5,3.1,4.1,4.2
CO5	TPS2	Understand	Respond	Guided Response	1.1,4.1
CO6	TPS3	Apply	Value	Mechanism	2.5,3.1,4.1,4.2

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO 1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO10	PO 11	PO12	PSO 1	PSO 2	PSO 3
CO1	S	M	M		M	L			M	L			S	M	L
CO2	S	S	M	L									S	L	L
CO3	S	M	L		L		L	L					M	L	L
CO4	S	M	M		S		M	L	L			L	S	S	M
CO5	S	M	M		S		M	M	L			L	S	S	M
CO6	S	M	M		S		M	M	L			L	S	S	M

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

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

Sample Questions for Course Outcome Assessment**

** (2 to 3 at the cognitive level of course outcome)

Course Outcome 1(CO1):

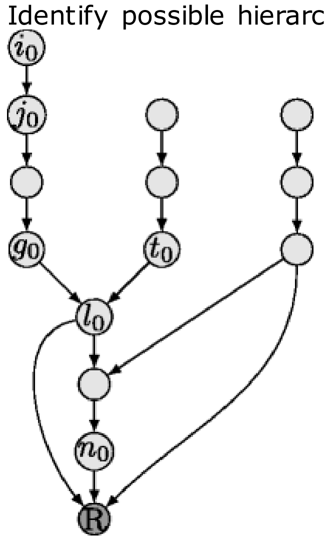
6. Until OGSA is truly stable, the Globus Toolkit remains the de facto standard, and one of the most important pieces of software in Grid system development. Justify.
7. Elaborate the importance of Architectural Models Client Server architectures
8. Analyse the need for pattern oriented software architecture in building large software applications. Give an example with neat sketch.

Course Outcome 2(CO2):

4. What is a hierarchical and what is a flat client-server model?
5. Explain how the reliability of smart grid can be enhanced by integrating intelligent electronic devices (IED) into it.
6. What are the data and functional requirements of grid computing? Explain the layered architecture of grid with a neat diagram?

Course Outcome 3(CO3):

6. Identify possible hierarchical relationship classes between two arbitrary genes i,j of DAG



2. Given the "Energy Situation" represents a complex subnet representing the hive storage. Give an example of a Petri Net for a multi-agent simulation of bee recruitment.

Course Outcome 4 (CO4):

7. Proxies can support replication transparency by invoking each replica, as explained in the text. Can (the server side of) an application be subject to a replicated calls?
8. Explain server virtualization with respect to logical and physical partitioning.
9. Ricart and Agrawala's algorithm has the problem that if a process has crashed and does not reply to a request from another process to access a resources, the lack of response will be interpreted as denial of permission. We suggested that all requests be answered immediately to make it easy

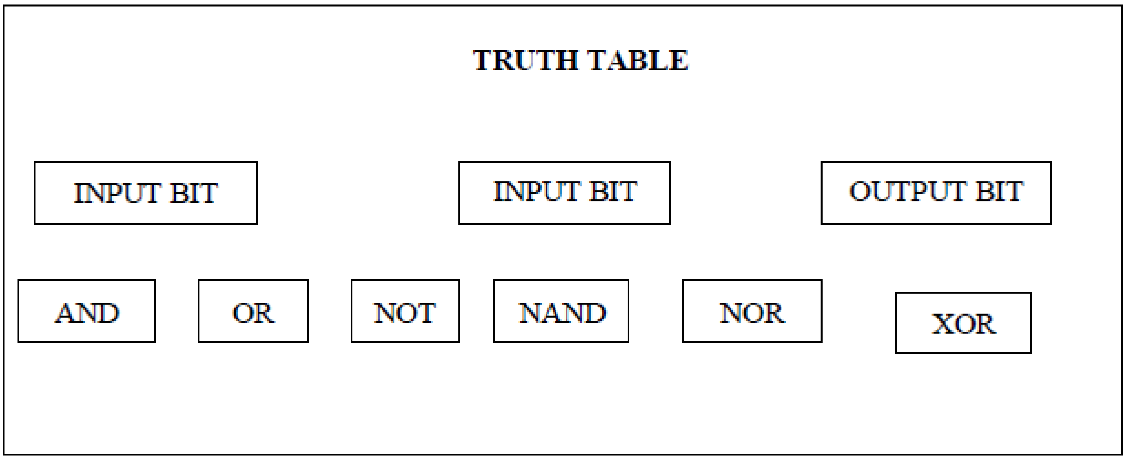
to detect crashed processes. Are there any circumstances where even this method is insufficient? Discuss.

Course Outcome 5 (CO5):

7. Why is the fault tolerance problem a greater challenge in collaborative p2p systems than in file sharing p2p systems?
8. Design a fault tolerant system and depict the needed elements and working of the syste,.
9. Why is it sometimes so hard to hide the occurrence and recovery from failures in a distributed system?

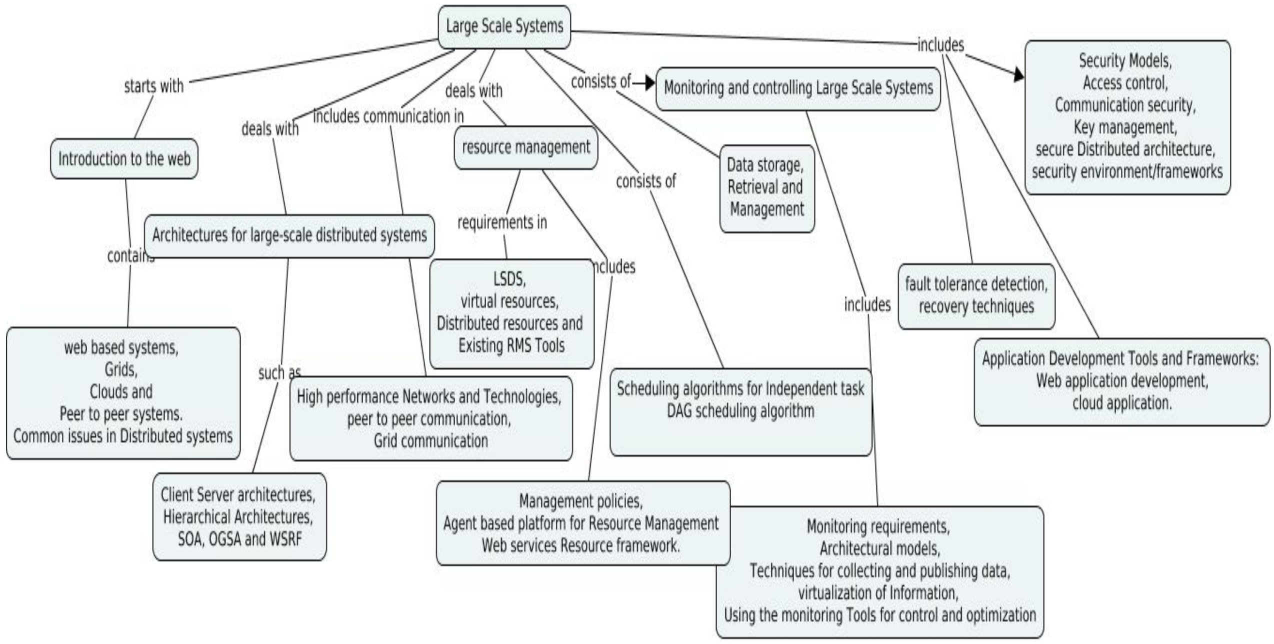
Course Outcome 6(CO6):

5. Design an ER diagram for a Banking system that allows its customers to open and manage bank accounts. You should clearly identify the entities, relationships, cardinality and the key constraints in your answer. You must also add proper attributes for each entity. The description of the Banking system is given below:
    a. A Bank allows its customers to open accounts with itself. There are three kinds of accounts, which are Savings account, Current Account and Salary account. In savings accounts Bank give an interest rate of 3%. The minimum balance for the savings account is INR 2000/-. In the salary account also, the bank gives an interest rate of 3% but allows the customer to have zero balance. In the Current account the bank changes the customer a fixed amount (say INR 1000 per year) and no interest is given. However, a customer can avail an overdraft of Rs 1 lakh at an interest rate of 7%. A customer is assigned a customer ID and can open multiple accounts with the Bank. An account may be single person account or joint account with a maximum of 4 customer in a joint account. A customer can perform different transactions using his/her account. S/he can deposit money, withdraw money, transfer money from one account to another. In addition, at the end of each month bank pays/charges the interest to the accounts, using the average balance of that month.
6. Design the Relational Schema for the E-R diagram that you have drawn for part Question 1. The relations must be at least in 3NF. Perform the following on the relations:
    a. Enter about 5 sets of meaningful data in each of the relations.
    b. Identify the domain of various attributes.
    c. Identify the Primary keys of all the relations.
    d. Identify the Foreign keys and referential integrity constraints in the relations.
7. Develop a GUI (details given below)by Using Tkinter and wxPython, compare the code complexity of both and give your observation



Details of GUI : the GUI for Truth table should accept two bits (0 or 1) as input and produce the Output as per the Logical operation to be chosen by pressing the button of that particular logical operation i.e. AND, OR, NOT,NAND, NOR, XOR. You may use other suitable components like text box, combo box, list, Radio Button, Check Box, Buttons etc. to implement the GUI.

Concept Map



Syllabus

Introduction – Basic concepts –The web –web based systems, Grids, Clouds and Peer to peer systems. Common issues in Distributed systems.

Architectures for large-scale distributed systems: Importance of Architectural Models Client Server architectures, Hierarchical Architectures, SOA, OGSA and WSRF. **Communication:** High performance Networks and Technologies, peer to peer communication, Grid communication

Resource Managements: Requirements of RM in LSDS, virtual resources, Distributed resources and Existing RMS Tools, Resource Management policies, Agent based platform for Resource Management Web services Resource framework. **Scheduling:** Scheduling methods, Scheduling algorithms for Independent task. DAG scheduling algorithms,

Data storage, Retrieval and Management: Data storage, Data Retrieval, Data Transfer, Replication and managements. **Monitoring and controlling Large Scale Systems:** Monitoring requirements, Architectural models for Monitoring systems, Techniques for collecting and publishing data, virtualization of monitoring Information, Using the monitoring Tools for control and optimization

Fault Tolerance: Fault Tolerance Models, Failure Detection and Recovery, Fault Tolerance Techniques.

Security: Security Models, Access control, Communication security, Key management, secure Distributed architecture, security environment/frameworks. **Application Development Tools and Frameworks:** Web application development, environment and Tools for cloud application.

Assignment:
Students should prepare and try to solve cases studies on Fault Tolerance, Resource Managements, Web application development, etc. Students will be asked submit and present their Understanding of the cases and solutions before the class.

Learning Resources

Text Book

2. Valentin Cristea, ciprain Dobre, Varrkey B. "Large-scale Distributed Computing and Applications: Models and Trends", Information science reference New York, 2010.
3. Dominique Luzeaux, Jean-René Ruault, Jean-Luc Wippler, "Large-scale Complex System and Systems of Systems Hardcover", Wiley-ISTE, 2011.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1.	**Introduction**		CO1
1.1	Basic concepts –The web –web based systems, Grids, Clouds and Peer to peer systems. common issues in Distributed systems	1	CO1
1.2	**Architectures for large-scale distributed systems**: Importance of Architectural Models Client Server architectures, Hierarchical Architectures	2	CO1
1.3	SOA, OGSA and WSRF	2	CO1
2	**Communication**		CO2
2.1	High performance Networks and Technologies	2	CO2
2.2	peer to peer communication	1	CO2
2.3	Grid communication	2	CO2
3	**Resource Managements:**		
3.1	Requirements of RM in LSDS, virtual resources	2	CO3
3.2	Distributed resources and Existing RMS Tools	2	CO3
3.3	Resource Management policies, Agent based platform for Resource Management Web services Resource framework.	2	CO3
3.4	**Scheduling:** Scheduling methods, Scheduling algorithms for Independent task.	2	CO3
3.5	DAG scheduling algorithms	1	CO3
4	**Data storage, Retrieval and Management:**		CO4
4.1	Data storage, Data Retrieval, Data Transfer, Replication and managements.	2	CO4
4.2	**Monitoring and controlling Large Scale Systems:** Monitoring requirements, Architectural models for Monitoring systems	2	CO4
4.3	Techniques for collecting and publishing data	1	CO4
4.4	virtualization of monitoring Information and monitoring Tools for control and optimization	2	CO4
5	**Fault Tolerance:**		CO5
5.1	Fault Tolerance Models, Failure Detection and Recovery	2	CO5
5.2	Fault Tolerance Techniques	2	CO5
6.	**Security**		CO6
6.1	Security Models, Access control, Communication security	2	CO6
6.2	Key management, secure Distributed architecture, security environment/frameworks	2	CO6
6.3	**Application Development Tools and Frameworks:** Web application development environment and Tools for cloud application	2	CO6
	TOTAL	**36**	

Course Designers:

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2. R.Subhashni rsica@tce.edu

21CBPL0	BIG DATA ANALYTICS

Category	L	T	P	Credit	Terminal Exam Type
PSE	3	0	0	3	Theory

Preamble

This course enables the students to familiarize with big data platform and its business implications. It also provides an overview of Hadoop framework, Map Reduce, PIG and HIVE. The course guides them to store, analyse and manipulate data by using the data analytics tools which helps them to gain a comprehensive knowledge on big data analytics.

Prerequisite

NIL

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Explain the role and characteristics of big data analytics in the real-world.	15
CO2	Describe the underlying concepts of Hadoop framework in distributed environment	15
CO3	Develop applications to handle big data in Hadoop environment	20
CO4	Solve data intensive problems using map reduce techniques	20
CO5	Demonstrate the efficient storage and processing of large datasets using HIVE	15
CO6	Write queries to perform data manipulation operations using PIG data flow system	15

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond		1.2,2.1.5,2.2.3,2.5.1,3.2.3, 4.5.3
CO2	TPS2	Understand	Respond		1.2,2.1.5,2.2.3,2.5.1,3.2.3, 4.5.3
CO3	TPS3	Apply	Value		1.2,2.1.5,2.2.3,2.5.1,3.2.3, 4.5.3
CO4	TPS3	Apply	Value		1.2,2.1.5,2.2.3,2.5.1,3.2.3, 4.5.3
CO5	TPS3	Apply	Value		1.2,2.1.5,2.2.3,2.5.1,3.2.3, 4.5.3
CO6	TPS3	Apply	Value		1.2,2.1.5,2.2.3,2.5.1,3.2.3, 4.5.3

Mapping with Programme Outcomes and Programme Specific Outcomes

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

CO 6	S	M	L	L		L		L			L	L	M	L	L

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Test		Assignment		Terminal Examination
	I	II	I	II	
Remember	20	20			20
Understand	40	20	50		20
Apply	40	60	50	100	60
Analyse					
Evaluate					
Create					

Assessment Pattern: Psychomotor

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

Sample Questions for Course Outcome Assessment**

Course Outcome 1(CO1):

1. Discuss in detail about the characteristics of Big Data.
2. Explain in detail about Nature of Data and its applications.
3. What is big data analytics? Explain four 'V's of Big data. Briefly discuss applications of big Data.

Course Outcome 2(CO2):

1. Explain core architecture of Hadoop with suitable block diagram. Discuss role of each component in detail.
2. List various configuration files used in Hadoop Installation. What is use of mapred-site.xml.
3. What is Name node & Data node in Hadoop Architecture.

Course Outcome 3(CO3):

1. Illustrate with an example of Hadoop HDFS architecture with an example.
2. How would you show your understanding of the tools, trends and technology in big data?
3. Analyze the NameNode recovery process. What will happen with a NameNode that doesn"t have any data?

Course Outcome 4(CO4):

1. Exhibit the following query: If reducers do not start before all mappers finish then why does the progress on MapReduce job shows something like Map(50%) Reduce(10%)? Why reducers progress percentage is displayed when mapper is not finished yet?

2.

Solve using MAP REDUCE. Count the number of companies in each state

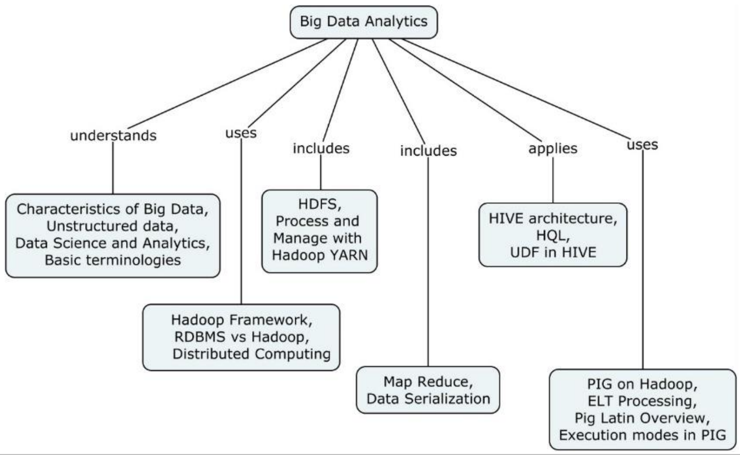
a.	REDMI-Kerela	UNILIVER-Odisha
b.	ACER-Delhi	ACER-Assam
c.	TITAN- Maharastra	REDMI-Delhi
d.	HP-Karnataka	ANGEL-Delhi
e.	SAMSUNG-Delhi	FEMINA-Delhi
f.	JIO-Haryana	BECON-Telangana
g.	REALME-DELHI	NOKIA- Tamilnadu
h.	ACER-Odisha	JIO -DELHI

3. Discuss Hadoop YARN in detail with failures in classic MapReduce.

Course Outcome 5(CO5):
1. Sketch a neat diagram that showcase the working of Hive.
2. Explain Metastore in Hive.
3. Illustrate HiveQL Data Definition Language? Explain any three HiveQL DDL command with its syntax and example.

Course Outcome 6(CO6):
1. Explain the uses of Map Reduce in Pig..
2. Interpret the role of scalar data type and complex data types in Pig.
3. Demonstrate the usage of 'filters', 'group', 'orderBy', 'distinct' keywords in pig scripts.

Concept Map



Syllabus

ESSENTIALS OF BIG DATA ANALYTICS: Data, Characteristics of data and Types of digital data, Sources of data, Working with unstructured data, Evolution and Definition of big data, Need of big data, Challenges of big data; Overview of business intelligence, Data science and Analytics, Classification of analytics, Challenges to big data analytics, Importance of big data analytics, Basic terminologies in big data environment.

OVERVIEW OF HADOOP FRAMEWORK: Introducing Hadoop, Need of Hadoop, limitations of RDBMS, SPARK, RDBMS versus Hadoop, Distributed computing challenges, History of Hadoop, Hadoop overview, Use case of Hadoop.

HADOOP DISTRIBUTORS: HDFS (Hadoop Distributed File System), Processing data with Hadoop, managing resources and applications with Hadoop YARN (Yet another Resource Negotiator), Interacting with Hadoop Ecosystem.

MAPREDUCE PROGRAMMING: Introduction, Mapper, Reducer, Combiner, Partitioner, Searching, Sorting, Compression, Real time applications using MapReduce, Data serialization and Working with common serialization formats, Big data serialization formats.

Apache HIVE Fundamentals: Hive architecture, Hive data types, Hive file format, Hive Query Language (HQL), User-Defined Function (UDF) in Hive.

Apache PIG Fundamentals: The anatomy of Pig, Pig on Hadoop, Pig Philosophy, Use case for Pig; ETL Processing, Pig Latin overview, Data types in Pig, Running Pig, Execution modes of Pig, HDFS commands, Relational operators, Piggy Bank, Word count example using Pig.

Learning Resources

Text Books:

1. Seema Acharya, Subhashini Chellappan, "Big Data Analytics", 2nd Edition, Wiley, 2019.
2. Boris lublinsky, Kevin t. Smith, Alexey Yakubovich, "Professional Hadoop Solutions", 1st Edition, Wrox, 2013.
3. Chris Eaton, Dirk Deroos et. al., "Understanding Big data", Indian Edition, McGraw Hill, 2015.
4. Tom White, "HADOOP: The definitive Guide", 3rd Edition, O Reilly, 2012.
5. Vignesh Prajapati, "Big Data Analytics with R and Hadoop", 1st Edition, Packet Publishing Limited, 2013

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1	**ESSENTIALS OF BIG DATA ANALYTICS**:		
1.1	Data, Characteristics of data and Types of digital data, Sources of data, Working with unstructured data.	1	CO1
1.2	Evolution and Definition of big data, and Need of big data, Challenges of big data.	1	CO1
1.3	Overview of business intelligence, Data science and Analytics, Classification of analytics, Challenges to big data analytics.	2	CO1
1.4	Importance of big data analytics, Basic terminologies in big data environment	1	CO1
2	**OVERVIEW OF HADOOP FRAMEWORK:**		
2.1	Introducing Hadoop, Need of Hadoop, limitations of RDBMS - SPARK.	1	CO2
2.2	RDBMS versus Hadoop, Distributed computing challenges.	2	CO2
2.3	History of Hadoop, Hadoop overview.	1	CO2
2.4	Use case of Hadoop	2	CO2
3	**HADOOP DISTRIBUTORS:**		
3.1	HDFS (Hadoop Distributed File System), Processing data with Hadoop.	2	CO3
3.2	Managing resources and applications with Hadoop YARN (Yet another Resource Negotiator)	3	CO3
3.3	Interacting with Hadoop Ecosystem.	2	CO3
4	**MAPREDUCE PROGRAMMING**:		
4.1	Introduction, Mapper, Reducer, Combiner, Partitioner	1	CO4
4.2	Searching, Sorting, Compression	1	CO4
4.3	Real time applications using MapReduce	2	CO4
4.4	Data serialization	1	CO4
4.5	Working with common serialization formats	1	CO4
4.6	Big data serialization formats.	1	CO4
5	**Apache HIVE Fundamentals:**		

5.1	Hive architecture, Hive data types	2	CO5
5.2	Hive file format, Hive Query Language (HQL)	2	CO5
5.3	User-Defined Function (UDF) in Hive.	1	CO5
6	**Apache PIG Fundamentals**:		
6.1	The anatomy of Pig, Pig on Hadoop, Pig Philosophy, Use case for Pig.	2	CO6
6.2	ETL Processing, Pig Latin overview, Data types in Pig, Running Pig, Execution modes of Pig	2	CO6
6.3	HDFS commands, Relational operators, Piggy Bank, Word count example using Pig.	2	CO6
	TOTAL	**36**	

Course Designer:

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2. Mrs. J. Felicia Lilian jflcse@tce.edu

21CBPM0	CLOUD AND DISTRIBUTED SYSTEMS

Category	L	T	P	Credit	Terminal Exam Type
PSE	3	0	0	3	Theory

Preamble

This course is to understand the basic concepts of distributed systems and distributed resource management also learns the basics of cloud computing, the services offered by the cloud, Virtualization, Cloud Storage and Cloud Security.

Prerequisite

Operating Systems, Computer Networks

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Explain the concepts of distributed computing and resource management.	10
CO2	Perform Mutual Exclusion and Deadlock detection using various distributed algorithms.	10
CO3	Illustrate the architecture, deployment and service models of cloud computing.	25
CO4	Identify the various virtualization technological concepts of Cloud Computing.	25
CO5	Solve the core issues of cloud computing such as cloud management, storage and security.	15
CO6	Develop cloud environment using different Cloud software and computing platforms.	15

*** Weightage depends on Bloom’s Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	Guided Response	1.2, 2.3.1, 2.4.6
CO2	TPS3	Apply	Value	Mechanism	1.2, 2.3.1, 2.3.2, 2.3.4
CO3	TPS2	Understand	Respond	Guided Response	1.2, 2.3.1, 2.4.6
CO4	TPS3	Apply	Value	Mechanism	1.2, 2.3.1, 2.3.2, 2.3.4
CO5	TPS3	Apply	Value	Mechanism	1.2, 2.4.5, 2.4.6, 2.5.1, 3.1.1, 3.2.1 – 3.2.6, 4.5.3, 4.5.5
CO6	TPS3	Apply	Value	Mechanism	1.2, 2.4.5, 2.4.6, 2.5.1, 3.1.1, 3.2.1 – 3.2.6, 4.5.3, 4.5.5

Mapping with Programme Outcomes and Programme Specific Outcomes

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

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

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

Assessment Pattern: Psychomotor

Psychomotor Skill	Miniproject /Assignment/Practical Component
Perception	-
Set	-
Guided Response	30
Mechanism	70
Complex Overt Responses	-
Adaptation	-
Origination	-

Sample Questions for Course Outcome Assessment**

** (2 to 3 at the cognitive level of course outcome)

Course Outcome 1(CO1):

9. List out the characteristics of Distributed Computing
10. Compare various models of distributed computations
11. Discuss briefly key challenges that one needs to address in the design and development of distributed applications.
12. Recall models of Distributed computations
13. Classify Distributed Systems
14. Write a simple RMI program that demonstrates the invocation of remote object services. For example, when a client sends a message "Ping", the server responds with "Pong".
15. Illustrate the remote procedure call with a suitable example

Course Outcome 2(CO2):

7. Identify the requirements of a mutual exclusion algorithms
8. Consider the following simple method to enforce mutual exclusion: all sites are arranged in a logical ring fashion and a unique token circulates around the ring hopping from a site to another site. When a site needs to executes its CS, it waits for the token, grabs the token, executes the CS, and then dispatches the token to the next site on the ring. If a site does not need the token on its arrival, it immediately dispatches the token to the next site (in zero time).
    a. What is the response time when the load is low?
    b. What is the response time when the load is heavy?

    Assume there are N sites, the message/token delay is T, and the CS execution time is E.
3. Explain global state detection based algorithms
4. Demonstrate the various models of deadlocks

Course Outcome 3(CO3):

1. Discuss the Layers and types of cloud
2. Discuss the IaaS cloud service model.
3. Explain the desired features of cloud

4. I am starting a new company to analyze videos. I'll need a lot of storage as videos consume quite a bit of disk. Additionally, I'll need ample computational power, possibly running applications concurrently. I have discovered some very good tools to facilitate development in Windows but the deployment will be more effiicently handled in the Linux environment. All the pointers say that I need to move to cloud. I have found that SaaS is the most attractive service, followed by PaaS and IaaS, in that order. Given the above information, which service do you recommend? Why?
5. Evaluate and contrast the merits and demerit of Cloud deployment models: public, private, hybrid, community

Course Outcome 4 (CO4):

10. Demonstrate the type of virtualization that is supported by the virtualization tool named PlateSpin Power Recon".
11. Illustrate the steps to add the OpenSolaris Guest OS to Sun xVM VirtualBox.
12. Define Virtualization.
13. Explain the concept of SOA.
14. Illustrate in detail about the compiler support for para virtualization architecture.
15. Examine in detail about hardware support for virtualization and CPU virtualization.

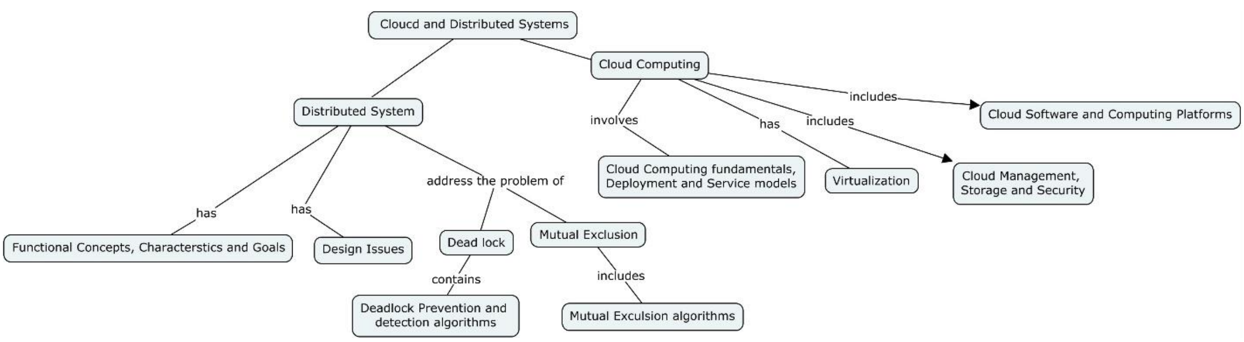
Course Outcome 5 (CO5):

10. Identify the Challenges in Cloud Security
11. Explain the use of cloud-based security groups that are used to counter and prevent the cloud security threats and attacks.
12. Evaluate about the architectural design of compute and storage clouds.
13. Generalize about the IAM.

Course Outcome 6(CO6):

8. Give some of the Applications of GAE
9. Define the MapReduce function
10. State and Explain the basic of Google App Engine infrastructure programming model.
11. Construct the design of OpenStack Nova system architecture and describe detail about it
12. Discuss model architecture of distributed file system and its components

Concept Map



Syllabus

Distributed Systems: Characteristics – Issues in Distributed Systems – Distributed System Model – Request/Reply Protocols – RPC – RMI – Logical Clocks and Casual Ordering of Events – Election Algorithm – Distributed Mutual Exclusion –Distributed Deadlock Detection Algorithms.

Cloud Computing: Evolution of Cloud Computing – Cloud Characteristics – Elasticity in Cloud – On-demand Provisioning – NIST Cloud Computing Reference Architecture– Architectural Design Challenges – Deployment Models: Public, Private and Hybrid Clouds – Service Models: IaaS – PaaS – SaaS – Benefits of Cloud Computing

Cloud Enabling Technologies: Introduction to Web Service and Service Oriented Architecture – SOAP – REST – Basics of Virtualization – Full and Para Virtualization– Implementation Levels of

Virtualization – Tools and Mechanisms – Virtualization of CPU – Memory – I/O Devices – Desktop Virtualization – Server Virtualization.

Cloud Management, Storage and Security: Resource Provisioning and Methods – Cloud Management Products – Cloud Storage – Provisioning Cloud Storage – Managed and Unmanaged Cloud Storage – Cloud Security Overview – Cloud Security Challenges –Security Architecture design – Virtual Machine Security – Application Security –Data Security.

Cloud Software and Computing Platforms: DFS – Map Reduce – Google App Engine (GAE) – Programming Environment for GAE – Architecture of GFS – Case Studies: Openstack, Heroku, and Docker Containers –Amazon EC2, AWS, Microsoft Azure, Google Compute Engine.

Learning Resources

Text Book

1. Andrew S. Tanenbaum, Maarten Van Steen, "Distributed Systems - Principles and Paradigms", Second Edition, Pearson, 2016.
2. George Coulouris, Jean Dollimore and Tim Kindberg, "Distributed Systems Concepts and Design", Fifth Edition, Pearson Education, 2017.
3. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2013.

Reference Books

1. Mukesh Singhal, "Advanced Concepts In Operating Systems", McGraw Hill Series in Computer Science, 1994.
2. Buyya R., Broberg J., Goscinski A., "Cloud Computing: Principles and Paradigm", John Wiley, 2011.
3. John W. Rittinghouse, James F. Ransome, "Cloud Computing: Implementation "Management and Security", CRC Press, 2010.

Online courses

3. https://www.digimat.in/nptel/courses/video/106105167
4. https://www.mooc-list.com/course/cloud-application-security-coursera
5. https://www.digimat.in/nptel/courses/video/106106168

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1.	**Distributed Systems**		CO1
1.1	Introduction, Characteristics, Issues in Distributed Systems	1	CO1
1.2	Distributed System Model, Request/Reply Protocols, RPC, RMI	2	CO1
1.3	Logical Clocks and Casual Ordering of Events	1	CO1
2	**Mutual Exclusion and Deadlock Detection Algorithms**		CO2
2.1	Election Algorithm , Distributed Mutual Exclusion	2	CO2
2.2	Distributed Deadlock Detection Algorithms.	2	CO2
3	**Cloud Computing**		CO3
3.1	Introduction, Evolution of Cloud Computing, Cloud Characteristics, NIST	2	CO3
3.2	Elasticity in Cloud, On-demand Provisioning	1	CO3
3. 3	Cloud Computing Reference Architecture, Architectural Design Challenges	1	CO3
3.4	Deployment Models: Public, Private and Hybrid Clouds	2	CO3
3.5	Service Models: IaaS – PaaS – SaaS – Benefits of Cloud Computing	2	CO3

4	**Cloud Enabling Technologies**		CO4
4.1	Introduction to Web Service and Service Oriented Architecture, SOAP, RES	2	CO4
4.2	Basics ofVirtualization, Full and Para Virtualization, Implementation Levels of Virtualization	2	CO4
4.3	Tools and Mechanisms, Virtualization of CPU, Memory, I/O Devices.	2	CO4
4.4	Desktop Virtualization, Server Virtualization.	2	CO4
5	**Cloud Management, Storage and Security**		CO5
5.1	Resource Provisioning and Methods, Cloud Management Products	1	CO5
5.2	Cloud Storage, Provisioning Cloud Storage, Managed and Unmanaged Cloud Storage	2	CO5
5.3	Cloud Security Overview, Cloud Security Challenges, Security Architecture design	1	CO5
5.4	Virtual Machine Security, Application Security, Data Security.	2	CO5
6	**Cloud Software and Computing Platforms**		CO6
6.1	DFS, Map Reduce	1	CO6
6.2	Google App Engine (GAE), Programming Environment for GAE, Architecture of GFS	2	CO6
6.3	**Case Studies**: Openstack, Heroku, Docker Containers, Amazon EC2, AWS, Microsoft Azure, Google Compute Engine.	3	CO6
	TOTAL	**36**	

Course Designers:

1. Mrs.P.Suganthi psica@tce.edu

21CBRA0	USABILITY DESIGN OF SOFTWARE APPLICATIONS

Category	L	T	P	Credit	Exam Type
PEES	3	0	0	3	Theory

Preamble

The course emphasizes creating user-friendly software applications by incorporating the principles of smart design and user experience design. Through this course, learners will get acquainted with user- friendly and interactive user interfaces for software applications. This course provides a deep understanding of how users of a software application can achieve the specified goals easily.

Prerequisite

NIL

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage in %
CO1	Understand the basic concepts of user-centered software design process	15
CO2	Describe the various aspects of user-centered design for real world problems.	15
CO3	Apply the heuristic principles to evaluate the interactive design for software applications.	25
CO4	Perform usability testing to redesign projects during the design life cycle.	15
CO5	Apply user experience (UX) design to digital artifacts.	15
CO6	Apply the design thinking technique for product development.	15

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	Guided Response	1.2, 4.3.2
CO2	TPS3	Understand	Respond	Guided Response	1.2, 4.3.2
CO3	TPS3	Apply	Value	Mechanism	1.2, 2.1.2, 3.2.3, 4.3.2
CO4	TPS3	Apply	Value	Mechanism	1.2, 2.1.2, 3.2.3, 4.5.3
CO5	TPS3	Apply	Value	Mechanism	1.2, 2.1.2, 3.2.3, 4.5.3
CO6	TPS3	Apply	Value	Mechanism	1.2, 2.1.2, 3.2.3, 4.5.3

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO 8	PO9	PO 10	PO 11	PO 12	PSO1	PSO 2	PSO 3
CO1	M	L											L		
CO2	S	M	L			L	L	L		L		L	M	L	L
CO3	S	M	L			L	L	L		L		L	M	L	L
CO4	S	M	L			L	L	L		L		L	M	L	L
CO5	S	M	L			L	L	L		L		L	M	L	L
CO6	S	M	L	L		L	L	L		L		L	M	L	L

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive levels	Continuous Assessment Tests		Assignments		Terminal examination
	1	2	1	2	
Remember	20	10			10
Understand	20	30	30		30
Apply	60	60	70	100	60
Analyse					
Evaluate					
Create					

Sample Questions for Course Outcome Assessment**

Course Outcome 1(CO1):

1. What are the elements of user centered design?
2. Briefly explain UCD Process.
3. Explain in detail about Agile aspects of user centered design

Course Outcome 2(CO2):

1. Explain User Cantered design Process to evaluate the following case study

Consider a system that includes a Web server and two database servers. Both Database servers are identical: the first acts as a main server, and the second acts as a redundant back-up in case the first one fails. Users use Web browsers to access data through the Web server. They also have the option of using a proprietary client that accesses the databases directly.

2. Explain the Ergonomics for mobile for the left hand side user.
3. "User Centered Design is a Multi Disciplinary Process" Comment your answers with an example.

Course Outcome 3(CO3):

1. Illustrate the various principles of Heuristic evaluation.
2. Examine the importance of Heuristic Evaluation for OS development
3. Experiment the frustrating experiences and error messages for the devices you have discussed and list the ways to improvise it for customer need

Course Outcome 4 (CO4):

1. Look at the entire competitive landscape to find all the mousetraps that exist and document what makes them tick. Conduct comparative research on other companies to see if there are products that achieve a similar goal in a different way.
2. How do we adapt and model all of our old design patterns to this new design system?
3. Illustrate the look and feel effect in Mac OS and Windows OS

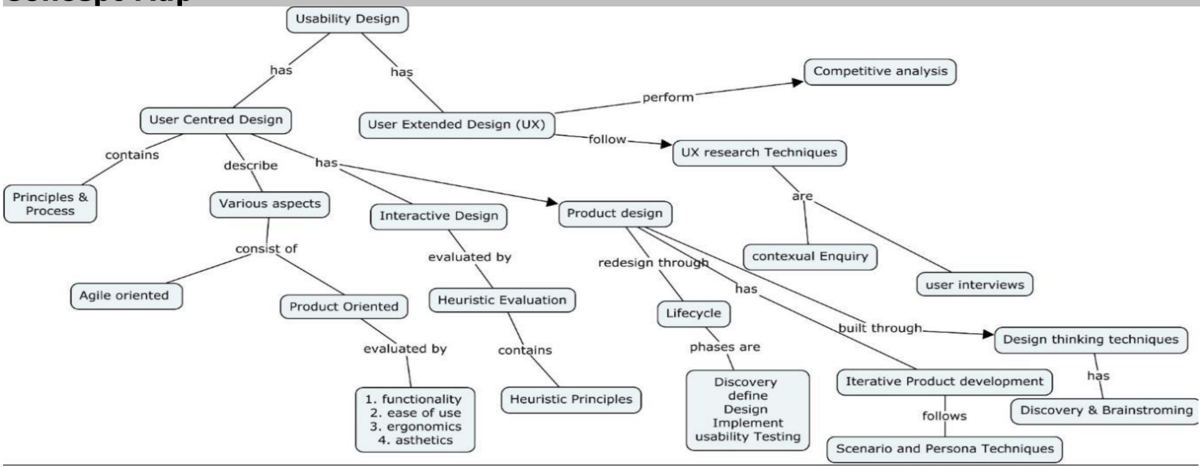
Course Outcome 5 (CO5):

1. Design a User Interface for hand gestures as a mode of interaction for children with cognitive challenges
2. How to conduct UX research with usability testing?
3. If tasked to perform a UX evaluation of a product, what would your process look like to accomplish this? Can you tell me about a project you did this for and what the outcome of the evaluation was?

Course Outcome 6(CO6):

1. Apply the story board for the game console you are developing
2. Illustrate the Speech Based Mobile Interface for the Textually Low Literate
3. Practice Interactive Information Platform for Remote Health Care
4. Illustrate with an example how to create user personas.

Concept Map



Syllabus

Introduction to User Centered Design

Basics of User Centered Design – Elements – Models and approaches – User Centered Design Principles – Usability – UCD Process – Agile Aspects of User Centered Design

Aspects of User Centered Design

Product Appreciation Assignment – Evaluating the product from user centered design aspects such as functionality, ease of use, ergonomics and aesthetics

Interactive Design Evaluation

Introduction to Interactive design process – Interactive design in practice – Introducing evaluation – Evaluation: Inspection, Analysis and Models – Heuristic Evaluation: 10 Heuristic principles, Examples – Group Assignment initiation (Website and App) – Evaluation for key tasks of the app or website for heuristic principles, severity, recommendations.

Project Design Life Cycle

Redesign project through the design lifecycle – Discovery – Define – Design – Implement – usability Testing

User Experience Design

Understanding user – their goals – context of use and environment of use Research Techniques: Contextual Enquiry, User Interviews – Competitive Analysis of UX

Product Development

Scenarios and Persona Technique – Overview of Design Thinking Techniques – Discovery and Brainstorming – Concept Development – Task flow detailing for the project – Prototyping Techniques – Paper, Electronic and Prototyping tools.

Learning Resources

1. Jenny Preece, Helen Sharp and Yvonne Rogers, "Interaction Design: Beyond Human- Computer Interaction", 5th Edition Wiley publications, 2019.
2. Elizabeth Goodman, Mike Kuniavsky, Andrea Moed, "Observing the User Experience A Practitioner's Guide to User Research", 2nd Edition Morgan Kaufmann publications, 2012.
3. Jesse James Garrett, "The Elements of User Experience: User-Centered Design for the Web and Beyond", 2nd Edition, Pearson Education, 2010.
4. Jonny Schneider, "Understanding Design Thinking, Lean, and Agile", 3rd edition, Orielly publications, 2014

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1.	**Introduction to User Centred Design**		
1.1	Basics of User Centred Design	1	CO1
1.2	Elements – Models and approaches	1	CO1
1.3	Usability – UCD Process	1	CO1
1.4	User Centred Design Principles	1	CO1
1.5	Agile Aspects of User Centred Design	1	CO1
2.	**Aspects of User Centred Design**		

2.1	Product Appreciation Assignment	1	CO2
2.2	Evaluating the product from user centered design	1	CO2
2.3	Evaluating the product from user centered design aspects : ease of use	1	CO2
2.4	Evaluating the product from user centered design aspects : ergonomics	1	CO2
2.5	Evaluating the product from user centered design aspects : aesthetics	1	CO2
3.	**Interactive Design Evaluation**		
3.1	Introduction to Interactive design process	1	CO3
3.2	Interactive design in practice	1	CO3
3.3	Introducing evaluation – Evaluation: Inspection, Analysis and Models	2	CO3
3.4	Heuristic Evaluation: 10 Heuristic principles	2	CO3
3.5	Examples – Group Assignment initiation (Website and App) – Evaluation for key tasks of the app or website for heuristic principles, severity, recommendations.	2	CO3
4.	**Project Design Life Cycle**		
4.1	Redesign project through the design lifecycle – Discovery – Define – Design – Implement	2	CO4
4.2	Usability Testing	2	CO4
5.	**User Experience Design**		
5.1	Understanding user	1	CO5
5.2	Understanding their goals	1	CO5
5.3	context of use	1	CO5
5.4	environment of use Research Techniques	1	CO5
5.5	Contextual Enquiry	1	CO5
5.6	User Interviews	1	CO5
5.7	Competitive Analysis of UX	1	CO5
6.	**Product Development**		
6.1	Scenarios and Persona Technique	1	CO6
6.2	Overview of Design Thinking Techniques	1	CO6
6.3	Discovery and Brainstorming	1	CO6
6.4	Concept Development	1	CO6
6.5	Task flow detailing for the project	1	CO6
6.6	Prototyping Techniques – Paper, Electronic and Prototyping tools.	2	CO6
	Total	**36**	

Course Designer:

1. Mr.V.Janakiraman vjncse@tce.edu

21CBRB0	IMAGE PROCESSING AND PATTERN RECOGNITION

Category	L	T	P	Credit	Terminal Exam Type
PEES	3	1	0	4	Theory

Preamble

This course on Image Processing and Pattern Recognition is designed to provide students with a comprehensive understanding of digital image processing techniques and their practical applications. The course covers the fundamental concepts of image formation and registration, image transformation and filtering, image segmentation and morphological operations, color models and processing, feature extraction techniques, and real-time applications in industries, medicine, and remote sensing.

Prerequisite

Nil

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Explain the basics of image formation and registration techniques	10%
CO2	Perform image transformation functions and filtering operations on images	15%
CO3	Demonstrate the various image segmentation and morphological operations for partition of objects	25%
CO4	Apply the knowledge of different color models and its processing techniques on images	20%
CO5	Illustrate various feature extraction techniques and recognize the images for real world applications	20%
CO6	Implement the image processing techniques for various real-time applications such as industry, medicine and remote sensing	10%

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	Guided Response	1.2, 4.3.2
CO2	TPS3	Apply	Value	Mechanism	1.2, 2.2, 2.3.1, 2.3.2, 3.1.4, 3.1.5
CO3	TPS3	Apply	Value	Mechanism	1.2, 2.3.1, 2.3.2, 2.3.3, 4.4.1, 4.5.3, 4.5.5
CO4	TPS3	Apply	Value	Mechanism	1.2, 2.2, 2.3.1, 2.3.2, 3.1.4, 3.1.5
CO5	TPS3	Apply	Value	Mechanism	1.2, 2.2, 2.3.1, 2.3.2, 3.1.4, 3.1.5
CO6	TPS3	Apply	Value	Mechanism	1.2, 4.3.4, 4.5.3, 4.5.6, 4.6.1

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	L											L		
CO2	S	M	L			L	L	L		L		L	M	L	L
CO3	S	M	L			L	L	L		L		L	M	L	L
CO4	S	M	L			L	L	L		L		L	M	L	L

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

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive levels	Continuous Assessment Tests		Assignments		Terminal examination
	1	2	1	2	
Remember	20	20			20
Understand	30	30	30		30
Apply	50	50	70	100	50
Analyse					
Evaluate					
Create					

Assessment Pattern: Psychomotor

Psychomotor Skill	Miniproject /Assignment/Practical Component
Perception	
Set	
Guided Response	30
Mechanism	70
Complex Overt Responses	
Adaptation	
Origination	

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 appropriate Image processing technique

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)

- Application identification and data set collection
- Perform feature selection and other image processing techniques such as filtering, segmentation and color processing
- Reporting the results and performance analysis for the chosen techniques
- Documentation

Some of the Mini-project titles may include: (but not limited to) • Face recognition
Number plate recognition • Posture recognition • Precision Agriculture • Disease Identification • Wound detection • Cancer detection

Sample Questions for Course Outcome Assessment**

Course Outcome 1(CO1):

1.What is Quantization?

2.What is meant by image formation, and how do different registration techniques affect it?

3.Explain the difference between geometric and photometric models used in image registration. Discuss their strengths and weaknesses.

Course Outcome 2(CO2):

1.Write detailed note on Sharpening Spatial Filters

2.Describe the benefits of Histogram in Image processing.

Course Outcome 3(CO3):

1.Explain the role of image transformation functions in filtering operations. Give examples of spatial filtering techniques.

2.What are the different edge detection techniques used in image segmentation, and how do they link and detect edges?

Course Outcome 4 (CO4):

1.Define colour models used in image processing. What are the differences between RGB, CMY, HSI, YCbCr, and Lab models?
2.Differentiate false colour and pseudo colour

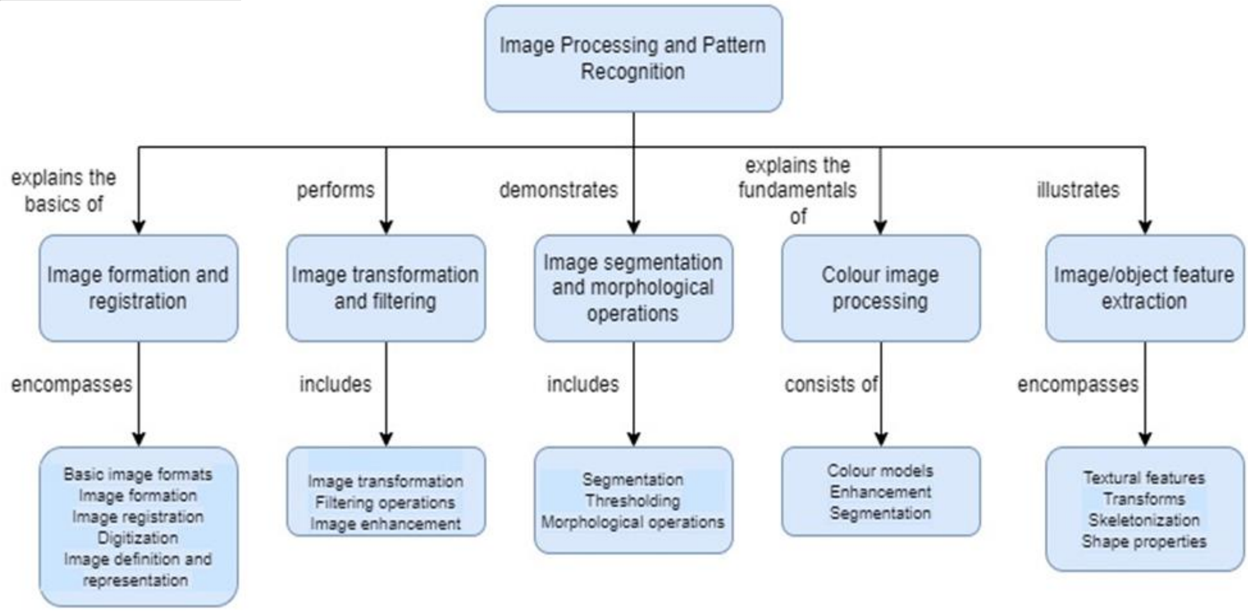
Course Outcome 5 (CO5):

1. Describe the different textural features used in image processing. How are they used for feature extraction? Give examples of their applications.
2.What is meant by skeletonization?

Course Outcome 6(CO6):

1. Explain in detail the image processing techniques used for various real-time applications such as industry, remote sensing and medicine.
2. Illustrate the various image processing techniques.

Concept Map



Syllabus

Introduction Basics of image formation and registration techniques Image processing systems and its applications. Basic image file formats. Image formation- Image Registration-Geometric and photometric models; Digitization - sampling, quantization; Image definition and its representation, neighbourhood metrics.

Image transformation functions and filtering operations Intensity transformations and spatial filtering: Enhancement, contrast stretching, histogram specification, local contrast enhancement; Smoothing, linear and order statistic filtering, sharpening, spatial convolution, Gaussian smoothing, DoG, LoG.

Image segmentation and morphological operations Segmentation: Pixel classification; Grey level thresholding, global/local thresholding; Optimum thresholding - Bayes analysis, Otsu method; Derivative based edge detection operators, edge detection/linking, Canny edge detector; Region growing, split/merge techniques, line detection, Hough transform. Morphological Filtering Basics: Dilation and Erosion Operators, Top Hat Filters.

Colour image processing: Fundamentals of different colour models - RGB, CMY, HSI, YCbCr, Lab; False colour; Pseudo colour; Enhancement; Segmentation.

Image/Object features extraction: Textural features - gray level co-occurrence matrix; Moments; Connected component analysis; Convex hull; Distance transform, medial axis transform, skeletonization/thinning, shape properties.

Learning Resources

Text Books:

1. R. C. Gonzalez and R. E. Woods, "Digital Image Processing", Prentice Hall, 4th Edition,2017

Reference Books:

1. Pitas, "Digital Image Processing - Algorithms and Applications", John Wiley,2010.

2. Frank Y. Shih, "Image Processing and Pattern Recognition: Fundamentals and Techniques", Wiley-IEEE Press, 2010
3. Anil K Jain, "Fundamentals of Digital Image Processing", Prentice Hall of India (PHI).

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1	**Introduction - Basics of image formation and registration techniques**		CO1
1.1	Image processing systems and its applications-Basic image file formats.	1	
1.2	Image formation- Image Registration-Geometric and photometric models	2	
1.3	Digitization - sampling, quantization	2	
1.4	Image definition and its representation-neighbourhood metrics	1	
2	**Image transformation functions and filtering operations**		CO2
2.1	Intensity transformations and spatial filtering	2	
2.2	Enhancement-contrast stretching-histogram specification-local contrast enhancement	2	
2.3	Smoothing, linear and order statistic filtering	1	
2.4	Sharpening-spatial convolution-Gaussian smoothing	2	
2.5	DoG-LoG	1	
3	**Image segmentation and morphological operations**		CO3
3.1	Segmentation-Pixel classification-Grey level thresholding-global/local thresholding	3	
3.2	Optimum thresholding - Bayes analysis, Otsu method-Derivative based edge detection operators- edge detection/linking-Canny edge detector	4	
3.3	Region growing-split/merge techniques-line detection-Hough transform	3	
3.4	Morphological Filtering Basics-Dilation and Erosion Operators-Top Hat Filters.	2	
4	**Colour image processing**		CO4
4.1	Fundamentals of different colour models - RGB, CMY, HSI, YCbCr, Lab	3	
4.2	False colour-Pseudo colour	3	
4.3	Enhancement- Segmentation.	3	
5	**Image/Object features extraction**		CO5
5.1	Textural features - gray level co-occurrence matrix-Moments	3	
5.2	Connected component analysis-Convex hull-Distance transform- medial axis transform	3	
5.3	Skeletonization/thinning- shape properties	3	
6.	Applying image processing techniques for an application	5	CO6
	Total No of Hours	**48**	

Course Designer:

1. Dr.P.Chitra pccse@tce.edu

21CBRC0	DATA VISUALIZATION

Category	L	T	P	Credit	**Terminal Exam Type**
PEES	3	0	0	3	Theory

Preamble

This course will help the students to understand the need of data visualization and guide them to represent an abstract view of data. To learn the various tools that provides an easy way to understand the trends, outliers and patterns in the data. To analyse a massive volume of data, the data visualization techniques are considered as an essential tool.

Prerequisite

NIL

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Explain the foundations and characteristics of data representation	15
CO2	Illustrate the basic concepts of data visualization and the levels of validation	20
CO3	Explore the data for analysing the knowledge through 2D data visualization	15
CO4	Develop a 3D visualization by interpreting the given data	15
CO5	Analyse the given data using various visualization tools such as rank analysis, Trend Analysis, etc.	20
CO6	Interpret various forms of data such as tables, spatial data, geometric data, etc.	15

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond		1.2,2.1.5,2.2.3,2.5.1,3.2.3, 4.5.3
CO2	TPS2	Understand	Respond		1.2,2.1.5,2.2.3,2.5.1,3.2.3, 4.5.3
CO3	TPS3	Apply	Value		1.2,2.1.5,2.2.3,2.5.1,3.2.3, 4.5.3
CO4	TPS3	Apply	Value		1.2,2.1.5,2.2.3,2.5.1,3.2.3, 4.5.3
CO5	TPS3	Apply	Value		1.2,2.1.5,2.2.3,2.5.1,3.2.3, 4.5.3
CO6	TPS3	Apply	Value		1.2,2.1.5,2.2.3,2.5.1,3.2.3, 4.5.3

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	M	L	L	L		L		L			L	L	L	L	L
CO 2	M	L	L	L		L		L			L	L	L	L	L
CO 3	S	M	L	L		L		L			L	L	M	L	L

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

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Test		Assignment		Terminal Examination
	I	II	I	II	
Remember	20	20			20
Understand	40	20	50		20
Apply	40	60	50	100	60
Analyse					
Evaluate					
Create					

Assessment Pattern: Psychomotor

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

Sample Questions for Course Outcome Assessment**

Course Outcome 1(CO1):

1. Write a Python program to display grid and draw line charts of the closing value of Alphabet Inc.between October 3, 2016 to October 7, 2016. Customized the grid lines with linestyle -, width .5.and color blue.
2. Define data visualization. Illustrate how data visualization is better than the traditional text based data methods.
3. Which types of features can can the human eye easily pick out of a time series plot?

Course Outcome 2(CO2):

1. Explain visualization purpose and factors influencing a visual perception?
2. How does edges, contrast and colors affect Visual Perception?
3. Explain the following: i. Matplotlib ii. Seaborn iii. Plotly iv. ggplot

Course Outcome 3(CO3):

1. Write and explain in detail a python program for the following data x = [1,2,3,4,5,6]y =[2,4,1,5,2,6] .Customize the line with green coloured dashed line ,blue marker with size 12.
2. Write a Python program to display a horizontal bar chart of the popularity of programmingLanguages.Sample data:Programming languages: Java, Python, PHP, JavaScript, C#, C++Popularity: 22.2, 17.6, 8.8, 8, 7.7, 6.7
3. Explain plotting a sine wave using Matplotlib

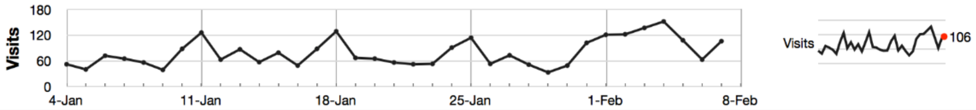
Course Outcome 4(CO4):

1. How gridlines can be used in Matplotlib. Explain it with the function and different options available

2. This question is an extension to visualizing more than 3 variables. Investigate on your own the term "scatterplot matrix", and draw one for the Food texture data set. Create an effective scatterplot matrix with the scatterplotMatrix function. List some bullet-points that interpret the plot.
3. Create a chart that shows the variability in website traffic for each day of the week.

Course Outcome 5(CO5):

1. Construct a correlation matrix using the core function of the data frame?
2. How can we visualize more than three dimensions of data in a single chart?
3. The data shown here are the number of visits to a university website for a particular statistics course. There are 90 students in the class.



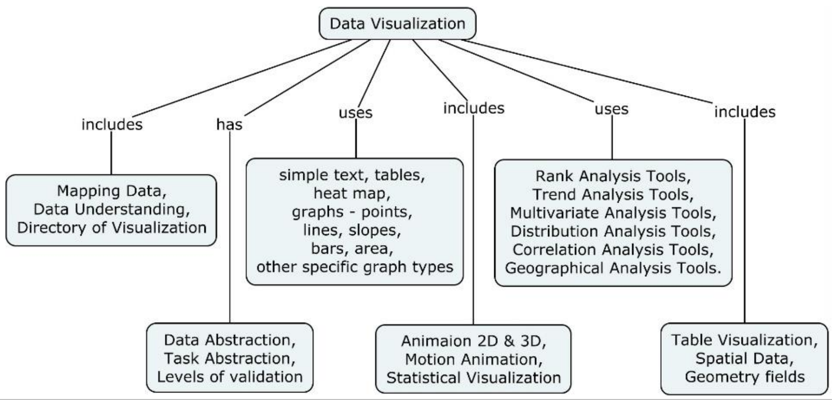
   a. What are the names (type) of the 2 plots shown?
   b. List any 2 interesting features in these data.

Course Outcome 6(CO6):

1. Construct a visualization graph to capture the track of a cab using GPS track logger.
2. With an example demonstrate different line style in a single graph.
3. Compare the defect types (number of defects) for different product grades (categories) given in the table. Which defects cost us the most money?

	Total defects	A	B	C	D	E
A4636	131	37	21	28		45
A2524	86	20	24	21	1	20
A3713	75	17	13	18		27
A4452	73	5	33	17		18
A4088	72	14	16	12	2	28
A2103	68	14	13	14	1	26
A2156	68	16	13	19	2	18
A3681	66	12	16	9	1	28
A1366	50	11	15	12		12
A2610	39	5	7	12		15
Total	**728**	**151**	**171**	**162**	**7**	**237**

Concept Map



Syllabus

From Data to Visualization - Mapping Data onto Aesthetics, Coordinate System and Axes Applications, Color Scales, Directory of Visualization – Amounts, Distribution, Proportions, x-y relationships, Geospatial Data, Uncertainity.

Foundation of data visualization – Need of visualization– understand the context, exploratory vs explanatory analysis, Difficulty in Validation. *Data Abstraction*: Dataset types, Attribute types, Semantics. *Task Abstraction*: Analyze, Produce, Search, Query. *Four levels of validation*: Validation approaches, Validation examples, Marks and Channel.

Visualization Techniques- simple text, tables, heat map, graphs - points, lines, slopes, bars, area, other specific graph types – pie, donut, Interactive Visualizations and Animations - Dynamic charts -

Dynamic maps - Animation types - 2D, 3D, Motion Animation - Animation Principles - Altair Package - Statistical Visualizations – Data Stories.

Data Visualization Tools: Rank Analysis Tools- Trend Analysis Tools- Multivariate Analysis Tools- Distribution Analysis Tools- Correlation Analysis Tools- Geographical Analysis Tools.

Visualize Tables and Spatial Data: Categorical regions - Spatial axis orientation - Spatial layout density. Arrange spatial data: Geometry - Scalar fields - Vector fields - Tensor fields.

Assessment for Assignment:
Students can for a team of 2 and perform visualization for various real time data analytics case studies using visualization tools such as Tableau, Zoho Analytics/Reports, Visual.ly, IBM Watson etc.

Learning Resources

Text Books:

1. Claus Wilke, 'Fundamentals of Data Visualization:A Primer on Making Informative and Compelling Figures", O'Reilly Media, 2019.
2. Alexandru Telea, 'Data Visualization:Principles and Practice, Second Edition', Taylor & Francis, 2015.

Reference Books:

1. Kyran Dale, 'Data Visualization with Python and JavaScript Scrape, Clean, Explore & Transform Your Data', O'Reilly Media, 2016.
2. Ware C and Kaufman M, 'Visual thinking for design', Morgan Kaufmann Publishers, 2008.
3. Chakrabarti S, 'Mining the web: Discovering knowledge from hypertext data', Morgan Kaufman Publishers, 2003.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1	**From Data to Visualization**		
1.1	Mapping Data onto Aesthetics, Coordinate System and Axes Applications, Color Scales,	2	CO1
1.2	Directory of Visualization – Amounts, Distribution, Proportions,	2	CO1
1.3	x-y relationships, Geospatial Data, Uncertainity.	1	CO1
2	**Foundation of data visualization**		
2.1	Need of visualization– understand the context, exploratory vs explanatory analysis, Difficulty in Validation.	2	CO2
2.2	Data Abstraction: Dataset types, Attribute types, Semantics.	2	CO2
2.3	Task Abstraction: Analyze, Produce, Search, Query.	2	CO2
2.4	Four levels of validation: Validation approaches, Validation examples, Marks and Channel.	1	CO2
3	**Visualization Techniques**		
3.1	Simple text, tables, heat map, graphs	2	CO3
3.2	Points, lines, slopes, bars, area, other specific graph types	2	CO3
3.3	Pie, donut, Interactive Visualizations	2	CO3
4	**Animations**		
4.1	Dynamic charts - Dynamic maps	2	CO4
4.2	Animation types - 2D, 3D, Motion Animation - Animation Principles	2	CO4
4.3	Altair Package - Statistical Visualizations – Data Stories	2	CO4

5	**Data Visualization Tools**:		
5.1	Rank Analysis Tools- Trend Analysis Tools-	2	CO5
5.2	Multivariate Analysis Tools	2	CO5
5.3	Distribution Analysis Tools	1	CO5
5.4	Correlation Analysis Tools	1	CO5
5.5	Geographical Analysis Tools.	1	CO5
6	**Visualize Tables and Spatial Data**:		
6.1	Categorical regions	1	CO6
6.2	Spatial axis orientation - Spatial layout density	1	CO6
6.3	Arrange spatial data: Geometry	1	CO6
6.4	Scalar fields - Vector fields - Tensor fields	2	CO6
	TOTAL	**36**	

Course Designer:

1. Dr. A. Malini amcse@tce.edu
2. Mrs. J. Felicia Lilian jflcse@tce.edu

21CBRD0	LOGISTICS MANAGEMENT

Category	L	T	P	Credit	Terminal Exam Type
PEES	3	0	0	3	Theory

Preamble

This course emphasis on students to create the role of logistics in a market-oriented society and examine the major functions of logistics, and also students will improve the employability and open up career paths such as inventory planning, distribution plans, warehouse management.

Prerequisite

NIL

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage in%
CO1	Understand the fundamental concepts of logistics and its management	10
CO2	Apply the various principles & concepts of logistics management to help and manage supply chain operations.	15
CO3	Apply the logistics KPI metrics & strategies against industry benchmark.	20
CO4	Apply collaborative planning, forecasting, and replenishment for supply chain integration.	20
CO5	Apply the global logistics strategies for improving the performance of a company.	15
CO6	Apply the sustainable logistic principles for environmental sustainability, procurement and supplier management.	20

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	Guided Response	1.2, 4.3.2
CO2	TPS3	Apply	Value	Mechanism	1.2,2.1.2,3.2.3,4.5.3
CO3	TPS3	Apply	Value	Mechanism	1.2,2.1.2,3.2.3,4.3.2
CO4	TPS3	Apply	Value	Mechanism	1.2,2.1.2,3.2.3,4.5.3
CO5	TPS3	Apply	Value	Mechanism	1.2,2.1.2,3.2.3,4.5.3
CO6	TPS3	Apply	Value	Mechanism	1.2,2.1.2,3.2.3,4.5.3

Mapping with Programme Outcomes and Programme Specific Outcomes

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

S-Strong;M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive levels	Continuous Assessment Tests		Assignments		Terminal examination
	1	2	1	2	
Remember	20	10			20
Understand	20	30	30		20
Apply	60	60	70	100	60
Analyze					
Evaluate					
Create					

Assessment Pattern: Psychomotor

Psychomotor Skill	Mini project/Assignment/Practical Component
Perception	
Set	
Guided Response	30
Mechanism	70
Complex Overt Responses	
Adaptation	
Origination	

Sample Questions for Course Outcome Assessment****

Course Outcome 1(CO1):

1. Define logistics.
2. Describe about Current trends and challenges in logistics management.
3. Explain the key objectives of logistic management.

Course Outcome 2(CO2):

1. The following are monthly costs incurred by Transport Company. Identify the basic costs of transportation. Rent of container Rs. 1,20,00,000, Rent of office Rs. 27,500, Diesel cost Rs.80,000,Driversalary Rs. 15,000, Cleaner salary 5,000, Vehicle repairs Rs.45,000, LoadingandunloadingcostsRs.25,000
2. Indian Oil Company wish supply LP gas to its customers for cooking purpose at cheaper rate by minimizing its transport costs? What is best means of transport?
3. Examine the need for inventory management.
4. Illustrate the concept of warehouse and examine its functions.

Course Outcome 3(CO3):

1. Illustrate how to achieve integration in logistics.
2. Develop are sources and logistics required in setting up a therapeutic drug monitoring services?
3. Illustrate the various strategies involved in logistics management.

Course Outcome 4(CO4):

1. Draw a graph illustrating the bullwhip effect and discuss its impact on the measures of supply chain performance.
2. Construct a unified view of Vendor-managed inventory (VMI) in automobile industries.
3. Illustrate the role of logistics in supply chain strategies

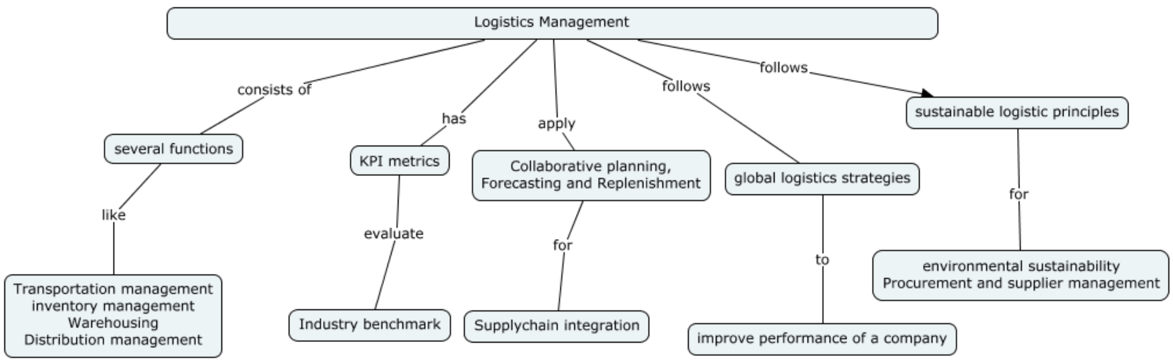
Course Outcome 5(CO5):

1. Illustrate with an example for Inco terms and international shipping terms
2. Explain in detail about trading.
3. Demonstrate the role of global logistics in SCM.

Course Outcome 6(CO6):

1. Expose the massive importance of Green Logistics and its major drivers.
2. Explain the feasible methods to achieve Supply chain Sustainability?
3. Elaborate the different stages in EIA.

Concept Map



Syllabus

Introduction to Logistics and Logistics Management

Definition and scope of logistics - Key objectives of logistics management - Evolution of logistics management- Current trends and challenges in logistics management

Transportation, Inventory, Warehousing, and Distribution Management

Transportation Management: Modes of transportation (land, sea, air)-Carrierselectionandnegotiation-Routingandscheduling-Transportationcostmanagement

Inventory Management: Types of inventories - Inventory costs and trade-offs - Inventory control policies (e.g., EOQ, safety stock, JIT)-Inventory performance metrics

Warehousing and Distribution: Types of warehouses and distribution centers - Design and layout of warehouses-Warehouse operations (e.g., receiving, put away, picking, packing)-Warehouse performance metrics

Logistics Performance, Strategy

Logistics Performance Measurement: Key performance indicators (KPIs) in logistics – Balanced score card approach to logistics performance measurement- Benchmarking and continuous improvement- Linking logistics performance to overall business performance

Logistics Strategy: Strategic role of logistics – Definition-role of logistics managers in strategic decisions-Strategy options, Lean Strategy, Agile Strategies & Other strategies-Designing & implementing a logistical strategy

Logistics Integration

Supply Chain Integration: Role of logistics in supply chain management - Collaborative planning, forecasting, and replenishment (CPFR) -Vendor-managed inventory (VMI)-Electronic data interchange (EDI) and other supply chain technologies

Global Logistics and Trade

International trade regulations and compliance-Inco terms and international shipping terms - Customs clearance and documentation - Global logistics strategies and challenges, Emerging Topics in Logistics Management - E-commerce logistics - Omni-channel logistics –Artificial intelligence and automation in logistics

Sustainable Logistics

Sustainability in Logistics - Overview of sustainable logistics - Importance of sustainable logistics Key sustainability challenges in logistics-Environmental

Sustainability in Logistics-Greenhouse gas emissions and carbon footprint of logistics operations-Sustainable transportation modes (e.g., electric vehicles, bicycles)-Sustainable packaging and materials handling - Labor rights and ethical considerations in logistics operations - Workforce diversity and inclusion-Health and safety in logistics operations Sustainable procurement and supplier management-Sustainable logistics network design and optimization - Return on investment (ROI) of sustainable logistics initiatives.

Learning Resources

1. SL.Ganapathi, SK.Nandhi," Logistics Management", 1st edition oxford university press, 2016.
2. Ram Singh, "International trade Logistics", 1st edition oxford university press, 2018.
3. Vinod.V.Sople "Logistics Management –The Supply Chain Imperative", 3rd edition, Pearson Education, 2016.

Course Contents and Lecture Schedule

Module No.	Topic	No.of Hours	Course Outcome
1	**Introduction to Logistics and Logistics Management**		
1.1	Definition and scope of logistics	1	CO1
1.2	Key objectives of logistics management	1	CO1
1.3	Evolution of logistics management	1	CO1
1.4	Current trends and challenges in logistics management	1	CO1
	Transportation, Inventory, Warehousing, and Distribution Management		
2.1	Transportation Management: Modes of transportation (land, sea, air)	1	CO2
2.2	Carrier selection and negotiation - Routing and scheduling - Transportation cost management	1	CO2
2.3	Inventory Management: Types of inventories	1	CO2
2.4	Inventory costs and trade-offs		
2.5	Inventory control policies (e.g., EOQ, safety stock, JIT)-Inventory Performance metrics	1	CO2
2.6	**Warehousing and Distribution:** Types of warehouses and distribution centers	1	CO2
2.7	Design and layout of warehouses	1	CO2
2.8	Warehouse operations (e.g.,receiving,putaway,picking,packing)-Warehouse performance metrics	1	CO2
	Logistics Performance, Strategy, and Integration		
3.3	Logistics Performance Measurement: Key performance indicators(KPIs) in logistics	1	CO3
3.2	Balanced scorecard approach to logistics performance measurement	1	CO3

3.3	Benchmarking and continuous improvement		CO3
3.4	Linking logistics performance to overall business performance	1	CO3
3.5	Logistics Strategy: Strategic role of logistics–Definition-role of logistics managers in strategic decisions	1	CO3
3.6	Strategy options, Lean Strategy, Agile Strategies &Other strategies	1	CO3
3.7	Designing &implementing a logistical strategy	1	CO3
	Supply Chain Integration		
4.1	Role of logistics in supply chain management	1	CO4
4.2	Collaborative planning, forecasting, and replenishment(CPFR)	1	CO4
4.3	Vendor-managed inventory(VMI)	1	CO4
4.4	Electronic data interchange (EDI) and other supply chain Technologies	2	CO4
	Global Logistics and Trade		
5.1	International trade regulations and compliance	1	CO5
5.2	Inco terms and international shipping terms	1	CO5
5.3	Customs clearance and documentation	1	CO5
5.4	Global logistics strategies and challenges	1	CO5
5.5	Emerging Topics in Logistics Management-E-commerce logistics	1	CO5
5.6	Omni-channel logistics		
5.7	Artificial intelligence and automation in logistics	1	CO5
	Sustainable Logistics		
6.1	Sustainability in Logistics-Overview of sustainable logistics	1	CO6
6.2	Importance of sustainable logistics Key sustainability challenges in logistics	1	CO6
6.3	Environmental Sustainability in Logistics-Green house gas emissions and carbon foot print of logistics operations	1	CO6
6.4	Sustainable transportation modes(e.g., electric vehicles, bicycles)- Sustainable packaging and materials handling	1	CO6
6.5	Labor rights and ethical considerations in logistics operations	1	CO6
6.6	Workforce diversity and inclusion-Health and safety in logistics Operations	1	CO6
6.7	Sustainable procurement and supplier management-Sustainable logistics network design and optimization	1	CO6
6.8	Return on investment (ROI)of sustainable logistics initiatives.	1	CO6
	Total	**36**	

Course Designer:

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2. Mr.V.Janakiraman vjncse@tce.edu

21CBQA0	DATA MINING FOR BUSINESS INTELLIGENCE	Category	L	T	P	Credit	Terminal Exam Type
		PEES	3	0	0	3	Theory

Preamble

Students will learn key quantitative techniques essential for analysing and improving business operations. Learn to apply important quantitative methods developed in the fields of data mining and business intelligence that are commonly used to solve business related problems. At the end of this course, students will better understand the need and appropriate place for data mining, the major techniques used in data mining, and the important pitfalls to avoid.

Prerequisite

NIL

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage** in %
CO1	Understand the principles of data mining, data pre-processing and data visualization techniques.	15
CO2	Identify an appropriate data mining technique for a given problem.	20
CO3	Apply various classification and clustering techniques using WEKA tool.	25
CO4	Apply common methods used in business intelligence by identifying Key Performance Indicators (KPI's), dashboards, reports and CRM concepts and solutions.	15
CO5	Implementation of a BI system by planning the resources and choosing the right size, shape, cost of architecture.	15
CO6	Solve practical problems using BI and provide needed decision support.	10

** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond		1.2,1.3,2.2,2.3,2.5.4,4.2
CO2	TPS3	Apply	Value		1.2,2.1,2.2,4.1,4.2
CO3	TPS3	Apply	Value		1.2, 2.1.2,4.4,4.5,4.6
CO4	TPS3	Apply	Value		1.2,2.3,4.2,4.3,4.4,4.5,4.6
CO5	TPS3	Apply	Value		1.2,2.1,2.3,4.5
CO6	TPS3	Apply	Value		1.2,2.1,2.5,3.1.5,4.3,4.5,4.6

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	L	L	L				L				M	M		L
CO2	S	M	M	L				L				M	S		L
CO3	S	M	S		M			L				M	S	L	L
CO4	S	S	M		M			L				M	M	L	L
CO5	S	S	M					L				M	M		L
CO6	S	S	M		M			L				M	M	L	L

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

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

Sample Questions for Course Outcome Assessment**

** (2 to 3 at the cognitive level of course outcome)

Course Outcome 1(CO1):

1. Define each of the following data mining functionalities: characterization, discrimination, association and correlation analysis, classification, regression, clustering, and outlier analysis. Give examples of each data mining functionality, using a real-life database that you are familiar with.
2. Present an example where data mining is crucial to the success of a business. What data mining functionalities does this business need (e.g., think of the kinds of patterns that could be mined)? Can such patterns be generated alternatively by data query processing or simple statistical analysis?
3. Suppose that the data for analysis includes the attribute age. The age values for the data tuples are (in increasing order) 13, 15, 16, 16, 19, 20, 20, 21, 22, 22, 25, 25, 25, 25, 30, 33, 33, 35, 35, 35, 35, 36, 40, 45, 46, 52, 70.
    - **a.** What is the mean of the data? What is the median?
    - **b.** What is the mode of the data? Comment on the data's modality (i.e., bimodal, trimodal, etc.).
    - **c.** What is the midrange of the data?
    - **d.** Can you find (roughly) the first quartile (Q1) and the third quartile (Q3) of the data?
    - **e.** Give the five-number summary of the data.
    - **f.** Show a boxplot of the data.
    - **g.** How is a quantile–quantile plot different from a quantile plot?

Course Outcome 2(CO2):

1. Explain the process of mining the World Wide Web.

2. Quantitative association rules may disclose exceptional behaviours within a data set, where "exceptional" can be defined based on statistical theory. Given the association rule
   Sex = female ⇒ mean wage = \$7.90/hr (overall mean wage = \$9.02/hr),
   Which suggests an exceptional pattern? The rule states that the average wage for females is only \$7.90 per hour, which is a significantly lower wage than the overall average of \$9.02 per hour. Discuss how such quantitative rules can be discovered systematically and efficiently in large data sets with quantitative attributes.
3. You are given the transaction data shown in the Table below from a fast food restaurant. There are 9 distinct transactions (order: 1 – order: 9) and each transaction involves between 2 and 4 meal items. There are a total of 5 meal items that are involved in the transactions. For simplicity we assign the meal items short names (M1 – M5) rather than the full descriptive names (e.g., Big Mac)

Metal Item	**List of item IDs**	**Metal Item**	**List of item IDs**
Order 1	M1, M2. M5	Order 6	M2, M3
Order 2	M2. M4	Order 7	M1, M3
Order 3	M2, M3	Order 8	M1, M2. M3, M5
Order 4	M1, M2, M4	Order 9	M1, M2, M3
Order 5	M1, M3		

   For all of the parts below the minimum support is 2/9 (.222) and the minimum confidence is 7/9 (.777). Note that you only need to achieve this level, not exceed it. Show your work for full credit (this mainly applies to part a).
   a. Apply the Apriori algorithm to the dataset of transactions and identify all frequent k itemset. Show all of your work. You must show candidates but can cross them off to show the ones that pass the minimum support threshold.
   b. Find all strong association rules of the form: X ^ Y ^ Z and note their confidence values.

Course Outcome 3(CO3):

1. Discuss the key issues of Hierarchical clustering methods.
2. Design an efficient method that performs effective naive Bayesian classification over an infinite data stream (i.e., you can scan the data stream only once). If we wanted to discover the evolution of such classification schemes (e.g., comparing the classification scheme at this moment with earlier schemes such as one from a week ago), what modified design would you suggest?
3. For the following medical diagnosis data, create a decision tree

Sore throat	**Fever**	**Swollen glands**	**Congestion**	**Headache**	**Diagnosis**
Yes	Yes	Yes	Yes	Yes	Strep throat
No	No	No	Yes	Yes	Allergy
Yes	Yes	No	Yes	No	Cold
Yes	No	Yes	No	No	Strep throat
No	Yes	No	Yes	No	Cold
No	No	No	Yes	No	Allergy
No	No	Yes	No	No	Strep throat
Yes	No	No	Yes	Yes	Allergy
No	Yes	No	Yes	Yes	Cold

Yes	Yes	No	Yes	Yes	Cold

Course Outcome 4 (CO4):

1. Create a visual to show the weather pattern in your city. Could you show together temperature, humidity, wind, and rain/snow over a period of time.
2. Businesses need a "two-second advantage" to succeed. What does that mean to you?
3. Assuming that data mining techniques are to be used in the following cases, identify whether the task required is supervised or unsupervised learning.
   i) Deciding whether to issue a loan to an applicant based on demographic and financial data (with reference to a database of similar data on prior customers).
   ii) In an online bookstore, making recommendations to customers concerning additional items to buy based on the buying patterns in prior transactions.
   iii) Identifying a network data packet as dangerous (virus, hacker attack) based on comparison to other packets whose threat status is known.

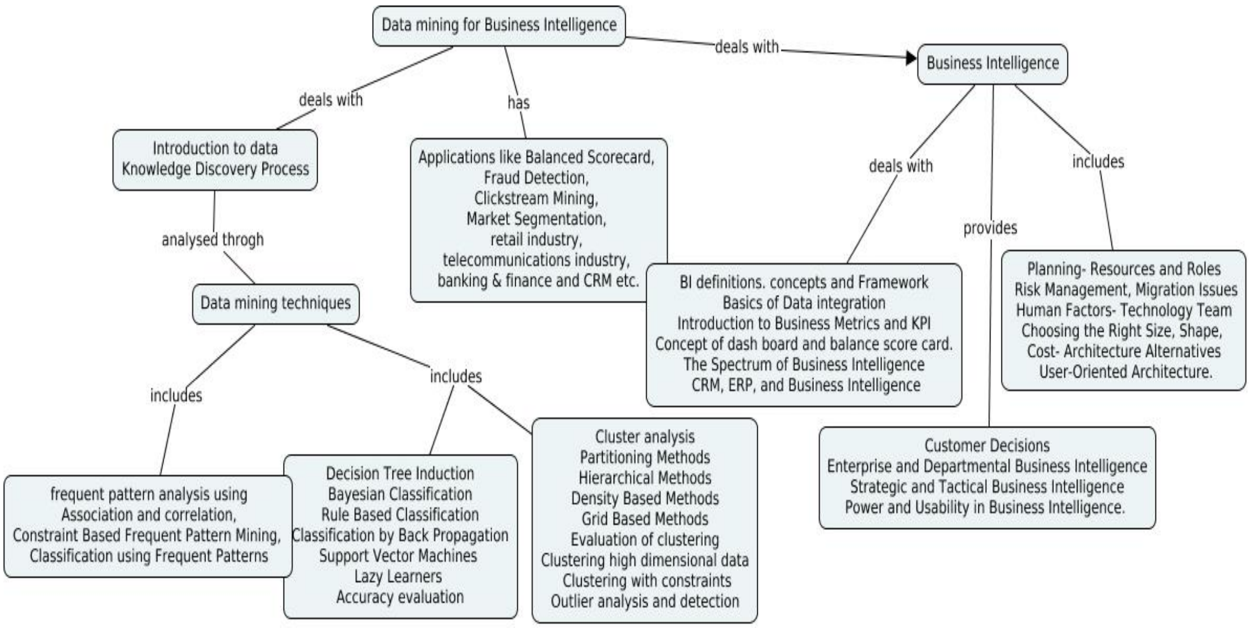
Course Outcome 5 (CO5):

1. How Optimization models are used for calls and product presentations planning?
2. Scenario: You are a new analyst for Acell, a company selling laptops. You have been provided with data about products and sales. Your task is to help the company to plan product strategy and pricing policies that will maximize Acell's projected revenues in 2009. Using an interactive visualization tool, answer the following questions.
   Price Questions
   a. At what prices are the laptops actually selling?
   b. Does price change with time? (Hint: Make sure that the date column is recognized as such. The software should then enable different temporal aggregation choices, e.g., plotting the data by weekly or monthly aggregates, or even by day of week.)
   c. Are prices consistent across retail outlets?
   d. How does price change with configuration?

Course Outcome 6(CO6):

1. How does big data impact the business models?
2. Here are a few comments from customer service calls received by Liberty.
   a. I loved the design of the shirt. The size fitted me very well. However, the fabric seemed flimsy. I am calling to see if you can replace the shirt with a different one. Or please refund my money.
   b. I was running late from work, and I stopped by to pick up some groceries. I did not like the way the manager closed the store while I was still shopping.
   c. I stopped by to pick up flowers. The checkout line was very long. The manager was polite but did not open new cashiers. I got late for my appointment.
   d. The manager promised that the product will be there, but when I went there the product was not there. The visit was a waste. The manager should have compensated me for my trouble.
   e. When there was a problem with my catering order, the store manager promptly contacted me and quickly got the kinks out to send me replacement food immediately. They are very courteous.
   Create a TDM with not more than six key terms. [Hint: Treat each comment as a document.]

Concept Map



Syllabus

Data Mining Systems

Introduction to Data Mining Systems – Knowledge Discovery Process – Data Mining Techniques – Issues – applications- Data Objects and attribute types, Statistical description of data, Data Pre-processing – Cleaning, Integration, Reduction, Transformation and discretization, Data Visualization, Data similarity and dissimilarity measures.

Frequent Pattern Analysis

Mining Frequent Patterns, Associations and Correlations – Mining Methods- Pattern Evaluation Method – Pattern Mining in Multilevel, Multi-Dimensional Space – Constraint Based Frequent Pattern Mining, Classification using Frequent Patterns

Classification and Clustering

Decision Tree Induction - Bayesian Classification – Rule Based Classification – Classification by Back Propagation – Support Vector Machines – Lazy Learners – Model Evaluation and Selection-Techniques to improve Classification Accuracy. Clustering Techniques – Cluster analysis-Partitioning Methods - Hierarchical Methods – Density Based Methods - Grid Based Methods – Evaluation of clustering – Clustering high dimensional data- Clustering with constraints, Outlier analysis-outlier detection methods- Weka tool.

Business performance management -BI definitions and concepts- BI Framework- Basics of Data integration- Introduction to Business Metrics and KPI – Concept of dash board and balance score card. The Spectrum of Business Intelligence- CRM, ERP, and Business Intelligence- Customer Decisions- Enterprise and Departmental Business Intelligence- Strategic and Tactical Business Intelligence- Power and Usability in Business Intelligence.

Business Intelligence Project Plan- Planning- Resources and Roles- Risk Management- Data Migration Issues- Human Factors- The Business Intelligence Technology Team- Choosing the Right Size, Shape, and Cost- Architecture Alternatives- User-Oriented Architecture.

Business Intelligence Applications: Data mining for business Applications like Balanced Scorecard, Fraud Detection, Clickstream Mining, Market Segmentation, retail industry, telecommunications industry, banking & finance and CRM etc.

Learning Resources

1. Jiawei Han, Micheline Kamber and Jian Pei, "Data Mining Concepts and Techniques", Third Edition, Elsevier Publisher, 2011.
2. Galit Shmueli, Nitin R. Patel, and Peter C. Bruce, Data Mining for Business Intelligence, 2nd Edition, Wiley, 2010.
3. Carlo Vercellis, Business Intelligence: Data Mining and Optimization for Decision Making,Wiley India Publications,2009.
4. Loshin D, "Business Intelligence", First Edition, Elsevier Science, 2003.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1.	**Data Mining Systems**		
1.1	Introduction to Data Mining Systems – Knowledge Discovery Process	1	CO1
1.2	Data Mining Techniques – Issues	1	CO1
1.3	applications- Data Objects and attribute types, Statistical description of data	1	CO1
1.4	Data Pre-processing – Cleaning, Integration, Reduction, Transformation and discretization,	1	CO1
1.5	Data Visualization, Data similarity and dissimilarity measures.	1	CO1
2	**Frequent Pattern Analysis**		
2.1	Mining Frequent Patterns, Associations and Correlations	1	CO2
2.2	Mining Methods- Pattern Evaluation Method	1	CO2
2.3	Pattern Mining in Multilevel, Multi-Dimensional Space	2	CO2
2.4	Constraint Based Frequent Pattern Mining	1	CO2
2.5	Classification using Frequent Patterns	2	CO2
3	**Classification and Clustering**		
3.1	Decision Tree Induction	1	CO3
3.2	Bayesian Classification – Rule Based Classification	1	CO3
3.3	Classification by Back Propagation – Support Vector Machines	1	CO3
3.4	Lazy Learners – Model Evaluation and Selection-Techniques to improve Classification Accuracy.	1	CO3
3.5	Clustering Techniques – Cluster analysis-Partitioning Methods	1	CO3
3.6	Hierarchical Methods – Density Based Methods - Grid Based Methods	1	CO3
3.7	Evaluation of clustering – Clustering high dimensional data	1	CO3
3.8	Clustering with constraints, Outlier analysis-outlier detection methods- Weka tool.	2	CO3
4	**Business performance management**		
4.1	BI definitions and concepts- BI Framework- Basics of Data integration	1	CO4
4.2	Introduction to Business Metrics and KPI – Concept of dash board and balance score card.	1	CO4
4.3	**The Spectrum of Business Intelligence-** CRM, ERP, and Business Intelligence- Customer Decisions	2	CO4
4.4	Enterprise and Departmental Business Intelligence	1	CO4

4.5	Strategic and Tactical Business Intelligence- Power and Usability in Business Intelligence.	1	CO4
5	**Business Intelligence Project Plan**		
5.1	Planning- Resources and Roles- Risk Management	1	CO5
5.2	Data Migration Issues- Human Factors- The Business Intelligence Technology Team	2	CO5
5.3	Choosing the Right Size, Shape, and Cost- Architecture Alternatives- User-Oriented Architecture	2	CO5
6	**Business Intelligence Applications**		
6.1	Balanced Scorecard, Fraud Detection, Clickstream Mining, Market Segmentation	2	CO6
6.2	Retail industry, telecommunications industry, banking & finance and CRM etc.	2	CO6
	TOTAL	**36**	

Course Designers:

1. R. Subhashni rsica@tce.edu

CURRICULUM AND DETAILED SYLLABI

FOR

B.TECH DEGREE (Computer Science and Business Systems) PROGRAMME

INDUSTRY SUPPORTED COURSES

FOR THE STUDENTS ADMITTED FROM THE

ACADEMIC YEAR 2020 – 2021 ONWARDS

THIAGARAJAR COLLEGE OF ENGINEERING

(A Government Aided ISO 9001-2008 Certified

Autonomous Institution affiliated to Anna University)

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20CB1A0	DEVOPS

Category	L	T	P	Credit
PEES	1	0	0	1

Preamble

The DevOps Foundation course provides a comprehensive overview of understanding the DevOps competencies needed to accelerate time-to-market by improving the flow of value through the continuous delivery pipeline. Students will map the current value stream through their delivery pipeline from idea to cash, and identify practices that will eliminate bottlenecks to flow

Prerequisite

NIL

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Gain insights into the DevOps environment and execute various Git commands	15
CO2	Managing authorization in Jenkins, Build and deploy codes using Jenkins and perform testing with selenium	15
CO3	Utilize Ansible CLI, execute Ansible Ad-Hoc Commands for one-off tasks and perform various actions using Docker CLI	20
CO4	Learn about Kubernetes Core Concept, Deploy Pods and scale your containerized Applications	20
CO5	Implementation of Devops using AWS cloud	15
CO6	Implement the latest releases such as Canary releases, Dark launches, Chaos Engineering	15

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	-	1.2, 1.3
CO2	TPS3	Apply	Value	-	1.2, 1.3, 2.1.2, 3.2.3, 4.5.3
CO3	TPS3	Apply	Value	-	1.2, 1.3, 2.1.2, 3.2.3, 4.3.2
CO4	TPS3	Apply	Value	-	1.2, 1.3, 2.1.2, 3.2.3, 4.5.3
CO5	TPS3	Apply	Value	-	1.2, 1.3, 2.1.2, 3.2.3, 4.5.3
CO6	TPS3	Apply	Value	-	1.2, 1.3, 2.1.2, 3.2.3, 4.5.3

Mapping with Programme Outcomes and Programme Specific Outcomes

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

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive levels	**CAT/Terminal Examination**
Remember	20
Understand	30
Apply	50
Analyse	0
Evaluate	0
Create	0

Sample Questions for Course Outcome Assessment**

Course Outcome 1(CO1):

1. Explain briefly about Devops life cycle
2. If you want to develop a new project in Devops platform what are the preparatory things you need?.
3. Suppose you want to configure GIT repository so that it runs the code sanity checking tooks before any commits? How do you prevent it from happening again if the sanity testing fails? And explain the basic GIT Commands

Course Outcome 2(CO2):

1. Explain in detail about architecture of Jenkins
2. Suppose you want to integrate the code in to shared repository how it will achieve?
3. How to automate Testing in DevOps lifecycle?
4. Which Testing tool are you comfortable with and what are the benefits of that tool?

Course Outcome 3(CO3):

1. Suppose you want to deploy the code how does Ansible work?
2. How exactly are containers (Docker in our case) different from hypervisor virtualization (vSphere)? What are the benefits?
3. Can I use json instead of yaml for my compose file in Docker?

Course Outcome 4 (CO4):

1. What are the main differences between the Docker Swarm and Kubernetes?
2. Give examples of recommended security measures for Kubernetes.
3. Consider you have 5-6 microservices for a single application performing various tasks, and all these microservices are put inside containers. How to make sure that these containers communicate with each other we need container orchestration?

Course Outcome 5 (CO5):

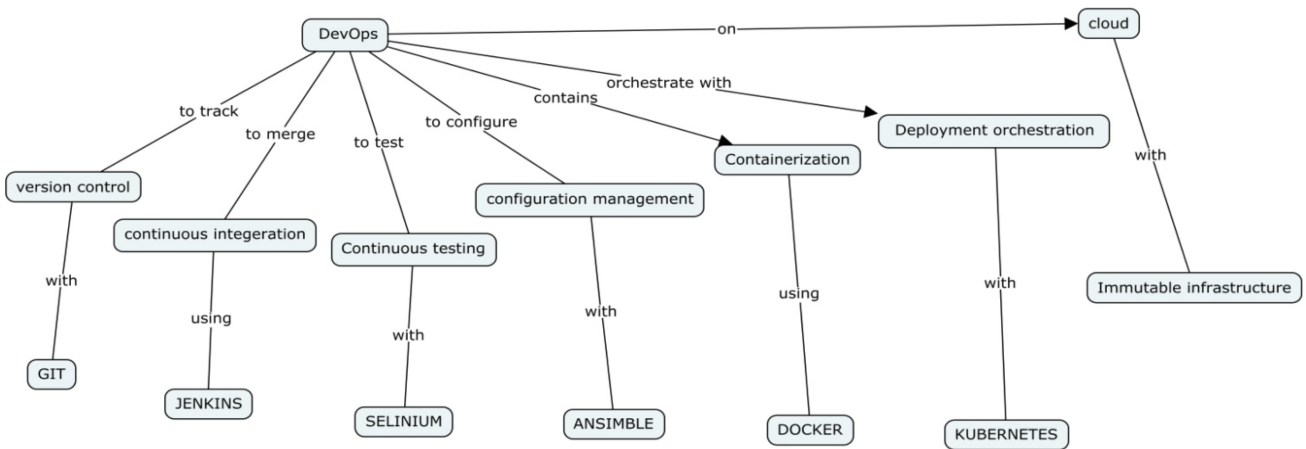
1. Explain with a use case where DevOps can be used in industry / real life.
2. Explain your understanding and expertise on both the software development side and the technical operations side of an organization you have worked with in the past?

Course Outcome 6(CO6):

1. How to achieve chaos engineering like netflix & amazon (with kolton andrus from gremlin)

2. Your software development teams want to release new product features frequently, but without endangering established production systems or confusing users who are familiar with the existing customer experience. What are the latest releases in Devops? Explain
3. What is canary testing?

Concept Map



Syllabus

- Overview & Principles of DevOps
- Version control with GIT
- Continuous integration using Jenkins
- Continuous testing with Selenium
- Continuous deployment; Configuration management with Ansible
- Containerization with Docker
- Deployment orchestration using Kubernetes
- Continuous Monitoring
- Introduction to DevOps on Cloud; Immutable Infrastructure
- Canary releases, Dark launches, Chaos Engineering
- Tools Used: GCP, GIT, Jenkins, Maven, selenium, Ansible, Docker, Kubernetes

Learning Resources

1. Devops basics - https://learning.tcsionhub.in/courses/industry-honour- certification/basic-devops
2. GIT basics - https://git-scm.com/
3. Kubernetes Basics - https://kubernetes.io/docs/tutorials/kubernetes-basics/
4. Jenkins basics - https://www.jenkins.io/doc/tutorials/
5. Docker-https://docs.docker.com/get-started/
6. Selenium testing - https://www.softwaretestingmaterial.com/selenium-tutorial/

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1	Overview & Principles of DevOps	1	CO1
2	Version control with GIT	1	CO1
3	Continuous integration using Jenkins	1	CO2
4	Continuous testing with Selenium	1	CO2

5	Continuous deployment; Configuration management with Ansible	2	CO3
6	Containerization with Docker	1	CO3
7	Deployment orchestration using Kubernetes	2	CO4
8	Continuous Monitoring	1	CO4
9	Introduction to DevOps on Cloud; Immutable Infrastructure	2	CO5
10	Canary releases, Dark launches, Chaos Engineering	2	CO6
Total		14	

Course Designers:

1. Dr. A. Malini amcse@tce.edu
2. Mr. V. Janakiraman vjncse@tce.edu
3. Expert from TCS

20CB2A0	APPLICATION SECURITY

Category	L	T	P	Credit	Terminal Exam Type
PEES	2	0	0	2	Theory

Preamble

The syllabus is designed for the students to learn and understand the basic concepts of application security. It gives a brief overview of all the aspects involved with Application Security. It examines secure coding practices and processes, web application security configuration management techniques, and web application security standards, also learn the convergence between web application security and associated threat vectors/attack methods.

Prerequisite

NIL

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Understand the concepts of OWASP 10 and Fundamentals of application security keywords	15
CO2	Explain the web application security vulnerabilities and different Attacks	35
CO3	Demonstrate the Installation & Setting up a proxy on Android & iOS mobile devices	20
CO4	Apply Hacking concepts in real-time mobile applications.	10
CO5	Apply IDOR attacks using the BurpSuite Autorize plugin	10
CO6	Analyze JavaScript files for secret endpoints Scanning websites using Acunetix	10

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO#	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond	-	1.2,1.3
CO2	TPS2	Understand	Respond	-	1.2, 1.3,2.1.2, 3.2.3,4.5.3
CO3	TPS2	Understand	Respond	-	1.2, 1.3,2.1.2, 3.2.3,4.3.2
CO4	TPS3	Apply	Value	-	1.2, 1.3,2.1.2, 3.2.3,4.5.3
CO5	TPS3	Apply	Value	-	1.2, 1.3,2.1.2, 3.2.3,4.5.3
CO6	TPS2	Apply	Value	-	1.2, 1.3,2.1.2, 3.2.3,4.5.3

Mapping with Programme Outcomes and Programme Specific Outcomes

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

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	CAT/Assignment	Terminal Examination
Remember	-	20
Understand	50	40
Apply	50	40
Analyse	-	0
Evaluate	-	0
Create	-	0

Sample Questions for Course Outcome Assessment**

** (2 to 3 at the cognitive level of course outcome)

Course Outcome1(CO1):
1. What is Application Security?
2. What are the three phases of application security?
3. Explain about Web Application Penetration Testing

Course Outcome2(CO2):
1. Discuss protection against CSRF?
2. Write a note on database vulnerabilities. Discuss some mechanisms to handle it.
3. Describe how source code disclosure can be effectively used to safeguard against the vulnerabilities in applications

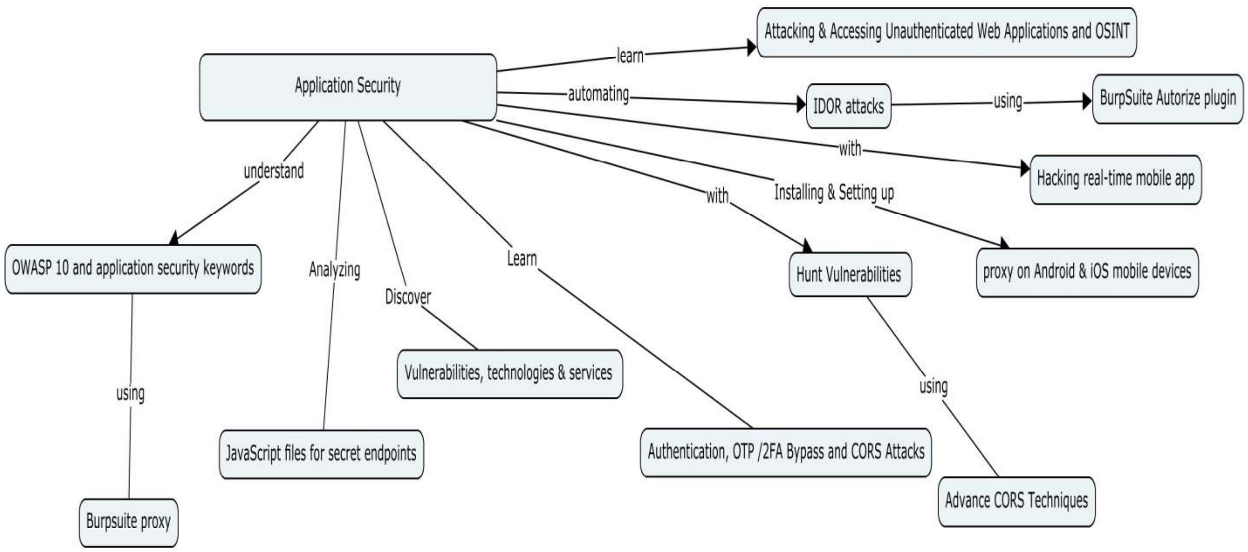
Course Outcome3(CO3):
1. What is server hacking?
2. Define Hunt Vulnerabilities
3. Exfiltrating Sensitive Information by CORS Vulnerability

Course Outcome 4 (CO4):
1. Explain API keys
2. Describe about HTTP Requests in Burp Suite
3. Discover the Automating IDOR attacks using the BurpSuite Autorize plugin

Course Outcome 5 (CO5):
1. What are the measures that one should take to secure his application?
2. Apply the Hacking techniques with Shodan

Course Outcome6(CO6):
1. Explain OSINT
2. Explore the secrets from GitHub commits
3. Illustrate the Scanning of websites using Acunetix.

Concept Map



Syllabus

OWASP10 and Fundamentals: Understanding application security keywords, Intercept requests using a Burpsuite proxy, Web Application Penetration Testing-Live

Discover Vulnerabilities and Attacks: Vulnerabilities technologies & services used on the target website, Gain full control over the target server using Authentication Bypass Attacks, OTP/2FA Bypass Attacks and using CSRF Attacks, Break down of XSS of all Hackerone Reports by Hackers.

CSRF: Hunt Vulnerabilities using Advance CSRF Techniques, Perform Complete Account Take over using CSRF on Live, Fix and Mitigations against CSRF Vulnerabilities

CORS Attacks: Gain full control over the target server using CORS Attacks, Hunt Vulnerabilities using Advance CORS Techniques, Exfiltrating Sensitive Information by CORS Vulnerability, Fix and Mitigations against CORS Vulnerabilities

Installing & Setting up a proxy on Android & iOS mobile devices, Intercepting HTTP Requests in Burp Suite, Hacking real-time mobile app tra c & changing the values, Hunting for secrets & API keys inside application source code

IDOR attacks: Automating IDOR attacks using the BurpSuite Autorize plugin

Application Security: Introduction to Reconnaissance of Application Security, Live Hacking with Shodan, Attacking & Accessing Unauthenticated Web Applications

OSINT: Introduction to OSINT, Exploring secrets from GitHub commits, Analyzing JavaScript files for secret endpoints, Scanning websites using Acunetix

Learning Resources

1. Andrew Hoffman., “Web Application Security: Exploitation and Countermeasures for Modern Web Applications”, 1st Edition, O'Reilly Media,2020.
2. Roger A Grimes, “The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws”, 2nd edition, Wiley, 2011.

3. DafyddStuttard and Marcus Pinto, "The Web Application Hacker's Handbook: Discovering and Exploiting Security Flaws", Wiley, 2008.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1.	OWASP10andFundamentals - Understanding application security keywords Intercept requests using a Burpsuite proxy	2	CO1
2.	Web Application Penetration Testing–Live	2	CO1
3.	Discover Vulnerabilities, technologies & services used on the target website	2	CO2
4.	Gain full control over the target server using Authentication Bypass Attacks and OTP/2FA Bypass Attacks	2	CO2
5.	Break down of XSS of all Hackerone Reports by Hackers, Gain full control over target server using CSRF Attacks	2	CO2
6.	Hunt Vulnerabilities using Advance CSRF Techniques, Perform Complete Account Takeover using CSRF on Live	2	CO2
7.	Fix and Mitigations against CSRF Vulnerabilities Gain full control over the target server using CORS Attacks	2	CO2
8.	Hunt Vulnerabilities using Advance CORS Techniques, Exfiltrating Sensitive Information by CORS Vulnerability	2	CO3
9.	Fix and Mitigations against CORS Vulnerabilities Installing & Setting up a proxy on Android & iOS mobile devices	2	CO3
10.	Intercepting HTTP Requests in Burp Suite, Hacking real-time mobile app tra c & changing the values	2	CO4
11.	Hunting for secrets & API keys inside application source code, Automating IDOR attacks using the BurpSuite Autorize plugin	2	CO4
12.	Introduction to Reconnaissance of Application Security, Live Hacking with Shodan	2	CO5
13.	Attacking & Accessing Unauthenticated Web Applications, Introduction to OSINT	2	CO6
14.	Exploring secrets from GitHub commits Analyzing JavaScript files for secret endpoints Scanning websites using Acunetix	2	CO6
	Total	**28**	

Course Designers:

1. Mr.Udhaya Prakash Senior Application Security Engineer, Poshmark
2. Mrs.P.Suganthi psica@tce.edu

CURRICULUM AND DETAILED SYLLABI

FOR

B.TECH DEGREE (Computer Science and Business Systems) PROGRAMME

INDUSTRY SUPPORTED COURSES

FOR THE STUDENTS ADMITTED FROM THE

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21CB1B0	VERSION CONTROL SYSTEM WITH GIT AND GITHUB

Category	L	T	P	Credit
PEES	1	0	0	1

Preamble

The Version Control with Git and GitHub course provides with a solid, hands-on foundation for understanding the Git version control system. Students will create a new Git project and configure it. They will also commit and review changes to code by using Git. Students will learn GitHub working and also add existing projects to GitHub.

Prerequisite

NIL

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	To understand basics of Git and GitHub and its difference from any centralized version control systems.	10
CO2	Implement Git operations such as create, change, stage, commit and view.	15
CO3	Create new repositories and clone those repositories on GitHub.	20
CO4	Implement new branches, merge local branches and share to a server.	15
CO5	Develop own git repository to collaborate and share the work with others.	25
CO6	Implement advanced git techniques such as tagging release, Stashing changes, Cherry-picking commits.	15

*** Weightage depends on Bloom's Level, number of contact hours,

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS2	Understand	Respond		1.2,2.1.1,2.1.3
CO2	TPS3	Apply	Value		1.2,2.1.1,2.4.6
CO3	TPS3	Apply	Value		1.2,2.1,1.1
CO4	TPS3	Apply	Value		1.2,2.1.1
CO5	TPS3	Apply	Value		1.2,2.1.1
CO6	TPS3	Apply	Value		1.2, 2.1.1, 2.1.4

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	S	M	L							M	M				L
CO2	M	L	L							L	L				
CO3	S	M	L							M	M				L
CO4	S	M	L							S	M				L
CO5	S	M	L							S	M				L
CO6	S	M	L							S	M				L

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	CAT/ Terminal Examination
Remember	20
Understand	30
Apply	50
Analyse	0
Evaluate	0
Create	0

Sample Questions for Course Outcome Assessment**

** (2 to 3 at the cognitive level of course outcome)

Course Outcome 1(CO1):

1. What do you understand by the term 'Version Control System'?
2. What is Git and list its features?
3. List the steps for git installation.
4. Create a repository and add a file to it.

Course Outcome 2(CO2):

1. Illustrate Git objects after second commit.
2. How Do We Know a SHA1 Hash Is Unique?
3. Write the usage of git commit statements using commit- all and give log messages.
4. Configure GitHub repository locally and push it to server.

Course Outcome 3(CO3):

1. Illustrate fetching, pulling requests from remote repository.
2. Explain techniques to resolve merge conflict and ways to skip it.

Course Outcome 4 (CO4):

1. How will you know in GIT if a branch has been already merged into master?
2. Elaborate on branching strategies with suitable example.
3. How to give an access to a specific person to repository?

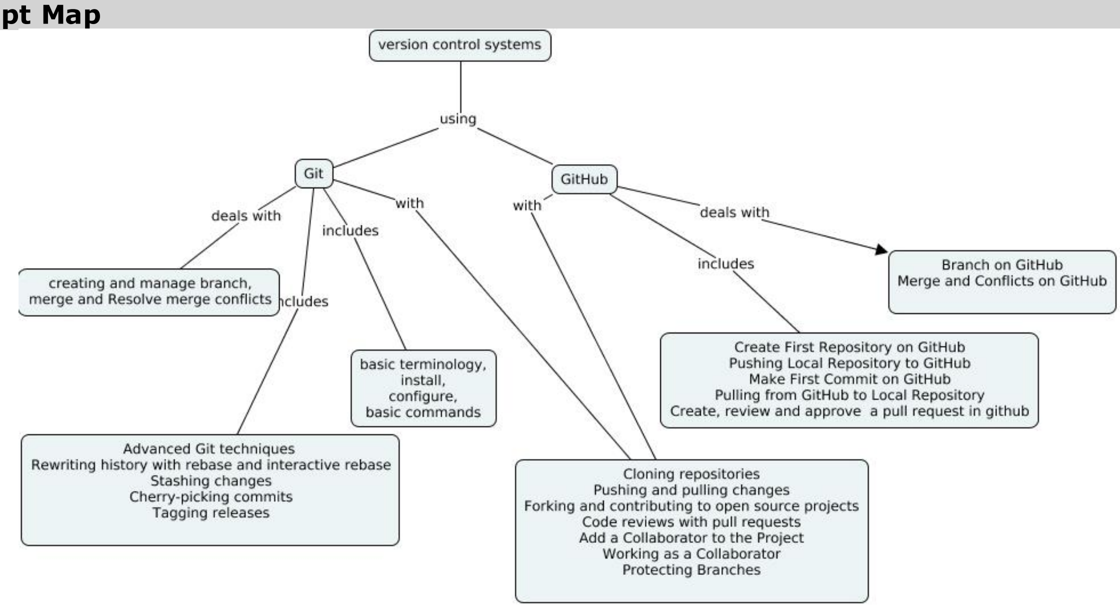
Course Outcome 5 (CO5):

1. Differentiate git merge and git rebase.
2. Elaborate on Git References and distinguish between direct and indirect commit statements.

Course Outcome 6(CO6):

1. Depict setting up git environment variables to determine its behaviour.
2. Explain stashing and cleaning operations with example.
3. Apply Commit through git SVN rebase.

Concept Map



Syllabus

Introduction to version control and Git - Overview of version control and Git- Benefits of using Git- Git terminology and concepts

Setting up Git and basic commands- Installing Git- Configuring Git- Basic Git commands: init, add, commit, status, log, diff, reset

The Basics of GitHub- Definition- Create First Repository on GitHub- Pushing Local Repository to GitHub- Make First Commit on GitHub- Pulling from GitHub to Local Repository- Creating a pull request in github- Review and Approve pull request

Branching and merging- Creating and managing branches- Merging branches- Resolving merge conflicts- Branching strategies- Branching on GitHub- Merge Conflicts on GitHub

Collaborating with Git and GitHub- Cloning repositories- Pushing and pulling changes- Forking and contributing to open source projects- Code reviews with pull requests- Add a Collaborator to the Project- Working as a Collaborator- Protecting Branches

Advanced Git techniques- Rewriting history with rebase and interactive rebase- Stashing changes- Cherry-picking commits- Tagging releases

Learning Resources

1. Prem Kumar Ponuthorai, Jon Loeliger, Version Control with Git, 3rd edition, O'Reilly Media, Inc, October,2022.
2. Scott Chacon, Ben Straub, Pro Git book, 2nd edition, Apress publisher, 2014.
3. Git basics- https://git-scm.com/

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours	Course Outcome
1	**Introduction to version control and Git**		
1.1	Overview of version control and Git- Benefits of using Git- Git terminology and concepts	1	CO1
2	**Setting up Git and basic commands**		
2.1	Installing Git- Configuring Git	1	CO2
2.2	Basic Git commands: init, add, commit, status, log, diff, reset	1	CO2
3	**The Basics of GitHub**		
3.1	Definition- Create First Repository on GitHub- Pushing Local Repository to GitHub	1	CO3
3.2	Make First Commit on GitHub- Pulling from GitHub to Local Repository	1	CO3
3.3	Creating a pull request in github- Review and Approve pull request	1	CO3
4	**Branching and merging**		
4.1	Creating and managing branches- Merging branches- Resolving merge conflicts	1	CO4
4.2	Branching strategies- Branching on GitHub- Merge Conflicts on GitHub	1	CO4
5	**Collaborating with Git and GitHub**		
5.1	Cloning repositories- Pushing and pulling changes	1	CO5
5.2	Forking and contributing to open source projects- Code reviews with pull requests	2	CO5
5.3	Add a Collaborator to the Project- Working as a Collaborator- Protecting Branches	1	CO5
6	**Advanced Git techniques**		
6.1	Rewriting history with rebase and interactive rebase	1	CO6
6.2	Stashing changes- Cherry-picking commits- Tagging releases	1	CO6
	TOTAL	**14**	

Course Designers:

1. Ms. R.Subhashni rsica@tce.edu
2. Mr. Sasikumar, Lead Consultant, ThoughtWorks

21CB2B0	**MERN Stack**

Category	L	P	Credit	Exam Type
PEES	2	0	2	Theory

Preamble The course explores the knowledge and skill about front-end and back-end servers. The students should able to develop web and hybrid mobile apps, as well as server-side support, to build a multi-platform solution.

Prerequisite

NIL

Course Outcomes

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

CO Number	Course Outcome Statement	Weightage*** in %
CO1	Create a framework to build interactive user interfaces and web applications using ReactJS	20
CO2	Apply Hook in-built functions to use state and lifecycle methods inside functional components.	15
CO3	Understand the schemas and relation for unstructured database.	15
CO4	Create open-source document oriented database for holding large amount of data using MongoDB	20
CO5	Create single-threaded, open-source, cross-platform server side application using NodeJS	15
CO6	Create web application framework to manage servers and routes using ExpressJS	15

CO Mapping with CDIO Curriculum Framework

CO #	TCE Proficiency Scale	Learning Domain Level			CDIO Curricular Components (X.Y.Z)
		Cognitive	Affective	Psychomotor	
CO1	TPS3	Apply	Value	Mechanism	1.2, 2.1.2, 3.2.3, 4.5.3
CO2	TPS3	Apply	Value	Mechanism	1.2, 2.1.2, 3.2.3, 4.5.3
CO3	TPS2	Understand	Respond	Guided Response	1.2, 4.3.2
CO4	TPS3	Apply	Value	Mechanism	1.2, 2.1.2, 3.2.3, 4.5.3
CO5	TPS3	Apply	Value	Mechanism	1.2, 2.1.2, 3.2.3, 4.5.3
CO6	TPS3	Apply	Value	Mechanism	1.2, 2.1.2, 3.2.3, 4.5.3

Mapping with Programme Outcomes and Programme Specific Outcomes

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

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive levels	Assignment / CAT / Terminal examination
Remember	10
Understand	30
Apply	60
Analyse	
Evaluate	
Create	

Assessment Pattern: Psychomotor

Psychomotor Skill	**Miniproject /Assignment/Practical Component**
Perception	
Set	
Guided Response	30
Mechanism	70
Complex Overt Responses	
Adaptation	
Origination	

Sample Questions for Course Outcome Assessment Course Outcome 1 (CO1):**

1. How is React different from AngularJS?
2. Illustrate conditional rendering in ReactJS.
3. What do you know about React Router?

Course Outcome 2 (CO2):

1. How does use State hook operate? What arguments does/does this hook accept, and what does the hook return?
2. Give an example of a straightforward Custom React Hook. Why are Custom Hooks necessary?
3. Illustrate with an example for componentWillMount()?

Course Outcome 3(CO3):

1. Explain the term "Indexing" in Mongodb.
2. Illustrate the process of Sharding.
3. Explain the concept of pipeline in the MongoDB aggregation framework

Course Outcome 4(CO4):

1. Illustrate the Replication Architecture in MongoDB
2. What are some utilities for backup and restore in MongoDB?
3. Illustrate the SET modifier in MongoDB

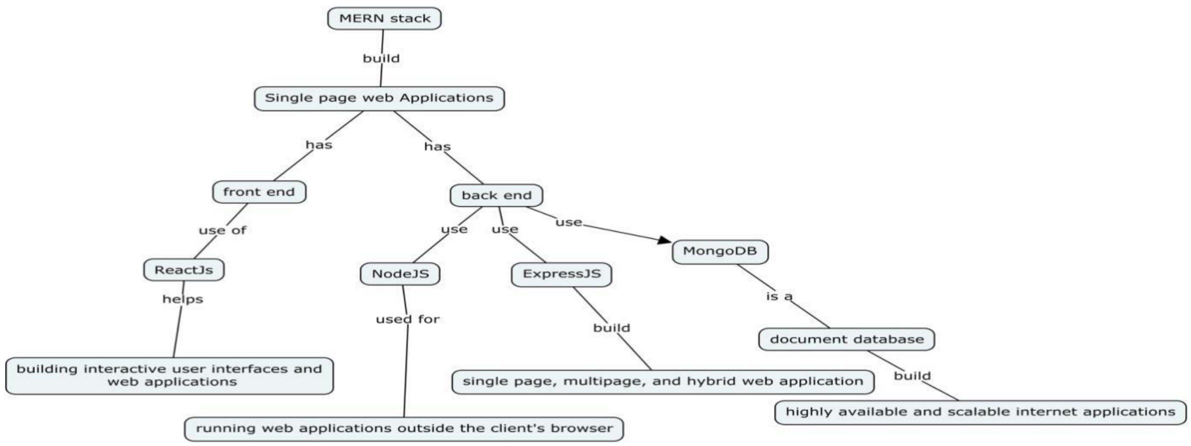
Course Outcome 5(CO5):

1. List down the major benefits of using Node.js?
2. Illustrate Event loop in Node.js and how does it work?
3. Explain REPL in the context of Node.js

Course Outcome 6(CO6):

1. What function are arguments available to Express JS route handlers?
2. How Should I Structure my Express JS Application?
3. Illustrate how to allow CORS in Express JS? Explain with an example.
4. Do Other MVC frameworks also support scaffolding?

Concept Map



Syllabus

REACTJS: HTML CSS Overview - Javascript Overview - ES6 Basics - React Basics (JSX, components, props) - React - State and Lifecycle - Create React App installation and hands on practice - Conditional Rendering, Lists & Keys - States and Props in detail - Problem solving - Application approach - React Router

Hooks Basics - Hooks in Detail (Ref, State, Effect) - Styled Components - State Management Basics - Application data Flow from backend to frontend - Redux - Redux Saga - Overview of our applications

- Features to be built in our application with all the concepts covered

MONGODB – Introduction – No SQL and SQL comparision – why MongoDB? - Understanding the Basics & CRUD Operations - Schemas & Relations: How to Structure Documents - Exploring The Shell & The Server - Using the MongoDB Compass to Explore Data Visually

OPERATIONS ON MONGODB: - Diving into Create Operations - Read Operations - A Closer look - Update Operations - Understanding Delete Operations - Working with Indexes - Working with Geospatial Data - Understanding the Aggregation Framework - Working Numeric Data - MongoDB & Security - Performance, Fault Tolerance & Deployment - Transactions - From Shell to Driver - Introducing Stitch

NODEJS - Understanding the Basics - Working with Express.js - Working with Dynamic Content & Adding Templating Engines - The Model View Controller (MVC) - Dynamic Routes and Advanced Models - Sessions & Cookies - Error Handling - Pagination - Understanding Async Requests - Working with REST APIs - Understanding Async Await in NodeJs - Nodejs and Typescript **EXPRESSJS** - Introduction, Project Setup, Server Setup, Basic Routing Sending Data, Rendering HTML, Routers, Advanced Routing, Middleware, Rendering Static Files, Parsing Form/JSON Data Parse Query Params

Assignment:

Creating a job listing website has never been easier — the easiest to use job board theme available. Create a community of employers and prospective employees.

Learning Resources

1. Vasan Subramanian, "Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node" 2nd edition, Apress, 2019.
2. Shama Hoque, "Full-Stack React Projects: Learn MERN stack development by building modern web apps using MongoDB, Express, React, and Node.js", 2nd Edition, Packt publishing Ltd, 2021.

3. https://www.udemy.com/course/mern-stack-course-mongodb-express-react-and-nodejs/
4. https://www.udemy.com/course/react-nodejs-express-mongodb-the-mern-fullstack-guide/

Course Contents and Lecture Schedule

Module no	**Topic**	No of hours	Course outcome
1	**REACTJS**		
1.1	HTML CSS Overview	1	CO1
1.2	Javascript Overview, ES6 Basics		CO1
1.3	React Basics (JSX, components, props)	1	CO1
1.4	React - State and Lifecycle		CO1
1.5	Create React App installation and hands on practice	1	CO1
1.6	Conditional Rendering, Lists & Keys	1	CO1
1.7	States and Props in detail		CO1
1.8	Problem solving - Application approach	1	CO1
1.9	React Router	1	CO1
2	**HOOKS**		
2.1	Hooks Basics	1	CO2
2.2	Hooks in Detail (Ref, State, Effect)		CO2
2.3	Styled Components	1	CO2
2.4	State Management Basics		CO2
2.5	Application data Flow from backend to frontend	1	CO2
2.6	Redux, Redux Saga	1	CO2
3	**MONGODB**		
3.1	Comparison between NoSQL and SQL, Why MongoDB?	1	CO3
3.2	Understanding the Basics & CRUD Operations	1	CO3
3.3	Schemas & Relations: How to Structure Documents	1	CO3
3.4	Exploring The Shell & The Server, Using the MongoDB Compass to Explore Data Visually	1	CO3
4	**OPERATIONS ON MONGODB**		
4.1	Diving into Create Operations, Read Operations - A Closer look	1	CO4
4.2	Update Operations, Understanding Delete Operations	1	CO4
4.3	Working with Indexes, Working with Geospatial Data	1	CO4
4.4	Understanding the Aggregation Framework	1	CO4
4.5	Working Numeric Data , MongoDB & Security	1	CO4
4.6	Performance, Fault Tolerance & Deployment	1	CO4
4.7	Transactions, From Shell to Driver, Introducing Stitch		CO4
5	**NODEJS**		
5.1	Understanding the Basics	1	CO5
5.2	Working with Express.js		CO5
5.3	Working with Dynamic Content & Adding Templating Engines	1	CO5
5.4	The Model View Controller (MVC)		CO5

5.5	Dynamic Routes and Advanced Models	1	CO5
5.6	Sessions & Cookies		CO5
5.7	Error Handling, Pagination, Understanding Async Requests		CO5
5.8	Understanding Async Await in NodeJs,	1	CO5
5.9	Nodejs and Typescript, Working with REST APIs		CO5
6	**EXPRESSJS**		
6.1	Introduction	1	CO6
6.2	Project Setup, Server Setup, Basic Routing		CO6
6.3	Sending Data, Rendering HTML,	1	CO6
6.4	Routers, Advanced Routing		CO6
6.5	Middleware, Rendering Static Files	1	CO6
6.6	Parsing Form/JSON Data	1	CO6
6.7	Parse Query Params		CO6
	Total	**28**	

Course Designers:

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