Sri Krishna College of Engineering and Technology

An Autonomous Institution, Affiliated to Anna University

Coimbatore – 641 008

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

CURRICULUM AND SYLLABI

B.Tech. COMPUTER SCIENCE AND BUSINESS SYSTEMS

REGULATION 2022 [2022-2026 BATCH]

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

VISION AND MISSION OF THE DEPARTMENT

VISION

To produce industry ready professionals with information technology acquaintance and human values to contribute to the society at large.

MISSION

- ➢ To develop and to promote student ability thereby to compete globally through excellence in education.
- ➢ To inculcate varied skill sets that meets industry standards and to practice moral values.
- ➢ To enrich high integrity to lead and to serve the society.

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

PROGRAMME OUTCOMES

PROGRAMME OUTCOMES

PO1 - **Engineering knowledge**: Apply the knowledge of mathematics, science, engineeringfundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 - **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 - **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 - **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 - **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6 - **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7 - **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8 - **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 - **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 - **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11 - **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12 - **Life-long learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS
PROGRAMME EDUCATIONAL OBJECTIVES & PROGRAMME SPECIFIC OUTCOMES

PROGRAMME EDUCATIONALOBJECTIVES

PEO1 Challenges in their profession through the application of theory and principles of computer engineering.

PEO2 Problem solving skills in computer science and business systems by applying mathematical, scientific, engineering and business fundamentals and also to pursue higher studies.

PEO3 Good scientific and engineering breadth so as to comprehend, analysis, design, and create novel products and solutions for the real-life problems.

PEO4 Possess professional and ethical attitude, effective communication skills, team working skills, multi-disciplinary approach, and an ability to relate engineering issues to broader social context with leadership qualities and progress through life-long learning.

PROGRAMME SPECIFIC OUTCOMES

At the end of the programme, Graduate shall have

PSO 1 Enriched knowledge in aiding academic excellence in order to adopt to changing demands in the cutting-edge technology.

PSO 2 Design varied solutions for real time problems with critical thinking and implement them by using modern software tools with reasoning in lieu of deploying them in the society towards beneficial grounds.

PSO 3 Knowledge of mathematics, science, business systems fundamentals, and an engineering specialization to the solution of complex engineering problems.

Mapping of PO's to PEO's

Programme Educational Objectives (PEO)	Programme Outcomes (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
PEO 1	3	3	3	3	3	2	2	2	2	3	3	3
PEO 2	3	3	3	3	3	2	2	2	3	3	3	3
PEO 3	3	3	3	3	3	3	2	2	2	3	3	3
PEO 4	2	3	3	3	3	3	3	3	3	3	3	3

Mapping of PO's to PSO's

Programme Specific Outcomes (PSO)	Programme Outcomes (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
PSO 1	3	3	3	3	3	2	2	2	2	2	2	2
PSO 2	3	3	3	3	3	3	2	2	3	2	3	3
PSO 3	3	3	3	3	3	3	2	2	3	2	3	2

Mapping of PSO's to PEO's

Programme Specific Outcomes (PSO)	Programme Educational Objectives (PEO)			
	1	2	3	4
PSO 1	3	3	3	2
PSO 2	3	3	3	3
PSO 3	3	3	3	3

1	Reasonably agreed	2	Moderately agreed	3	Strongly agreed

B.TECH. COMPUTER SCIENCE AND BUSINESS SYSTEMS

REGULATION 2022 [2022-2026 BATCH]

SEMESTER I

S No.	Course Code	Course	L/T/P	Contact hrs/week	Credits	Int/Ext	Category
1	22MA106	Discrete Mathematics	3/1/0	4	4	40/60	BSC
2	22MA107	Probability and Statistics	3/1/0	4	4	40/60	BSC
3	22EE112	Principles of Electrical Engineering	3/0/2	5	4	50/50	ESC
4	22CB101	Computer Programming	3/0/2	5	4	50/50	ESC
5	22PH103	Physics for Computing Science	3/0/2	5	4	50/50	BSC
6	22EN102	Business Communication and Value Science I	2/0/2	4	3	50/50	HSMC
MANDATORY COURSE							
7	22MCXXX	Mandatory Course I	2/0/0	2	0	0/100	MC
			Total	**29**	**23**	**600**	

SEMESTER II

S No.	Course Code	Course	L/T/P	Contact hrs/week	Credit	Int/Ext	Category
1	22MA205	Linear Algebra	3/1/0	4	4	40/60	BSC
2	22EN201	Business Communication and Value Science II	2/1/0	3	3	40/60	HSMC
3	22MG211	Fundamentals of Economics	3/0/0	3	3	40/60	ESC
4	22CB201	Data Structures	3/0/0	3	3	40/60	PCC
5	22TA101	Heritage of Tamils	1/0/0	1	1	40/60	HSMC
6	22EC211	Principles of Electronics Engineering	3/0/2	5	4	50/50	ESC
7	22MA206	Statistical Modelling	3/0/2	5	4	50/50	BSC
8	22CB202	Data Structures laboratory	0/0/3	3	1.5	60/40	PCC
MANDATORY COURSE							
9	22MCXXX	Mandatory Course II	2/0/0	2	0	0/100	MC
			Total	**29**	**23.5**	**800**	

SEMESTER III

S No.	Course Code	Course	L/T/P	Contact hrs/week	Credit	Int/Ext	Category
1	22CB301	Computer Organization and Architecture	3/0/0	3	3	40/60	ESC
2	22CB302	Object Oriented Programming	1/0/4	5	3	50/50	PCC
3	22CB303	Database Management Systems	1/0/4	5	3	50/50	PCC
4	22TA201	Tamils and Technology	1/0/0	1	1	40/60	HSMC
5	22MA308	Computational Statistics	3/0/2	5	4	50/50	BSC
6	22CB304	Software Engineering	3/0/2	5	4	50/50	PCC
MANDATORY COURSE							
7	22MCXXX	Mandatory Course III	2/0/0	2	0	0/100	MC
			Total	**26**	**18**	**600**	

SEMESTER IV

S No.	Course Code	Course	L/T/P	Contact hrs/week	Credit	Int/Ext	Category
1	22CB401	Introduction to Innovation, IP Management and Entrepreneurship	3/0/0	3	3	40/60	ESC
2	22EN401	Business Communication and Value Science III	3/0/0	3	3	40/60	HSMC
3	22GE201	Universal Human Values	3/0/0	3	3	40/60	HSMC
4	22CB402	Design and Analysis of Algorithms	1/0/4	5	3	50/50	PCC
5	22MA408	Operations Research	3/0/2	5	4	50/50	BSC
6	22CB403	Operating Systems	3/0/2	5	4	50/50	PCC
MANDATORY COURSE							
7	22MCXXX	Mandatory Course IV	2/0/0	2	0	0/100	MC
			Total	**26**	**20**	**600**	

S No.	Course Code	Course	L/T/P	Contact hrs/week	Credit	Int/Ext	Category
SEMESTER V							
1	22CB501	Formal Languages and Automata Theory	3/1/0	4	4	40/60	PCC
2	22CB502	Business Strategy	3/0/0	3	3	40/60	ESC
3	22CB503	Design Thinking	3/0/0	3	3	40/60	PCC
4	22CB9XX	Professional Elective– 1	3/0/0	3	3	40/60	PEC
5	22CB504	Software Design with UML	3/0/2	5	4	50/50	PCC
6	22CB505	Information Security	3/0/2	5	4	50/50	PCC
PROJECT WORK							
7	22CB506	Mini Project – 1	0/0/4	4	2	60/40	PW
			Total	**26**	**23**	**700**	

S No.	Course Code	Course	L/T/P	Contact hrs/week	Credit	Int/Ext	Category
SEMESTER VI							
1	22XXXXX	Open Elective – 1	3/0/0	3	3	40/60	OEC
2	22CB9XX	Professional Elective – 2	3/0/0	3	3	40/60	PEC
3	22EN603	Business Communication and Value Science IV	2/0/0	2	2	40/60	HSMC
4	22CB601	Artificial Intelligence	3/0/0	3	3	40/60	PCC
5	22CB602	Computer Networks	3/0/2	5	4	50/50	PCC
6	22CB603	Compiler Design	3/0/2	5	4	50/50	PCC
7	22CB604	Artificial Intelligence Laboratory	0/0/3	3	1.5	60/40	PCC

S No.	Course Code	Course	L/T/P	Contact hrs/week	Credit	Int/Ext	Category
EMPLOYABILITY ENHANCEMENT SKILLS							
8	22EES01	Employability Enhancement Skills			2		EES
			Total	**24**	**22.5**	**700**	

SEMESTER VII

S No.	Course Code	Course	L/T/P	Contact hrs/week	Credit	Int/Ext	Category
1	22CB9XX	Professional Elective – 3	3/0/0	3	3	40/60	PEC
2	22CB9XX	Professional Elective – 4	3/0/0	3	3	40/60	PEC
3	22CB9XX	Professional Elective – 5	3/0/0	3	3	40/60	PEC
4	22CB7XX	Emerging Elective – 1	3/0/0	3	3	40/60	EEC
5	22XXXXX	Open Elective – 2	3/0/0	3	3	40/60	OEC
6	22CB7XX	Emerging Elective – 2	3/0/2	5	4	50/50	EEC
PROJECT WORK							
7	22CB701	Mini Project – 2	0/0/4	4	2	60/40	PW
			Total	**24**	**21**	**700**	

SEMESTER VIII

S No.	Course Code	Course	L/T/P	Contact hrs/week	Credit	Int/Ext	Category
PROJECT WORK							
1	22CB801	Project Evaluation	0/0/24	24	12	60/40	PW
			Total	**24**	**12**	**100**	

HUMANITIES SCIENCE AND MANAGEMENT COURSES (16 credits)

S No.	Course Code	Course	L/T/P	Contact hrs/week	Credit	Int/Ext	Category
1.	22TA101	Heritage of Tamils	1/0/0	1	1	40/60	HSMC
2.	22EN102	Business Communication and Value Science I	2/0/2	4	3	50/50	HSMC
3.	22TA201	Tamils and Technology	1/0/0	1	1	40/60	HSMC
4.	22EN201	Business Communication and Value Science II	2/1/0	3	3	40/60	HSMC
5.	22EN401	Business Communication and Value Science III	3/0/0	3	3	40/60	HSMC
6.	22GE201	Universal HumanValues	3/0/0	3	3	40/60	HSMC
7.	22EN603	Business Communication and Value Science IV	2/0/0	2	2	40/60	HSMC

BASIC SCIENCES COURSE (28 credits)

S No.	Course Code	Course	L/T/P	Contact hrs/week	Credit	Int/Ext	Category
1	22MA106	Discrete Mathematics	3/1/0	4	4	40/60	BSC
2	22MA107	Probability and Statistics	3/1/0	4	4	40/60	BSC
3	22PH103	Physics for Computing Science	3/0/2	5	4	50/50	BSC
4	22MA205	Linear Algebra	3/1/0	4	4	40/60	BSC
5	22MA206	Statistical Modelling	3/0/2	5	4	50/50	BSC
6	22MA308	Computational Statistics	3/0/2	5	4	50/50	BSC
7	22MA408	Operations Research	3/0/2	5	4	50/50	BSC

ENGINEERING SCIENCES COURSESS (24 credits)

S No.	Course Code	Course	L/T/P	Contact hrs/week	Credit	Int/Ext	Category
1	22EE112	Principles of Electrical Engineering	3/0/2	5	4	50/50	ESC
2	22CB101	Computer Programming	3/0/2	5	4	50/50	ESC
3	22MG211	Fundamentals of Economics	3/0/0	3	3	40/60	ESC
4	22EC211	Principles of Electronics Engineering	3/0/2	5	4	50/50	ESC
5	22CB301	Computer Organization and Architecture	3/0/0	3	3	40/60	ESC
6	22CB401	Introduction to Innovation, IP Management and Entrepreneurship	3/0/0	3	3	40/60	ESC
7	22CB502	Business Strategy	3/0/0	3	3	40/60	ESC

PROFESSIONAL CORECOURSES (49 credits)

S No.	Course Code	Course	L/T/P	Contact hrs/week	Credit	Int/Ext	Category
1.	22CB201	Data Structures	3/0/0	3	3	40/60	PCC
2.	22CB202	Data Structures Laboratory	0/0/3	3	1.5	60/40	PCC
3.	22CB302	Object Oriented Programming	1/0/4	5	3	50/50	PCC
4.	22CB303	Database Management Systems	1/0/4	5	3	50/50	PCC
5.	22CB304	Software Engineering	3/0/2	5	4	50/50	PCC
6.	22CB402	Design and Analysisof Algorithms	1/0/4	5	3	50/50	PCC
7.	22CB403	Operating Systems	3/0/2	5	4	50/50	PCC
8.	22CB501	Formal Languages and Automata Theory	3/1/0	4	4	40/60	PCC
9.	22CB503	Design Thinking	3/0/0	3	3	40/60	PCC
10.	22CB504	Software Design with UML	3/0/2	5	4	50/50	PCC
11.	22CB505	Information Security	3/0/2	5	4	50/50	PCC
12.	22CB601	Artificial Intelligence	3/0/0	3	3	40/60	PCC
13.	22CB602	Computer Networks	3/0/2	5	4	50/50	PCC
14.	22CB603	Compiler Design	3/0/2	5	4	50/50	PCC
15.	22CB604	Artificial Intelligence Laboratory	0/0/3	3	1.5	60/40	PCC

MANDATORY COURSES

S.No.	Course Code	Course Title	Category
1	22MC101	Induction Program	MC
2	22MC102	Environmental Sciences	MC
3	22MC103	Soft Skills	MC
4	22MC105	General Aptitude	MC
5	22MC106	Life Skills and Ethics	MC
6	22MC107	Stress Management	MC
7	22MC108	Constitution of India	MC
8	22MC109	Essence of Indian Traditional Knowledge	MC

EMPLOYABILITY ENHANCEMENT SKILLS

S. No.	Course Code	Course Title	Duration	Credit	Category
1	22EES01	Employability Enhancement Skills	4 Weeks	2	EES

PROFESSIONAL ELECTIVE COURSES (PEC)

S.No.	Course Code	Course	L	T	P	Credit	Int/Ext
Digital Technology and Data Science							
1	22CB911	Conversational Systems	3	0	0	3	40/60
2	22CB912	Fundamentals of Cloud Application Development	3	0	0	3	40/60
3	22CB913	Machine Learning	3	0	0	3	40/60
4	22CB921	Robotics and its Applications	3	0	0	3	40/60
5	22CB922	Modern Web Applications	3	0	0	3	40/60
6	22CB923	Data Mining and Analytics	3	0	0	3	40/60
7	22CB931	Cognitive Science and Analytics	3	0	0	3	40/60
8	22CB932	Internet of Things	3	0	0	3	40/60
9	22CB933	Cryptology	3	0	0	3	40/60
10	22CB941	Quantum Computation and Quantum Information	3	0	0	3	40/60
11	22CB942	Social Information Network	3	0	0	3	40/60
12	22CB943	Mobile Computing	3	0	0	3	40/60
13	22CB963	Image Processing and Pattern Recognition	3	0	0	3	40/60
14	22CB964	Advanced Java Programming	3	0	0	3	40/60
Business Systems							
1	22CB951	Behavioural Economics	3	0	0	3	40/60
2	22CB952	Computational Finance &Modeling	3	0	0	3	40/60
3	22CB953	Industrial Psychology	3	0	0	3	40/60
4	22CB961	Enterprise Systems	3	0	0	3	40/60
5	22CB962	Advance Finance	3	0	0	3	40/60
6	22CB967	Financial Management	3	0	0	3	40/60
7	22CB968	Financial and Cost Accounting	3	0	0	3	40/60
8	22CB969	Fundamentals of Management	3	0	0	3	40/60
9	22CB970	Human Resource Management	3	0	0	3	40/60

EMERGING ELECTIVE COURSES

S No.	Course Code	Course	L/T/P	Contact hrs/week	Credit	Int/Ext	Category
1	22CB702	Usability Design of Software Applications	3/0/2	5	4	50/50	EEC
2	22CB703	IT Project Management	3/0/2	5	4	50/50	EEC
3	22CB704	Marketing Research and Marketing Management	3/0/0	3	3	40/60	EEC
4	22CB705	Services Science and Service Operations Management	3/0/0	3	3	40/60	EEC

OPEN ELECTIVE COURSES OFFERED TO OTHER DEPARTMENTS

S.No.	Course Code	Course	L	T	P	Credit	Int/Ext
1	22CB001	Java Programming	3	0	0	3	40/60
2	22CB002	Usability Design	3	0	0	3	40/60
3	22CB003	Financial Modelling	3	0	0	3	40/60
4	22CB004	Artificial Intelligence and Expert Systems	3	0	0	3	40/60
5	22CB005	Intellectual Property and Entrepreneurship	3	0	0	3	40/60

VALUE ADDED COURSES

S. No.	Course Code	Course	Credit	Category
1	22VA801	Amazon Web Services	1	VAC
2	22VA802	Industry 4.0	1	VAC
3	22VA803	Mobile Applications and Services	1	VAC
4	22VA804	ReactJS	1	VAC
5	22VA805	Spring Boot	1	VAC

SCHEME OF CREDIT DISTRIBUTION – SUMMARY

S. No	Stream	Credits/Semester								Credits	AICTE NORMS
		I	II	III	IV	V	VI	VII	VIII		
	Humanities Science and Management (HSMC)	3	4	1	6		2			16	12
2.	Basic Sciences (BSC)	12	8	4	4					28	24
3.	Engineering Sciences (ESC)	8	7	3	3	3				24	29
4.	Professional Core(PCC)		4.5	10	7	15	12.5			49	49
5.	Professional Electives (PEC)					3	3	9		15	18
6.	Open Electives (OEC) / Emerging Elective (EEC)						3	10		13	12
7.	Project Work (PW)					2		2	12	16	15
8.	Employability Enhancement Skills (EES)						2			2	
9.	Mandatory Course (MC)									Non credit	
	Total	**23**	**23.5**	**18**	**20**	**23**	**22.5**	**21**	**12**	**163**	**159**

22MA106   **DISCRETE MATHEMATICS**   **3/1/0/4**
Nature of Course: J (Problem Analytical)
Pre requisites: Nil

Course Objectives:

1   To know the fundamental concepts of Group theory
2   To learn the working of class of functions which transform a finite set into another finite set which relates to input and output functions in computer science
3   To acquaint with the concepts of calculus needed for problems in all engineering disciplines

Course Outcomes:
Upon completion of the course, students shall have ability to

C106.1	Apply double integral and triple integral to compute area, volume for two dimensional and three-dimensional solid structure	[AP]
C106.2	Understand the basic concepts of Boolean algebra	[U]
C106.3	Recall the basic concepts of sets, groups and truth table	[R]
C106.4	Apply the basic concepts of mathematical induction.	[AP]
C106.5	Use logical notation to define and reason mathematically about the fundamental data types and structures used in computer algorithms and systems.	[AP]

Course Contents:

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

Calculus: Basic concept of Differential calculus and integral calculus – evaluation of double and triple integrals (cartesian Coordinates) - Change the order of integration (cartesian Coordinates) - application of double (area) and triple (volume) integral (cartesian Coordinates). **Abstract algebra**: Set: definition – simple problems, Relation: types – simple problems, Group: monoid - semigroup – group – Abelian group – simple problems, Ring: definition – simple problems, field: definition – simple problems.

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

Total Hours: 60

Text Books:

1.   I. N. Herstein, Topics in Algebra, John Wiley and Sons. 2nd Edition 1975.
2.   M. Morris Mano, Digital Logic & Computer Design, Pearson, 2017.
3.   B. S. Grewal, Higher Engineering Mathematics, Khanna Publication, Delhi, 2018.

Reference Books:

1   Gilbert Strang: Introduction to linear algebra, Fourth Edition, 2021.

2 Peter V. O'Neil, Advanced Engineering Mathematics, 7th Edition, Thomson Learning,2021.

3 M. D. Greenberg, Advanced Engineering Mathematics, 2nd Edition, Pearson Education, 1998.

4 P. N. Wartikar and J. N. Wartikar, Applied Mathematics. Vol. I & II, Vidyarthi Prakashan, 1975.

Web References:

1 http://nptel.ac.in/video.php?subjectId=122107037

2 http://nptel.ac.in/courses/122107036/

3 http://nptel.ac.in/video.php?subjectId=117102060

Online Resources:

1 https://www.coursera.org/learn/pre-calculus

2 https://www.coursera.org/learn/linearalgebra1

3 https://alison.com/courses/Advanced-Mathematics-1

4 https://www.edx.org/course/algebra-lineal-mexicox-acf-0903-1x

Continuous Assessment				End Semester Examination	Total
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**	**End Semester Examination**	**Total**
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C106.1	Apply	Quiz	20
C106.2	Understand	Seminar	20
C106.3	Remember	Tutorial	20
C106.4	Apply	Assignment	20
C106.5	Apply	Quiz	

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	30	30	30
Apply	50	50	50

Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C106.1	3	3	1	-	-	-	-	-	-	-	-	-	-	2	3
C106.2	2	2	1	-	-	-	-	-	-	-	-	-	-	1	2
C106.3	1	1	1	-	-	-	-	-	-	-	-	-	-	1	2
C106.4	3	2	1	-	-	-	-	-	-	-	-	-	-	1	2
C106.5	3	2	1	-	-	-	-	-	-	-	-	-	-	1	2

22MA107   **PROBABILITY AND STATISTICS**   **3/1/0/4**
Nature of Course: J (Problem Analytical)
Pre requisites: Nil

Course Objectives:
1   To study the basic probability concepts
2   To understand and have a well – founded knowledge of standard distributions which can be used to describe real life phenomena
3   To learn the concepts of evaluation using statistical analysis

Course Outcomes:
Upon completion of the course, students shall have ability to
C107.1   Recall the concepts of basic probability.   [R]
C107.2   Understand the types of data and graphical representation in statistics.   [U]
C107.3   Examine distribution in cluster analysis of similar binary variables.   [AP]
C107.4   Apply the concepts of sampling techniques.   [AP]
C107.5   Apply the concepts of distributions which is the basic for analytics and   [AP]
            inferential statistics.
Course Contents:

Probability: Concept of experiments, sample space, event. Definition of Combinatorial Probability-Definition of conditional probability, Baye's Theorem (Statement only) – Simple problems. Probability distributions: discrete& continuous distributions- Binomial, Poisson, Geometric, Uniform, Exponential, Normal, Chi-square, t, F distributions (No derivations of mean, variance and moment generating function & Simple problems only). Expected values & moments: mathematical expectation & its properties (statements only), Moments (first four moments including variance, skewness (Karl Pearson's)) & their properties (Statements only), Moment generating function- Definition – Simple problems.

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: Simple bar diagram, Pie chart, Pareto chart-Frequency curves: Histogram, Frequency curve, Frequency polygon, Ogives- Descriptive measures: Central tendency- Mean, Median and Mode, Dispersion-Range, Quartile deviation, Standard deviation. Bivariate data. Summarization, marginal and conditional frequency distribution (Problems only). Scatter diagram. Linear regression - Least squares method – correlation (Karl Pearson's)- Rank correlation (Spearman's).

Sampling Techniques: Random sampling - Sampling from finite and infinite populations. Estimates and standard error (sampling with replacement and sampling without replacement), Sampling distribution of sample mean, stratified random sampling (Theory only).
                                                                              Total Hours: 60

Text Books:
1.   S.M. Ross, Introduction of Probability Models, 11th edition, Academic Press, 2014.

2.   A. Goon, M. Gupta and B. Das Gupta, Fundamentals of Statistics (vol. I and vol. II),World Press, 2016.

Reference Books:

1. S.M. Ross, A first course in Probability, 9th edition, Pearson Education,2013.
2. I.R. Miller, J.E. Freund and R. Johnson, Probability and Statistics for Engineers, Pearson Education, 2017.

Web References:
1   http://nptel.ac.in/courses/111104079/
2   http://nptel.ac.in/video.php/subjectId=117105085
3   http://nptel.ac.in/syllabus/111105041/
4   http://freevideolectures.com/Course/3028/Econometric-Modelling/22#

Online Resources:
1   www.edx.org/Probability
2   https://ocw.mit.edu/courses/.../18-440-probability-and-random-variables-spring-2014/
3   https://onlinecourses.nptel.ac.in/noc15_ec07/

Continuous Assessment			Total Continuous Assessment	End Semester Examination	Total
Formative Assessment	**Summative Assessment**	**Total**			
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C107.1	Remember	Quiz	20
C107.2	Understand	Seminar	20
C107.3	Apply	Tutorial	20
C107.4& C107.5	Apply	Assignment	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	

Remember	20	20	20
Understand	30	30	30
Apply	50	50	50
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C107.1	1	1	1	-	-	-	-	-	-	-	-	-	-	2	2
C107.2	2	2	2	-	-	-	-	-	-	-	-	-	-	1	2
C107.3	3	3	2	-	-	-	-	-	-	-	-	-	-	1	2
C107.4	3	3	2	-	-	-	-	-	-	-	-	-	-	1	2
C107.5	3	3	2	-	-	-	-	-	-	-	-	-	-	1	2

22EE112   PRINCIPLES OF ELECTRICAL ENGINEERING   3/0/2/4

Nature of Course: G(Theory Analytical)
Pre requisites: Nil

Course Objectives:
1. To remember the basic concepts in ac circuit and dc circuits.
2. To analyse the electrical circuit parameters of dc circuits by applying network theorems.
3. To understand and apply the principle of electrostatics and electro mechanics in single phase transformer.
4. To understand the signal measuring devices and electrical wiring systems.

Course Outcomes:
Upon completion of the course, students shall have the ability to

C112.1	Extend the basic concepts of work, power, energy for electrical, mechanical and thermal systems	[U]
C112.2	Apply knowledge of Kirchhoff's laws and network theorems to solve electrical networks	[AP]
C112.3	Experiment with the construction, principle of operation, specifications and applications of capacitors and batteries	[A]
C112.4	Apply fundamental concepts of magnetic and electromagnetic circuits for operation of single-phase transformer	[AP]
C112.5	Distinguish of single phase and three phase ac circuits with wiring systems and the use of measuring instruments	[A]

Course Contents:

Introduction and overviews: Electron Devices, Circuits and Systems, Integrated Circuits, Analog and digital signals. **Basic Concepts and Circuit Analysis**: 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, Concept of work, power, energy and conversion of energy. DC Circuits-Current-voltage relations of electric network by mathematical equations to analyse the network (Thevenin's theorem, Norton's Theorem, Maximum Power Transfer theorem) voltage source and current sources, ideal and practical, Kirchhoff's laws and applications to network solutions using mesh analysis, 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.

Principle of Electro mechanics and Electrostatics: Electrostatic field, electric field intensity, electric field strength, absolute permittivity, relative permittivity, capacitor composite, dielectric capacitors, capacitors in series& parallel, energy stored in capacitors, charging and discharging of capacitors, Principle of batteries, types, construction and application. Electro-mechanics: Electricity and Magnetism, magnetic field and faraday's law, self and mutual inductance, Ampere's law, Magnetic circuit, Magnetic material and B-H

Curve, Single phase transformer, principle of operation, EMF equation, voltage ratio, current ratio, KVA rating, efficiency and regulation, Electromechanical energy conversion, Basic concept of indicating and integrating instruments.

Measurements and Sensors: Introduction to measuring devices/sensors and transducers related to electrical signals, Elementary methods for the measurement of electrical quantities in DC and AC systems and their practical application. Electrical Wiring and Illumination system: Basic layout of distribution system, Types of Wiring System &Wiring Accessories, Necessity of earthing, Types of earthing, Different types of lamps (Incandescent, Fluorescent, Sodium Vapour, Mercury Vapour, Metal Halide, CFL, LED)

Total Hours:45

Lab Components

1	Familiarization of electrical Elements, sources, measuring devices and transducers related to electrical circuits	[R]
2	Determination of resistance temperature coefficient	[U]
3	Verification of Network Theorem (Superposition, Thevenin, Norton, Maximum Power Transfer theorem).	[AP]
4	Examine the Simulation of R-L-C series circuits for XL>XC , XL< XC & XL= XC	[A]
5	Test for Time response of RC circuit	[A]
6	Verification of relation in between voltage and current in three phase balanced star and delta connected loads	[AP]
7	Demonstration of measurement of electrical quantities in DC and AC systems	[A]

Total Hours:30

Text Books:

1. Fitzgerald. A.E., Charles Kingsely Jr, Stephen D.Umans, Electric Machinery, Tata McGraw Hill, 6th edition 2015.
2. B.L.Theraja- A Textbook of Electrical Technology, Volume- I, S.Chand and Company Ltd., New Delhi, 2015.
3. V. K. Mehta, - Basic Electrical Engineering, S. Chand and Company Ltd., New Delhi,2012
4. J. Nagrath and Kothari – Theory and problems of Basic Electrical Engineering, Prentice Hall of India Pvt. Ltd, 2nd edition, 2017.

Reference Books:

1. Edward Hughes – Electrical Technology- 10thedition, Pearson Education Publication,2011.
2. Vincent. Del. Toro, Electrical Engineering Fundamentals,2nd edition Prentice Hall India, 2015.
3. Sudhakar Shyam Mohan, Circuits and Networks: Analysis and Synthesis,5th edition, Tata McGraw-Hill Education, 2015.

Web References:

1. http://nptel.ac.in/course.php?disciplineId=108
2. https://ocw.mit.edu/courses/find-by
   topic/#cat=engineering&subcat=electricalengineering&spec=electricpower
3. https://nptel.ac.in/video.php?subjectId=117103063
4. https://onionesquereality.wordpress.com/.../more-video- lectures-iit-open
5. https://nptel.iitg.ernet.in/Elec_Comm_Engg/.../Video-ECE.pdf

Online Resources:

1. Electricity & Magnetism, Part 1- PHYS 102.1x (edx.in)
2. Fundamentals of Electrical Engineering@coursera
3. Circuits and Electronics@edxonline
4. https://www.coursera.org/learn/electronics
5. NPTEL e learning courses

Continuous Assessment										End Semester Examination	Total
Theory				**Practical**							
Formative Assessment	Summative Assessment	Total	Total (A)	Formative Assessment	Summative Assessment	Total (B)	Total (A+B)	Total Continuous Assessment		End Semester Examination	Total
80	**120**	**200**	**100**	**75**	**25**	**100**	**200**	**50**		**50**	**100**

Formative Assessment based on Capstone Model - Theory			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment,Case Study, Seminar, Group Assignment)**	**FA(10%) [80 Marks]**
C112.1	Understand	Quiz & Assignment	**20**
C112.2	Apply	Assignment	**20**
C112.3	Analyse	Case study	**20**
C112.4	Apply	Group Assignment	**20**
C112.5	Analyse		

Assessment based on Summative and End Semester Examination - Theory			
Bloom's Level	**Summative Assessment (15%) [120 Marks]**		**End Semester Examination (35%) [100 Marks]**
	CIA1: (60 Marks)	**CIA2: (60 Marks)**	
Remember	10	10	10
Understand	40	40	40

Apply	30	30	30
Analyse	20	20	20
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination - Practical

Bloom's Level	Continuous Assessment (25%) [100 Marks]		End Semester Examination (15%) [100 Marks]
	FA: (75 Marks)	SA: (25 Marks)	
Remember	10	10	10
Understand	30	30	30
Apply	40	40	40
Analyse	20	20	20
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (50%)								End Semester Examination (50%)
CA 1 (100 Marks)			CA 2 (100 Marks)			Practical Exam (100 Marks)		Theory Examination (35%) Practical Examination (15%)
SA 1 (60M)	FA 1		SA 2 (60M)	FA 2		FA (75M)	SA (25M)	
	Component-I (20 Marks)	Component-II (20 Marks)		Component-I (20 Marks)	Component-II (20 Marks)			

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C112.1	1	1	1	-	-	-	-	-	-	-	-	-	-	2	2
C112.2	2	2	2	-	-	-	-	-	-	-	-	-	-	1	2
C112.3	3	3	2	-	-	-	-	-	-	-	-	-	-	1	2
C112.4	3	3	2	-	-	-	-	-	-	-	-	-	-	1	2
C112.5	3	3	2	-	-	-	-	-	-	-	-	-	-	1	2

22CB101 **COMPUTER PROGRAMMING** 3/0/2/4

Nature of Course: F (Theory Programming)
Prerequisites: Nil

Course Objectives:
1 To understand problem solving concepts.
2 To learn operators and expressions in C.
3 To gain knowledge about the control structures in C.
4 To write C programs using arrays, functions, pointers, structures and files.
5 To learn Unix system interface and programming method.

Course Outcomes:
Upon completion of the course, students shall have ability to
C101.1 Apply problem solving techniques to solve real world problems   [AP]
C101.2 Examine C fundamental constructs and control structures   [AP]
C101.3 Analyse the concept of pointers and arrays in programs and execute it. [A]
C101.4 Classify the concept of structures, functions and files in programs and [A]
        execute it.
C101.5 Understand Unix system interface and programming method   [U]

Course Contents:

General Problem-Solving concepts: Algorithm, and Flowchart for problem solving with Sequential Logic Structure, Decisions and Loops. **Imperative languages**: Introduction to imperative language; syntax and constructs of a specific language (ANSI C). Operators and Expressions: 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. Control Flow with discussion on structured and unstructured programming: Statements and Blocks, If-Else-If, Switch, Loops – while, do, for, break and continue, Goto 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. Pointers and Arrays: Pointers and address, Pointers and Function Arguments, 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 and how they are evaluated.

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.

Total Hours:45

Lab Exercises:

1. Algorithm and flowcharts of small problems like GCD [AP]
2. Structured code writing with: [A]
    i. Small but tricky codes
    ii. Proper parameter passing
    iii. Command line Arguments
    iv. Variable parameter
    v. Pointer to functions
    vi. User defined header
    vii. Make file utility
    viii. Multi file program and user defined libraries
    ix. Interesting substring matching / searching programs
    x. Parsing related assignments

Total Hours: 30

Text Books:
1   B. W. Kernighan and D. M. Ritchi, The C Programming Language, 2nd Edition, PHI,2008.
2   B. Gottfried, Programming in C, Second Edition, Schaum Outline Series, 1st Edition,2008.

Reference Books:

1   Herbert Schildt, C: The Complete Reference, 4th Edition, McGraw Hill,2015.
2   Yashavant Kanetkar, Let Us C, BPB Publications,15th Edition 2017.

Web References:
1   https://onlinecourses.nptel.ac.in/noc17_cs43/
2   http://raptor.martincarlisle.com/
3   https://scratch.mit.edu/

Continuous Assessment									End Semester Examination	Total
Theory				Practical			Total (A+B)	Total Continuous Assessment		
Formative Assessment	Summative Assessment	Total	Total (A)	Formative Assessment	Summative Assessment	Total (B)				
80	120	200	100	75	25	100	200	50	50	100

Formative Assessment based on Capstone Model - Theory			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (10%) [80 Marks]**
C101.1	Apply	Quiz & Assignment	**20**
C101.2	Apply	Assignment	**20**
C101.3	Analyse	Case study	**20**
C101.4	Analyse	Group Assignment	**20**
C101.5	Understand		

Assessment based on Summative and End Semester Examination - Theory			
Bloom's Level	**Summative Assessment (15%) [120 Marks]**		**End Semester Examination (35%) [100 Marks]**
	CIA1: (60 Marks)	**CIA2: (60 Marks)**	
Remember	10	10	10
Understand	40	40	40
Apply	40	40	40
Analyse	10	10	10
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination – Practical			
Bloom's Level	**Continuous Assessment (25%) [100 Marks]**		**End Semester Examination (15%) [100 Marks]**
	FA: (75 Marks)	**SA: (25 Marks)**	
Remember	-	-	-
Understand	-	-	-
Apply	60	60	60
Analyse	40	40	40
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination									
Continuous Assessment (50%)									End Semester Examination (50%)
CA 1 (100 Marks)			CA 2 (100 Marks)			Practical Exam (100 Marks)		Theory Examination (35%) Practical Examination (15%)
SA 1 (60M)	FA 1		SA 2 (60M)	FA 2		FA (75M)	SA (25M)	
	Component-I (20 Marks)	Component-II (20 Marks)		Component-I (20 Marks)	Component-II (20 Marks)			

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C101.1	3	2	3	1	-	-	1	-	-	-	1	-	2	3	-
C101.2	3	2	3	1	-	-	1	-	-	-	1	-	1	1	-
C101.3	3	2	3	1	-	-	1	-	-	-	1	-	2	2	-
C101.4	3	2	3	1	-	-	1	-	-	-	1	-	2	2	-
C101.5	3	2	3	1	-	-	1	-	-	-	1	-	1	1	-

22PH103   **PHYSICS FOR COMPUTING SCIENCE**   3/0/2/4

Nature of Course: E (Theory Skill Based)
Pre requisites: Nil

Course Objectives:

1	To learn the basic concepts of physics needed for computing engineering
2	To apply the physics concepts in solving real time engineering problem
3	To implement and visualize theoretical aspects in the laboratory
4	To familiarize the students to handle various instruments and equipment

Course Outcomes:
Upon completion of the course, students shall have ability to

C103.1	Reproduce the basic concepts of lasers, fibre optics, thermodynamics, simple harmonic and damped oscillations	[R]
C103.2	Discuss the fundamental concepts of interference, diffraction and polarization	[U]
C103.3	Describe the basics of Quantum mechanics and crystallography	[U]
C103.4	Solve complex problems in everyday life using the knowledge gained from the course	[AP]
C103.5	Practice to solve problems using theoretical knowledge as a team	[AP]

Course Contents:

Oscillation and fundamental of wave optics: 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. **Interference-principle of superposition – Polarisation:** Basic definition and types of interference of light - young's double slit experiment of interference and Newton's rings - Diffraction-Two kinds of diffraction (Fresnel's diffraction and Fraunhofer's diffraction) -Difference between interference and diffraction -Fraunhofer diffraction at single slit-plane diffraction grating (multi slit diffraction). Coherence - Temporal and Spatial Coherence. Polarization definition - production of polarized beam as plane, elliptical and circularly polarized light, polarisation by reflection (Brewster's law), double refraction.

Quantum Mechanics and Crystallography:
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, Debye Scherrer powder method, Laue method- Atomic packing factor for SC, BCC, FCC and HCP structures. Semiconductor Physics - Basic concept of Band theory - classification of materials into conductor, semiconductor and Insulator.

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: CO_2 and Neodymium lasers; Properties of laser

beams: mono-chromaticity, coherence, directionality and highly intense, applications of lasers in engineering. Fiber optics and Types of optical fibers. **Thermodynamics:** Basic definitions of Zeroth law of thermodynamics, first law of thermodynamics, Applications of 1st law, second law of thermodynamics and concept of heat Engine, entropy, change in entropy in reversible and irreversible processes, third law of thermodynamics (definition only).

Total Hours:45

Lab Component

1	Determination of Magnetic field along the axis of current carrying coil – Stewart and Gee	[E]
2	Determination of Hall co-efficient of semiconductor	[E]
3	Determination of Plank Constant	[E]
4	Determination of wavelength of light by Laser diffraction method	[E]
5	Determination of wavelength of light by Newton's ring method	[E]
6	Determination of laser and optical parameter	[E]
7	Determination of Stefan's Constant.	[E]
8	Determination of pressure required to shut off the fuel pump nozzle.	[E]
9	Determination of capacitance required to shut off the circuit in a circuit breaker.	[E]
10	Determination of earth, neutral and phase line in a circuit.	[E]

Total Hours: 30

TEXT BOOKS
1. Beiser A, Concepts of Modern Physics, Fifth Edition, McGraw Hill International,2010.
2. David Halliday, Robert Resnick, Jearl Walker, Fundamentals of Physics, Wileyplus,2010.

REFERENCE BOOKS
1. Ajoy Ghatak, Optics Fifth Edition, Tata McGraw Hill,2012.
2. Sears &Zemansky, University Physics, Addison-Wesley,2001.
3. Jenkins and White, Fundamentals of Optics, Third Edition, McGraw-Hill,2006.

WEB RESOURCES
1   https://www.drdo.gov.in/drdo/data/Laser%20and%20its%20Applications.pdf
2   https://www3.nd.edu/~wers/ame.20231/planckdover.pdf
3   https://www.corning.com/in/en/products/communication-networks/.../fiber.html
4   https://physics.info/
5   http://www.feynmanlectures.caltech.edu/info/
6   http://nptel.ac.in/courses/113106032/4%20-%20Crystal%20structure.pdf
7   http://www.phys.ufl.edu/courses/phy2054/s09/lectures/2054_ch21A.pdf

Continuous Assessment								Total Continuous Assessment	End Semester Examination	Total
Theory				Practical			Total (A+B)			
Formative Assessment	Summative Assessment	Total	Total (A)	Formative Assessment	Summative Assessment	Total (B)				
80	120	200	100	75	25	100	200	50	50	100

Formative Assessment based on Capstone Model - Theory

Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (10%) [80 Marks]
C103.1	Remember	Online Quiz - I	20
C103.2	Understand	Assignment - I	20
C103.3	Understand	Online Quiz - II	20
C103.4	Apply	Assignment - II	20
C103.5	Apply		

Assessment based on Summative and End Semester Examination - Theory

Bloom's Level	Summative Assessment (15%) [120 Marks]		End Semester Examination (35%) [100 Marks]
	CIA1: (60 Marks)	CIA2: (60 Marks)	
Remember	20	20	20
Understand	50	50	50
Apply	30	30	30
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination - Practical

Bloom's Level	Continuous Assessment (25%) [100 Marks]		End Semester Examination (15%) [100 Marks]
	FA: (75 Marks)	SA: (25 Marks)	
Remember	20	20	20
Understand	30	30	30
Apply	50	50	50
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination								
Continuous Assessment (50%)								End Semester Examination (50%)
CA 1 (100 Marks)			CA 2 (100 Marks)			Practical Exam (100 Marks)		Theory Examination (35%) Practical Examination (15%)
SA 1 (60M)	FA 1		SA 2 (60M)	FA 2		FA (75M)	SA (25M)	
	Component-I (20 Marks)	Component-II (20 Marks)		Component-I (20 Marks)	Component-II (20 Marks)			

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C103.1	3	2	1	1	-	-	-	-	-	-	-	1	1	-	-
C103.2	2	1	1	1	-	-	-	-	-	-	-	1	1	-	-
C103.3	3	2	2	1	-	-	-	-	-	-	-	1	2	-	-
C103.4	3	2	1	1	-	-	-	-	-	-	-	1	1	-	-
C103.5	3	2	1	1	-	-	-	-	-	-	-	1	1	-	-

22EN102   BUSINESS COMMUNICATION AND VALUE SCIENCE I   2/0/2/3

Nature of Course: E(Theory Skill based)

Pre requisites: Nil

Course Objectives:
1   Understand what life skills are and their importance in leading a happy and well -adjusted life
2   Motivate students to look within and create a better version of self
3   Introduce them to key concepts of values, life skills and business communication

Course Outcomes:
Upon completion of the course, students shall have ability to
C102.1   Understand the need for life skills and values.   [U]
C102.2   Recognize own strengths and opportunities of Business Communication   [R]
C102.3   Analyze the life skills in different fields.   [A]
C102.4   Apply the basic tenets of communication in workplace.   [AP]
C102.5   Analyze the basic   communication   practices   in   different   types   of situations.   [A]

Course Contents:

Introduction to Values - its importance and necessity – Overview of Business Communication (Importance of oral & written communication)- Listening skills (Hearing Vs Listening) – Body Language

Tenses – Verbs – Helpings verbs – Subject-verb agreement – Articles – Prepositions – Conjunctions – Adjectives – Adverbs – Voice – Parts of Sentence – Identification of errors – Effective Communication - Types of Communication (Verbal, Written & Non-verbal Communication) – Barriers to Effective Communication – Tips to develop communication skills – Principles of Listening – The Process of Listening – Types of Listening.

Email writing (Formal and Informal)- Its Advantages & Disadvantages – Pronunciation and Enunciation – Summary Writing – Story Writing – Vocabulary Enrichment – Life Skills – importance and necessity – Thinking skill – Social skill – Emotional skill – Howard Gardner's Multiple Intelligence – Embracing Adversity

Total Hours: 30

Lab Components
1   Immersion activity   [AP]
2   Create resume   [AP]
3   Group assignment   [AP]
4   Trek followed by project   [AP]
5   Group activities   [AP]
6   Record a conversation   [AP]

Total Hours:30

Text Books:
1. APAART: Speak Well 1 (English language and communication), Oxford, 2015.
2. APAART: Speak Well 2 (Soft Skills), Oxford, 2015.

Reference Books:
1. Alan Mc'carthy and O'dell – English Vocabulary in Use – Third Edition – Cambridge University Press 2017.
2. Dr. Saroj Hiremath – Business Communication – Nirali Prakashan,2012.

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

Continuous Assessment									End Semester Examination	Total
Theory				**Practical**			Total (A+B)	Total Continuous Assessment		
Formative Assessment	Summative Assessment	Total	Total (A)	Formative Assessment	Summative Assessment	Total (B)				
80	120	200	100	75	25	100	200	50	50	100

Formative Assessment based on Capstone Model - Theory			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (10%) [80 Marks]**
C102.1	Understand	Technical Presentation	**20**
C102.2	Remember	Quiz	**20**
C102.3& C102.5	Analyse	Group Assignment	**20**
C102.4	Apply	Group Activities	**20**

Assessment based on Summative and End Semester Examination - Theory			
Bloom's Level	**Summative Assessment (15%) [120 Marks]**		**End Semester Examination (25%) [100 Marks]**
	CIA1: (60 Marks)	**CIA2: (60 Marks)**	
Remember	20	20	20
Understand	30	30	30
Apply	10	10	10
Analyse	40	40	40
Evaluate	-	-	-
Create	-	-	-
Assessment based on Continuous and End Semester Examination – Practical			
Bloom's Level	**Continuous Assessment (25%) [100 Marks]**		**End Semester Examination (25%) [100 Marks]**
	FA: (75 Marks)	**SA: (25 Marks)**	
Remember	20	20	20
Understand	30	30	30
Apply	10	10	10
Analyse	40	40	40
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination							
Continuous Assessment (50%)							**End Semester Examination (50%)**
CA 1 (100 Marks)			**CA 2 (100 Marks)**			**Practical Exam (100 Marks)**	**Theory Examination (25%) Practical Examination (25%)**
SA 1 (60M)	**FA 1**		**SA 2 (60M)**	**FA 2**		**FA (75M)**	**SA (25M)**	
	Component-I (20 Marks)	**Component-II (20 Marks)**		**Component-I (20 Marks)**	**Component-II (20 Marks)**		

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C102.1	-	-	-	-	-	-	-	1	3	3	1	-	2	-	-
C102.2	-	-	-	-	-	-	-	1	2	2	1	-	1	-	-
C102.3	-	-	-	-	-	-	-	1	3	2	1	-	1	-	-
C102.4	-	-	-	-	-	-	-	1	3	2	1	-	1	-	-
C102.5	-	-	-	-	-	-	-	1	3	2	1	-	1	-	-

22MA205 **LINEAR ALGEBRA** **3/1/0/4**

Nature of Course: J (Problem Analytical)
Pre requisites: NIL

Course Objectives:

1   To analyze and solve a linear system of equations to find the determinant.
2   To understand the concepts independence, basis, dimensions orthogonality in vector spaces.
3   Evaluate mathematical expressions to compute quantities that deal with linear systems and Eigen value problems.
4   To find the Eigen values and Eigenvectors of a matrix or a linear transformation and diagonalize a matrix using it.
5   To diagonalize the symmetric and non-symmetric matrix using singular value decomposition and principal component analysis.

Course Outcomes:

Upon completion of the course, students shall have ability to

C205.1	Relate characteristics of solutions of a linear system to determinant and rank of its associated matrices.	[R]
C205.2	Test for independence of vectors and find the dimension and basis of a given vector space.	[U]
C205.3	Use computational techniques and algebraic skills essential for the study of systems of linear equations.	[AP]
C205.4	Solve algebraic Eigen value problems and find the extreme values of the given function.	[AP]
C205.5	Utilize singular value decomposition and principal component analysis to characterize and analyze matrices, especially the correlation matrix.	[AP]

Course Contents:

Determinants Introduction – Properties (without proof) - Solution of system of linear equations by Cramer's rule – Inverse of a matrix (using determinant).

Matrices Introduction –Definition of vectors and linear combinations - Types of matrix: Symmetric, skew symmetric, Hermitian and unitary matrices (Simple problems)- Matrix operations - Rank of a matrix - Solution of system of linear equations by Gaussian elimination and LU decomposition. Eigen values and Eigenvectors, Linear transformation (orthogonal transformation). Singular value decomposition (simple problems) and Principal component analysis (definition)– Introduction to their application in image processing and machine learning (problems not included).

Vector Space Vector space: Definition of dimension – Basis: Definition – simple problems, Orthogonality: Definition – simple problems, Definition of Projection – Simple problems in Gram-Schmidt orthogonalization and QR decomposition (theorems not included).

Total Hours: 60

Text Books:

1   Gilbert Strang, Introduction to linear algebra, 5th edition, Wellesley-Cambridge Press, 1988.
2   B. S. Grewal, Higher Engineering Mathematics ,43rd edition, Khanna publishers, 2014.
3   Veerarajan T, Engineering Mathematics, 2nd edition, McGraw Hill India, 2018.

Reference Books:

1   Peter V. O'Neil, Advanced Engineering Mathematics, 7th edition, Cengage Learning Custom Publishing,2011.
2   M. D. Greenberg, Advanced Engineering Mathematics, 2nd edition, Pearson, 1998.

Web References:

1   https://www.udemy.com/topic/linear-algebra
2   https://www.edx.org/course/introduction-to-linear-models-and-matrix-algebra
3   https://www.deeplearningbook.org/contents/linear_algebra.html
4   https://machinelearningmastery.com/introduction-matrices-machine-learning

Online Resources:

1   https://onlinecourses.nptel.ac.in/noc19_ma06
2   https://www.coursera.org/learn/linear-algebra-machine-learning
3   https://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/related-resources/

Continuous Assessment			Total Continuous Assessment	End Semester Examination	Total
Formative Assessment	**Summative Assessment**	**Total**			
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C205.1	Remember	Quiz	20
C205.2	Understand	Seminar	20
C205.3	Apply	Tutorial	20
C205.4	Apply	Assignment	
C205.5			20
Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%)**

	CIA1 : [60 Marks]	CIA2 : [60 Marks]	[100 Marks]
Remember	20	20	20
Understand	30	30	30
Apply	50	50	50
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination					
Continuous Assessment (40%) [200 Marks]					End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks		
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)	
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component – II (20 Marks)

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C205.1	1	1	-	-	-	-	-	-	-	-	-	-	-	1	2
C205.2	2	2	-	-	-	-	-	-	-	-	-	-	-	1	2
C205.3	3	3	-	-	-	-	-	-	-	-	-	-	-	1	2
C205.4	3	3	-	-	-	-	-	-	-	-	-	-	-	1	2
C205.5	3	3	-	-	-	-	-	-	-	-	-	-	-	1	2

22EN201   BUSINESS COMMUNICATION AND VALUE SCIENCE II   2/1/0/3

Nature of Course   E (Theory Skill Based)
Pre requisites   Business Communication and Value Science I
Course Objectives:

1   To develop the art of effective writing, reading, presentation and group discussion skills.
2   To help students to identify their personality traits and evolve as a better team player.
3   To introduce the key concepts of morality, behavior and beliefs.
4   To introduce the key concepts diversity and inclusion.

Course Outcomes:
Upon completion of the course, students shall have ability to

C201.1	Remember the tools of structured written communication and basics of presentation skills.	[R]
C201.2	Apply the basic concept of speed reading, skimming and scanning.	[AP]
C201.3	Understand and identifying the individual personality types and their role in a team along with the concept of morality and diversity.	[U]
C201.4	Recognize the concept of outward behavior and internal Behavior.	[AP]
C201.5	Organize an event to generate awareness and get support for a cause through communicative ability.	[AP]

Course Contents:

Good and Bad Writing. Identification of Common errors in punctuation rules, use of words - SATORI (sharing personal experience) - Introduction to basic presentation skills & ORAI app

Speed Reading - Introduction to skimming and scanning – Analysing personality traits - Dr.Meredith Belbin and his research on team work - Belbin's 8 Team Roles and Lindgren's Big 5 personality traits - Belbin's 8 team player styles

Diversity & Inclusion- Different forms of Diversity in our society – Organizing events to support - TCS values, Respect for Individual and Integrity.

Activities:
1. Immersion (interview)
2. Create CV
3. Group Assignment- Form an NGO
4. Group activities
5. Create and present a street play to articulate and amplify the social cause.

                                                              Total Hours: 45

Reference Books:

1 Dr. A.P.J. Abdul Kalam& Arun Tiwari, Guiding Souls: Dialogues on the purpose of life, Ocean Books Pvt. Ltd, 2005.
2 Dr. A.P.J. Abdul Kalam & Acharya Mahapragya, The Family and the Nation, HarperCollins Publishers India, a joint venture with India Today, New Delhi, 2015.
3 Dr. A.P.J Abdul Kalam & Y.S. Rajan, The Scientific Indian: A Twenty First Century Guide to the World Around Us, Penguin Viking, 2011.
4 Dr.A.P.J. Abdul Kalam, Forge Your Future: Candid, Forthright, Inspiring, Rajpal & Sons, 2014
5 & Peter H. Diamandis & Steven Kotler, Abundance: The Future is Better Than You Think,Simon & Schuster, 2012.
6 Simon Sinek, Start With Why: How Great Leaders Inspire Everyone to Take Action, Penguin Publishers, 2011.
7 Sandra Moriaty, Nancy D. Mitchell, William D.Wells, Advertising & IMC: Principles and Practice, Pearson Education India, 15 June 2016.

Web References:

1 https://www.eolss.net/Sample-Chapters/C14/E1-37-01-00.pdf
2 https://www.brown.edu/academics/science-and-technology-studies/frameworkmaking-ethicaldecisions
3 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
4 https://m.youtube.com/watch?v=dT_D68RJ5T8&feature=youtube
5 https://m.youtube.com/watch?v=7sLLEdBgYYY&feature=youtube

Continuous Assessment			Total Continuous Assessment	End Semester Examination	Total
Formative Assessment	Summative Assessment	Total			
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C201.1	Remember	Technical Presentation	20
C201.2 C201.4	Apply	Group Assignment	20
C201.3	Understand	Quiz	20

C201.5	Apply	Seminar		20

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	20	20	20
Understand	30	30	40
Apply	50	50	40
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
	FA 1 (40 Marks)			FA 2 (40 Marks)		
SA 1 (60 Marks)	Component - I (20 Marks)	Component - II (20 Marks)	SA 2 (60 Marks)	Component - I (20 Marks)	Component - II (20 Marks)	

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C201.1	-	-	-	-	3	-	-	-	3	2	1	-	2	2	-
C201.2	-	-	-	-	1	-	-	-	3	1	1	-	2	1	-
C201.3	-	-	-	-	1	-	-	-	3	2	1	-	2	3	-
C201.4	-	-	-	-	1	-	-	-	3	2	1	-	2	2	-
C201.5	-	-	-	-	1	-	-	-	3	3	1	-	2	3	-

22MG211   **FUNDAMENTALS OF ECONOMICS**   **3/0/0/3**

Nature of Course: C (Theory Concept)

Pre requisites: NIL

Course Objectives:
1   To impart the knowledge of micro economics that deals with the study of economic decision making by individuals and individual firms.
2   To make the students understand the various concepts in macroeconomics that deals with the performance and behaviour of an economy.
3. To impart the knowledge of the economic behaviour of firms operating in perfect and imperfect competition.
4. To study the role of money and credit creation by banks in the economic development of a nation.

Course Outcomes:
Upon completion of the course, students shall have ability to

C211.1   Understand basic principles and concepts of Microeconomics and apply them to solve the business problems.   [U]

C211.2   Examine the behaviour and performance of an economy of a nation.   [AP]

C211.3   Understand basic principles and concepts of Macroeconomics and apply them to solve the business problems.   [U]

C211.4   Understand the concepts of banking and central bank's monetary policy in economic development of a nation.   [U]

C211.5   Classify the behaviour of firms operating in perfect and imperfect completions.   [A]

Course Contents:

Introduction: Economics –meaning - Elasticity of demand - Elasticity of Supply; principles of Demand and Supply – Microeconomics and Macroeconomics.

Microeconomics:— 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

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; 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

Text Books:
1 Pindyck, Robert S., and Daniel L. Rubinfeld, Microeconomics,7th Edition, Pearson Education, 2009.
2 Dornbusch, Fischer and Startz. Macroeconomics, 12th Edition, McGraw Hill Education, 2018.
3 Paul Anthony Samuelson, Economics, William D. Nordhaus, 19th Edition, McGraw HillEducation, 2010.

Reference Books:

1 Hal R, Varian, Intermediate Microeconomics: A Modern Approach, W.W Norton and Company, 2009.
2 N. Gregory Mankiw, Principles of Macroeconomics, Cengage Learning India Pvt. Ltd., 2015.
3 S. Sankaran, Business Economics, Margham Publication, Chennai. Margham Publications, 2012.

Web References:
1   https://www.rbi.org.in
2   https://data.oecd.org/economy.htm
3   https://www.focus-economics.com
4   www.mospi.gov.in
5   https://www.ibef.org

Continuous Assessment			Total Continuous Assessment	End Semester Examination	Total
Formative Assessment	**Summative Assessment**	**Total**			
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C211.1	Understand	Quiz	20
C211.2	Apply	Tutorial	20
C211.3	Understand	Group Assignment	20
C211.4	Understand		
C211.5	Analyze	Presentation	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	30	30	30
Apply	30	30	30
Analyse	20	20	20
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks			**CA 2 : 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C211.1	-	3	2	-	-	2	2	1	1	-	-	1	2	2	-
C211.2	-	2	1	-	-	1	1	1	1	-	-	1	1	1	-
C211.3	-	3	2	-	-	2	2	1	1	-	-	1	2	2	-
C211.4	-	1	1	-	-	1	1	1	1	-	-	1	1	1	-
C211.5	-	2	1	-	-	1	1	1	1	-	-	1	1	1	-

22CB201   **DATA STRUCTURES**   **3/0/0/3**

Nature of Course: F (Theory Programming)
Pre requisites: Computer Programming

Course Objectives:
1   To understand the algorithms and data structures used for solving a problem
2   To learn linear data structures such as linked list, stack and queue
3   To gain knowledge in non-linear data structures such as trees and graphs
4   To be familiar with file structures

Course Outcomes:
Upon completion of the course, students shall have ability to
C201.1   Analyse time and space complexity of an algorithm   [A]
C201.2   Understand linear and non-linear data structures   [U]
C201.3   Apply the suitable data structure to solve the problem   [AP]
C201.4   Distinguish the different searching and sorting algorithms   [A]
C201.5   Understand the concept of file structures   [U]

Course Contents:

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: 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) and 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.

Total Hours: 45

Text Books:

1. E. Horowitz and S. Sahni, Fundamentals of Data Structures, Pitman Publishing, 1977.
2. V. Aho, J.E. Hopcroft and J. D. Ullman," Data Structures and Algorithms", 1st Edition, Pearson India,2002.

Reference Books:

1. Donald E. Knuth, The Art of Computer Programming: Volume 1: Fundamental Algorithms, 3rd edition, Addison Wesley; 1997.
2. Thomas, H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Introduction to Algorithms, 3rd edition, MIT Press, 2009.
3. Pat Morin, Open Data Structures: An Introduction (Open Paths to Enriched Learning), 31st ed. Edition, 31st ed. Edition, UBC Press, 2013.

Web References:

1 http://nptel.ac.in/courses//106103069/
2 https://www.coursera.org/learn/data-structures
3 http://web.stanford.edu/class/cs97si/

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	tTotal	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C201.1	Analyze	Quiz	20
C201.2	Understand	Tutorial	20
C201.3	Apply	Group Assignment	20
C201.4	Analyze		
C201.5	Understand	Assignment	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	20	20	20
Understand	30	30	30
Apply	20	20	20
Analyse	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C201.1	3	3	2	3	-	-	-	-	-	-	2	-	1	3	2
C201.2	3	2	2	2	-	-	-	-	-	-	2	-	1	2	1
C201.3	3	3	2	2	-	-	-	-	-	-	2	-	1	3	2
C201.4	3	2	2	2	-	-	-	-	-	-	2	-	1	2	1
C201.5	2	2	2	1	-	-	-	-	-	-	1	-	1	2	1

Nature of Course: C (Theory Concept)

Pre requisites: NIL

Course Objectives:
1 To know various concepts of Tamil Language families.
2 To know about the essentialities of Heritage.
3 To understand the Aram concepts of Tamils and the cultural influence.

Course Outcomes:
Upon completion of the course, students shall have ability to

C101.1	Know about the language families in India, impact of religions and the contribution of Bharathiyar and Bharathidhasan.	[U]
C101.2	Observe the growth of sculpture, making of musical instruments and the role of temples in socio and economic lives.	[U]
C101.3	Understand the significance of folklore and martial arts.	[U]
C101.4	Learn the sangam literature, sangam age and overseas conquest of Cholas.	[U]
C101.5	Understand the contribution of Tamils to Indian Freedom Struggle, role of Siddha medicine and print history of Tamil Books.	[U]

Course Contents:

Language and Literature: Language Families in India - Dravidian Languages – Tamil as a Classical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

Heritage - Rock Art Paintings to Modern Art – Sculpture: Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils. **Folk And Martial Arts:** Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

Thinai Concept Of Tamils - Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas. Contribution of Tamils to Indian national movement and indian culture: Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

Total Hours: 15

Text-cum-Reference Books:
1 தமிழக வரலாறு – மக்களும் பண்பாடும் – கே. கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2 கணினித் தமிழ் – முனைவர் இல. சுந்தரம் . (விகடன் பிரசுரம்).

3	கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4	பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5	Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6	Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7	Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8	The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9	Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu).
10	Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author).
11	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu).
12	Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C101.1	Understand	Quiz	20
C101.2	Understand	Seminar	20
C101.3	Understand	Seminar	20
C101.4	Understand	Quiz	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	

Remember	40	40	40
Understand	60	60	60
Apply	-	-	-
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C101.1	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
C101.2	-	-	-	-	-	-	-	1	1	-	-	1	-	-	-
C101.3	-	-	-	-	-	-	-	1	1	-	-	1	-	-	-
C101.4	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
C101.5	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-

22EC211   **PRINCIPLES OF ELECTRONICS ENGINEERING**   **3/0/2/4**

Nature of Course: G (Theory Analytical)

Pre requisites: Nil

Course Objectives:
1. To introduce the basic concepts of semiconductors and its types
2. To enable the students to understand the diode characteristics and diode-based circuits
3. To enable the student to understand the bipolar junction transistor and fluid effect transistor configurations with its characteristics
4. To allow students to gain knowledge in Operational amplifier and its circuits
5. To enable the students to understand the fundamentals of digital circuits

Course Outcomes:
Upon completion of the course, students shall have ability to

C211.1	Understand the basics of semiconductors	[U]
C211.2	Analyse the diode characteristics and its applications	[A]
C211.3	Apply the concepts of BJT's, FET and its characteristics	[AP]
C211.4	Analyse the characteristics of Operational Amplifier	[A]
C211.5	Understand the fundamentals of digital circuits and its implementation	[U]

Course Contents:
Semiconductors and Diodes: 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 and Field effect 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-Inverter

Feed Back, Operational Amplifiers and Digital Electronics Fundamentals: 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, sensitivies (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 two and three variable K- map Definitions: Logic ICs, half and full adder/subtractor, multiplexers, demultiplexers, flip-flops, shift registers, counters.

Total Hours:45

List of experiments:
1. Examine Forward and Reverse Characteristic of PN junction diode   [U]
2. Examine Forward and Reverse Characteristics of Zener diode   [U]
3. Classify Input and output characteristics of Bipolar junction transistors   [A]
4. Understand Drain and transfer characteristics of JFET   [U]
5. Design of Integrator and differentiator using op amp ic741   [AP]
6. Design of Adder and subtractor using op amp IC 741   [AP]
7. Classify basic logic functions using combinational circuits.   [A]

Total Hours:30

Text Books:

1. Salivahanan, Electron Devices and Circuits, 4th edition, McGraw Hill Education India Private Ltd., 2016.
2. D.Roy Choudhry, Shail Jain, Linear Integrated Circuits, New Age International Pvt. Ltd.,2010.
3. M. Morris Mano, Michael D.Ciletti., Digital Design,5th Edition, Pearson education, 2013.

Reference Books:

1. Ben Streetman, Sanjay Banerjee Solid State Electronic Devices 6th Edition, prentice hall,2000.

2. Albert Paul Malvino, Electronic PrincipleTata Mcgraw-Hill Publishing Company Limited,1st edition 1976.

3. D Schilling, C Belove, T Apelewicz, R Saccardi. Electronics Circuits: Discrete & Integrated1st edition,1996.

4. Jacob Millman, Chritos C Halkias, Satyabrata Jit, Electronic Devices and Circuits, 4th edition (SIE), McGraw Hill Education India Private Ltd, 2015

5. Sedra and Smith, Microelectronic Circuits, Oxford University Press, 5th Edition, 2005.

6. Robert Boylestad and Louis Nashelsky, Electron Devices and Circuit Theory, 11th edition, Pearson New International Edition, 2013

Web References:
1. http://www.learnabout-electronics.org/
2. https://www.electronics-tutorials.ws/
3. http://engineering.nyu.edu/gk12/amps-cbri/pdf/Basic%20Electronics.pdf

Online Resources:
1. https://freevideolectures.com/course/1990/circuits-and-electronics
2. https://nptel.ac.in/courses/117103063/
3. https://www.allaboutcircuits.com/video-lectures/

Continuous Assessment							Total (A+B)	Total Continuous Assessment	End Semester Examination	Total
Theory				Practical						
Formative Assessment	Summative Assessment	Total	Total (A)	Formative Assessment	Summative Assessment	Total (B)				
80	120	200	100	75	25	100	200	50	50	100

Formative Assessment based on Capstone Model - Theory			
Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (10%) [80 Marks]
C211.1	Understand	Quiz & Assignment	20
C211.2	Analyse	Assignment	20
C211.3	Apply	Case study	20
C211.4	Analyse	Group Assignment	20
C211.5	Understand		

Assessment based on Summative and End Semester Examination - Theory			
Bloom's Level	Summative Assessment (15%) [120 Marks]		End Semester Examination (35%) [100 Marks]
	CIA1: (60 Marks)	CIA2: (60 Marks)	
Remember	-	-	20
Understand	40	40	30
Apply	40	40	30
Analyse	20	20	20
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination - Practical			
Bloom's Level	Continuous Assessment (25%) [100 Marks]		End Semester Examination (15%) [100 Marks]
	FA: (75 Marks)	SA: (25 Marks)	
Remember	-	-	-
Understand	40	40	40
Apply	40	40	40
Analyse	20	20	20
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination								
Continuous Assessment (50%)								End Semester Examination (50%)
CA 1 (100 Marks)			CA 2 (100 Marks)			Practical Exam (100 Marks)		Theory Examination (35%) Practical Examination (15%)
SA 1 (60M)	FA 1		SA 2 (60M)	FA 2		FA (75M)	SA (25M)	
	Component-I (20 Marks)	Component-II (20 Marks)		Component-I (20 Marks)	Component-II (20 Marks)			

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C211.1	3	3	2	1	-	-	-	-	-	-	1	-	1	-	2
C211.2	3	2	1	1	-	-	-	-	-	-	1	-	1	-	2
C211.3	3	2	2	1	-	-	-	-	-	-	1	-	1	-	2
C211.4	3	2	2	1	-	-	-	-	-	-	1	-	1	-	2
C211.5	3	3	3	3	-	-	-	-	-	-	1	1	1	-	2

22MA206   **STATISTICAL MODELLING**   **3/0/2/4**

Nature of Course: G (Theory Analytical)
Pre Requisites: Probability and Statistics

Course Objectives:
1 To study the linear statistical models
2 To learn the concept of testing hypothesis using statistical analysis

3 To understand the fundamental concepts of estimation methods

4 To learn the concepts of R Programming.

Course Outcomes:
Upon completion of the course, students shall have ability to

C206.1	Remember the basic concepts of linear statistical models and Estimation methods	[R]
C206.2	Learn the concept of testing of hypothesis using statistical analysis	[U]
C206.3	Interpret the results of Bivariate and Multivariate Regression and Correlation Analysis, for forecasting and also perform ANOVA and F-test	[AP]
C206.4	Apply the knowledge of time series analysis in economics and engineering.	[AP]
C206.5	Apply non-parametric methods in estimation	[AP]

Course Contents:

Linear Statistical Models (no derivations): Simple linear regression & correlation, multiple regression & multiple correlation (three variables), Analysis of variance: one way, two way (no RBD, Latin square design)

Estimation (no derivations): Definition of Point estimation, criteria for good estimates (un-biasedness, consistency)- Simple problems, Method of estimation: Maximum likelihood estimation - **Sufficient Statistic (no derivations)**: Concept & examples, complete sufficiency, their application in estimation (Simple problems) - **Test of hypothesis**: Concept & formulation, Type I and Type II errors, Neyman Pearson lemma(statement only),Procedures of testing: Small samples- Student's t test, F test , Chi square test- Large samples -Mean and proportions only.

Non-parametric Inference (no derivations): Comparison with parametric inference, Use of order statistics. Signtest, Wilcoxon signed rank test, Tolerance region (simple problems) - **Basics of Time Series Analysis & Forecasting:** Stationary, ARIMA Models: Identification, Estimation and Forecasting (simple problems).**Programming Method: R statistical programming language.**

Total Hours:45

Lab Exercises:

Implementation of the following Experiments   [U]
    1. Introduction to R, Functions, Control flow and Loops

2. Working with Vectors and Matrices
3. Reading in Data, Writing Data, Working with Data, Manipulating Data
4. Simulation
5. Linear model
6. Data Frame
7. Graphics in R
8. Building ARIMA Models
9. Fitting the multiple regression

Total Hours:30

Text Books:
1. I.R. Miller, J.E. Freund and R. Johnson, Probability and Statistics for Engineers, 8th edition, Pearson Education, 2001.
2. A. Goon, M. Gupta and B. Das Gupta, Fundamentals of Statistics, 1999.
3. Chris Chatfield, The Analysis of Time Series: An Introduction, 6th Edition, CRC Press, 2001.

Reference Books:
1. D.C. Montgomery &E.Peck, Introduction to Linear Regression Analysis, 5th Edition,2012.
2. A.M. Mood, F.A. Graybill & D.C. Boes, Introduction to the Theory of Statistics, Wiley, New York, 1974
3. N. Draper & H. Smith, Applied Regression Analysis, Wiley, 2014.
4. Garrett Grolemund, Hands-on Programming with R, O'Reilly Media, Inc, 2014.
5. Jared P. Lander, R for Everyone: Advanced Analytics and Graphics, Pearson education, 2013.

Web References:
1   https://onlinecourses.nptel.ac.in/noc17_ch03/preview
2   https://www.edx.org/course/statistical-modeling-and-regression-analysis

Continuous Assessment										End Semester Examination	Total
Theory				**Practical**			**Total (A+B)**	**Total Continuous Assessment**			
Formative Assessment	Summative Assessment	Total	Total (A)	Formative Assessment	Summative Assessment	Total (B)					
80	**120**	**200**	**100**	**75**	**25**	**100**	**200**	**50**		**50**	**100**

Formative Assessment based on Capstone Model - Theory			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (10%) [80 Marks]**
C206.1	Remember	Quiz & Assignment	**20**

C206.2	Understand	Assignment	20
C206.3	Apply	Case study	20
C206.4	Apply	Group Assignment	20
C206.5	Apply		

Assessment based on Summative and End Semester Examination - Theory

Bloom's Level	Summative Assessment (15%) [120 Marks]		End Semester Examination (35%) [100 Marks]
	CIA1: (60 Marks)	CIA2: (60 Marks)	
Remember	20	-	20
Understand	40	20	40
Apply	40	80	40
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination - Practical

Bloom's Level	Continuous Assessment (25%) [100 Marks]		End Semester Examination (15%) [100 Marks]
	FA: (75 Marks)	SA: (25 Marks)	
Remember	20	-	20
Understand	40	20	40
Apply	40	80	40
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (50%)								End Semester Examination (50%)
CA 1 (100 Marks)			CA 2 (100 Marks)			Practical Exam (100 Marks)		Theory Examination (35%) Practical Examination (15%)
SA 1 (60M)	FA 1		SA 2 (60M)	FA 2		FA (75M)	SA (25M)	
	Component-I (20 Marks)	Component-II (20 Marks)		Component-I (20 Marks)	Component-II (20 Marks)			

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C206.1	1	1	1	-	-	-	-	-	-	-	-	-	-	1	2
C206.2	2	2	2	1	1	-	-	-	-	-	-	-	-	1	2
C206.3	3	3	2	1	1	-	-	-	-	-	-	-	-	1	2
C206.4	3	3	2	-	1	-	-	-	-	-	-	-	-	1	2
C206.5	3	3	2	-	1	-	-	-	-	-	-	-	-	1	2

22CB202   **DATA STRUCTURES LABORATORY**   **0/0/3/1.5**

Nature of Course: M (Practical Application)
Pre requisites: Data Structures

Course Objectives:

1   To design and implement linear data structures – lists, stacks, and queues
2   To implement sorting, searching and hashing algorithms
3   To solve problems using tree and graph structures

Course Outcomes:
Upon completion of the course, students shall have ability to

C202.1	Implement linear data structures, such as lists according to the needs of different applications	[AP]
C202.2	Analyse linear data structures, such as queues, and stacks, according to the needs of different applications	[A]
C202.3	Inspect efficient tree structures to meet requirements for searching and indexing	[A]
C202.4	Evaluate efficient tree structures to meet requirements for sorting problems	[E]
C202.5	Solve graph problems and implement efficient graph traversal algorithms to solve them	[AP]

Lab Exercises:

1. Write a C program that uses functions to perform the following: a) Create a singly linked list of integers. b) Delete a given integer from the above linked list. c) Display the contents of the above list after deletion.
2. Write a C program that uses functions to perform the following: a) Create a doubly linked list of integers. b) Delete a given integer from the above doubly linked list. c) Display the contents of the above list after deletion.
3. Write a C program that uses stack operations to convert a given infix expression into its postfix Equivalent, Implement the stack using an array.
4. Write C programs to implement a double ended queue ADT using i) array and ii) doubly linked list respectively.
5. Write a C program that uses functions to perform the following: a) Create a binary search tree of characters. b) Traverse the above Binary search tree recursively in Postorder.
6. Write a C program that uses functions to perform the following: a) Create a binary search tree of integers. b) Traverse the above Binary search tree non recursively in inorder.
7. Write C programs for implementing the following sorting methods to arrange a list of integers in ascending order: a) Insertion sort b) Merge sort
8. Write C programs for implementing the following sorting methods to arrange a list of integers in ascending order: a) Quick sort b) Selection sort
9. Write a C program to implement all the functions of a dictionary (ADT) using hashing.

10. Write C programs for implementing the following graph traversal algorithms: a)Depth first traversal b)Breadth first traversal

Total Hours: 45

Text Books:

1. E. Horowitz and S. Sahni, Fundamentals of Data Structures, Pitman Publishing, 1977.
2. V. Aho, J.E. Hopcroft and J. D. Ullman," Data Structures and Algorithms", 1st Edition, Pearson India, 2002.

Reference Books:

1. Donald E. Knuth, The Art of Computer Programming: Volume 1: Fundamental Algorithms, 3rd edition, Addison Wesley; 1997.
2. Thomas, H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Introduction to Algorithms, 3rd edition, MIT Press, 2009.
3. Pat Morin, Open Data Structures: An Introduction (Open Paths to Enriched Learning), 31st ed. Edition, UBC Press, 2013.

Web References:
1   http://nptel.ac.in/courses//106103069/
2   https://www.coursera.org/learn/data-structures
3   http://web.stanford.edu/class/cs97si/

Continuous Assessment				End Semester Examination	Total
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
75	25	100	60	40	100

Assessment based on Continuous and End Semester Examination			
Bloom's Level	**Continuous Assessment (60%) [100 Marks]**		**End Semester Practical Examination (40%) [100 Marks]**
	FA (75 Marks)	**SA (25 Marks)**	
Remember	-	-	-
Understand	-	-	-
Apply	60	60	60
Analyse	30	30	30

Evaluate	10	10	10
Create	-	-	-

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C202.1	3	3	2	3	-	-	-	-	-	-	2	-	1	3	2
C202.2	3	2	2	2	-	-	-	-	-	-	2	-	1	2	1
C202.3	3	3	2	2	-	-	-	-	-	-	2	-	1	3	2
C202.4	3	2	2	2	-	-	-	-	-	-	2	-	1	2	1
C202.5	2	2	2	1	-	-	-	-	-	-	1	-	1	2	1

22CB301   **COMPUTER ORGANIZATION AND ARCHITECTURE**   **3/0/0/3**

Nature of Course: C (Theory Concept)

Pre requisites: Nil

Course Objectives:

1	To recognize the basic structure of a digital computer and representation of non-numeric data.
2	To learn different arithmetic operations and organization of control unit.
3	To study different ways of communication with I/O devices, concept of pipelining and its impact in processor design and parallel processors.

Course Outcomes:

Upon completion of the course, students shall have ability to

C301.1	Discuss the functionalities of various blocks of a digital computer and express the data representation.	[U]
C301.2	Apply the concept of Arithmetic and Logic Unit.	[AP]
C301.3	Infer the concepts of memory system, concurrence access in parallel processors and classify the approaches for I/O communication.	[U]
C301.4	Identify hazards in pipelining and outline its impact in the performance of the processors.	[U]
C301.5	Compare various types of I/O mapping techniques	[U]

Course Contents:

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 device interface, I/O transfers – program controlled, interrupt driven and DMA, privileged and non-privileged instructions, software interrupts and exceptions. Programs and processes – 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.

                                                                   Total Hours: 45

Text Books:

1. Morris Mano*,* Computer System Architecture, 3rdEdition, Prentice Hall of India, New Delhi, 2014.
2. David A. Patterson and John L. Hennessy, Computer Organization and Design: The Hardware/Software Interface, Elsevier, 5th Edition 2013.
3. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Naraig Manjikian, Computer Organization and Embedded Systems, McGraw-Hill, 6th Edition 2014.

Reference Books:

1. John P. Hayes, Computer Architecture and Organization, McGraw-Hill ,3rd Edition, 2013.
2. William Stallings, Computer Organization and Architecture – Designing for Performance, 10thEdition, Pearson Education, 2015.
3. Vincent P. Heuring and Harry F. Jordan, Computer System Design and Architecture, Prentice Hall, 2ndEdition, 2004.

Web References:

1. http://pages.cs.wisc.edu/~david/courses/cs354/onyourown/reps.chars.html
2. https://www.cp.eng.chula.ac.th/~piak/teaching/ca/s1.htm

Online Resources:

1. https://www.coursera.org/learn/comparch
2. https://nptel.ac.in/courses/106105163/

Continuous Assessment			Total Continuous Assessment	End Semester Examination	Total
Formative Assessment	**Summative Assessment**	**Total**			
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component**	**FA (16%) [80 Marks]**
C301.1	Understand	Online Quiz	20
C301.2	Apply	Tutorial	20
C301.3	Understand	Assignment	20
C301.4 & C301.5	Understand	Group Assignment	20

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Assessment based on Summative and End Semester Examination			
Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	20	20	20
Understand	40	60	60
Apply	40	20	20
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C301.1	1	2	2	1	-	-	-	-	1	-	-	-	1	1	-
C301.2	1	1	3	1	-	-	-	-	1	-	-	-	1	-	1
C301.3	1	1	2	-	1	1	-	1	1	1	2	1	-	1	1
C301.4	1	1	1	1	1	1	1	1	1	-	1	1	1	1	1
C301.5	1	1	2	1	1	-	1	-	-	1	1	-	1	1	1

22CB302   **OBJECT ORIENTED PROGRAMMING**   **1/0/4/3**

Nature of Course: F (Theory Programming)

Pre requisites: Computer Programming

Course Objectives:

1. To explain the difference between object oriented programming and procedural programming.
2. To build C++ classes using fundamentals of Object oriented programming.
3. To apply object oriented concepts to solve bigger computing problems with generic programming.

Course Outcomes:

Upon completion of the course, students shall have ability to

C302.1	Understand the concepts and relative merits of C++	[U]
C302.2	Develop programs using object oriented concepts such as encapsulation, inheritance and polymorphism	[AP]
C302.3	Implement stream I/O, templates and operator overloading	[AP]
C302.4	Understand the Object Oriented Design and Modeling	[U]
C302.5	Experiment generic programming concepts in object-oriented programming Modeling	[A]

Course Contents:

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, #define constant vs const, Operator new and delete, the typecasting operator, Inline Functions in contrast to macro, default arguments

The 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 Modeling: UML concept, Use case for requirement capturing, Class diagram, Activity diagram and Sequence Diagram for design, Corresponding C++ code from design.

                                               Total Hours: 45

Lab Exercises:

1. Study of different UML diagrams
2. Programs on concept of classes and objects
3. Programs using friend functions

4. Programs using static polymorphism
5. Programs using constructors
6. Programs using inheritance
7. Programs on dynamic polymorphism
8. Programs on exception handling
9. Programs on generic programming using template function & template class
10. Programs on file handling

Total Hours : 30

Text Books:

1. Bjarne Stroustrup, The C++ Programming Language, Pearson Education, 3rd Edition, 2018.
2. Debasish Jana, C++ and Object-Oriented Programming Paradigm, PHI Learning, 2nd Edition, 2014.

Reference Books:

1. Bjarne Stroustrup, Programming: Principles and Practice Using C++, Addison Wesley, 2009.
2. Bjarne Stroustrup, The Design and Evolution of C++, Pearson Education, 2009.

Web References:

1. https://www.studytonight.com/cpp/cpp-and-oops-concepts.php
2. https://www.tutorialspoint.com/What-are-basic-Object-oriented-programming-concepts

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc16_cs17/preview
2. https://www.geeksforgeeks.org/basic-concepts-of-object-oriented-programming-using-c/
3. http://www.iitk.ac.in/esc101/05Aug/tutorial/java/concepts/index.html

Continuous Assessment									Total Continuous Assessment	End Semester Practical Examination	Total
Theory				Practical			Total (A+B)				
Formative Assessment	Summative Assessment	Total	Total (A)	Formative Assessment	Summative Assessment	Total (B)					
80	120	200	100	75	25	100	200		50	50	100

Formative Assessment based on Capstone Model - Theory			
Course Outcome	**Bloom's Level**	**Assessment Component**	**FA (10%) [80 Marks]**
C302.1	Understand	Online Quiz	20
C302.2	Apply	Tutorial	20
C302.3	Apply	Assignment	20
C302.5	Analyze	Case Study / Tutorial	20

Assessment based on Summative Assessment - Theory		
Bloom's Level	**Summative Assessment (15%) [120 Marks]**	
	CIA1: (60 Marks)	**CIA2: (60 Marks)**
Remember	10	10
Understand	40	20
Apply	50	50
Analyze	-	20
Evaluate	-	-
Create	-	-

Assessment based on Continuous and End Semester Examination - Practical			
Bloom's Level	**Continuous Assessment (25%) [100 Marks]**		**End Semester Examination (50%) [100 Marks]**
	FA: (75 Marks)	**SA: (25 Marks)**	
Remember	-	-	-
Understand	20	20	20
Apply	80	80	80
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination							
Continuous Assessment (50%)							**End Semester Practical Examination (50%)**
CA 1 (100 Marks)			**CA 2 (100 Marks)**			**Practical Exam (100 Marks)**	
	FA 1			**FA 2**			
SA 1 (60M)	**Component-I (20 Marks)**	**Component-II (20 Marks)**	**SA 2 (60M)**	**Component-I (20 Marks)**	**Component-II (20 Marks)**	**FA (75M)**	**SA (25M)**

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C302.1	1	2	2	2	2	1	1	2	1	1	1	1	2	1	1
C302.2	1	2	2	2	1	2	1	2	1	2	1	1	2	1	2
C302.3	2	2	3	3	2	1	2	2	2	3	2	2	2	2	1
C302.4	1	2	3	3	2	1	1	2	1	3	2	1	2	1	1
C302.5	1	1	2	1	1	1	2	1	2	2	2	1	1	1	1

22CB303   **DATABASE MANAGEMENT SYSTEMS**   **1/0/4/3**

Nature of Course: F (Theory Programming)

Pre requisites: Nil

Course Objectives:

1. To discuss the fundamentals of data models to conceptualize and depict a database system using ER diagram.
2. To illustrate the relational database implementation using SQL with effective relational database design concepts.
3. To explain the fundamental concepts of transaction processing- concurrency control techniques and recovery procedure

Course Outcomes:

Upon completion of the course, students shall have ability to

C303.1	Describe different data models and DBMS architecture.	[U]
C303.2	Analyze entity relation diagram and transform it into a relational database schema and explore SQL Programming language.	[A]
C303.3	Demonstrate relational database design with normalization theory.	[AP]
C303.4	Practice the query evaluation techniques, query optimization and familiar with basic database storage structures and access techniques.	[AP]
C303.5	Identify the basic issues of transaction processing and concurrency control.	[U]

Course Contents:

Introduction: Introduction to Database. Hierarchical, Network and Relational Models. **Database system architecture**: Data Abstraction, Data Independence. **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, Open source and Commercial DBMS - MYSQL, ORACLE, DB2, SQL server.

Relational Database Design: Domain and data dependency, Armstrong's axioms, Functional Dependencies, Normal forms, Dependency preservation, Lossless design. **Query processing and optimization**: Evaluation of relational algebra expressions, Query equivalence, Join strategies, Query optimization algorithms. **Storage strategies**: Indices, B-trees, Hashing.

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, Data warehousing and data mining.

Total Hours: 45

Lab Exercises:
1. Conceptual Database design using E-R DIAGRAM
2. Implementation of SQL commands DDL, DML, DCL and TCL
3. Queries to demonstrate implementation of Integrity Constraints
4. Practice of Inbuilt functions
5. Implementation of Join and Nested Queries AND Set operators
6. Implementation of virtual tables using Views
7. Practice of Procedural extensions (Procedure, Function, Cursors, Triggers)
8. Application Development using front end tools
9. Document Database creation using MongoDB
10. Study of Cloud Storage
11. Mini Project (Application Development using DB)
    i) IT Training Group Database
    ii) Blood Donation System
    iii) Salary Management System
    iv) Traffic Light Information System

Total Hours: 30

Continuous Assessment									End Semester Practical Examination	Total
Theory				Practical			Total (A+B)	Total Continuous Assessment		
Formative Assessment	Summative Assessment	Total	Total (A)	Formative Assessment	Summative Assessment	Total (B)				
80	120	200	100	75	25	100	200	50	50	100

Formative Assessment based on Capstone Model - Theory			
Course Outcome	Bloom's Level	Assessment Component	FA (10%) [80 Marks]
C303.1	Understand	Online Quiz	20
C303.2	Analyze	Case Study	20
C303.3 & C303.4	Apply	Assignment	20
C303.5	Understand	Group Assignment	20
Assessment based on Summative Assessment - Theory			
Bloom's Level	Summative Assessment (15%) [120 Marks]		
	CIA1: (60 Marks)	CIA2: (60 Marks)	
Remember	10	20	
Understand	30	20	
Apply	30	60	
Analyze	30	-	
Evaluate	-	-	
Create	-	-	

Assessment based on Continuous and End Semester Examination - Practical

Bloom's Level	Continuous Assessment (25%) [100 Marks]		End Semester Examination (50%) [100 Marks]
	FA: (75 Marks)	SA: (25 Marks)	
Remember	30	30	30
Understand	30	20	30
Apply	20	30	20
Analyze	20	20	20
Evaluate	20	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (50%)								End Semester Practical Examination (50%)
CA 1 (100 Marks)			CA 2 (100 Marks)			Practical Exam (100 Marks)		
SA 1 (60M)	FA 1		SA 2 (60M)	FA 2		FA (75M)	SA (25M)	
	Component-I (20 Marks)	Component-II (20 Marks)		Component-I (20 Marks)	Component-II (20 Marks)			

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C303.1	3	2	3	3	2	1	1	-	1	-	1	1	3	2	2
C303.2	2	2	3	3	2	1	1	1	2	1	1	1	2	3	2
C303.3	2	2	2	2	3	1	1	1	2	1	1	1	2	3	2
C303.4	2	2	2	2	3	1	1	1	1	-	1	1	2	1	2
C303.5	3	2	3	2	2	2	2	3	2	-	1	2	3	1	2

22TA201   **TAMILS AND TECHNOLOGY**   **1/0/0/1**

Nature of Course: C (Theory Concept)

Pre requisites: NIL

Course Objectives:

1. To know about weaving, ceramic, design and construction technologies in sangam age.
2. To know the significance of technologies such as manufacturing, agriculture and irrigation.
3. To understand the development of Scientific Tamils and Tamil Computing.

Course Outcomes:
Upon completion of the course, students shall have ability to

C201.1	Describe about the weaving industry in sangam age and ceramic technology.	[U]
C201.2	Observe the design of houses, sculptures and construction of temples.	[U]
C201.3	Relate the various manufacturing materials and stone types in Silappathikaram.	[U]
C201.4	Understand the significance of agriculture and irrigation technology in ancient period.	[U]
C201.5	Explain the growth of scientific Tamil, Tamil computing and digitization of Tamil books.	[U]

Course Contents:
Weaving and Ceramic Technology: Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries. **Design and Construction Technology:** Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple) - Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.

Manufacturing Technology: Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel - Copper and gold - Coins as source of history - Minting of Coins – Beads making-industries Stone beads - Glass beads - Terracotta beads - Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram. **Agriculture and Irrigation Technology:** Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

Scientific Tamil & Tamil Computing: Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.

                                              Total Hours: 15

Text-cum-Reference Books:

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே. கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).

2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம் . (விகடன் பிரசுரம்).

3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)

4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)

5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)

6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.

7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).

8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)

9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu).

10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author).

11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu).

12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Continuous Assessment			Total Continuous Assessment	End Semester Examination	Total
Formative Assessment	Summative Assessment	Total			
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C201.1	Understand	Seminar	20
C201.2	Understand	Quiz	20
C201.3, C201.4	Understand	Quiz	20
C201.5	Understand	Seminar	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	40	40	40
Understand	60	60	60
Apply	-	-	-
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks			**CA 2 : 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C201.1	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1
C201.2	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1
C201.3	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1
C201.4	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1
C201.5	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1

22MA308   **COMPUTATIONAL STATISTICS**   **3/0/2/4**

Nature of Course: K (Problem Programming)
Pre requisites: Probability and Statistics
Course Objectives:
   1   To study the concepts of linear regression models, data science to analyze the business problems, effectively visualize the data
   2   To develop a sound understanding of current, modern computational statistical approaches and their application to a variety of datasets.
   3   To understand the key technologies in data science and business analytics such as data mining, machine learning, visualization techniques, predictive modeling, and statistics.

Course Outcomes:

Upon completion of the course, students shall have ability to

C308.1	Interpret the basic concepts of linear statistical models	[U]
C308.2	Utilize the results of Multivariate Regression models	[AP]
C308.3	Develop a sound understanding of current, modern computational statistical approaches and their application to a variety of datasets.	[AP]
C308.4	Construct non-trivial Python programs.	[AP]
C308.5	Apply algorithms for Data Visualization.	[AP]

Course Contents:

Multivariate Normal Distribution: Multivariate Normal Distribution Functions, Conditional Distribution and its relation to regression model, Estimation of parameters-**Multiple Linear Regression Model:** Standard multiple regression models with emphasis on detection of collinearity, outliers, non-normality and autocorrelation, Validation of model assumptions-**Multivariate Regression:** Assumptions of Multivariate Regression Models, Parameter estimation, Multivariate Analysis of variance and covariance.

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

Python Concepts, Data Structures, Classes: Interpreter, Program Execution, Statements, Expressions, Flow Controls, Functions, Numeric Types, Sequences and Class Definition, Constructors, Text & Binary Files - Reading and Writing. **Data Wrangling:** Combining and Merging Datasets, Reshaping and Pivoting, Data Transformation, String Manipulation, Regular Expressions. **Data Aggregation, Group Operations, Time series:** GroupBy Mechanics, Data Aggregation, Groupwise Operations and Transformations, Pivot Tables and Cross Tabulations, Time Series Basics, Data Ranges, Frequencies and Shifting **Visualization in Python:** Matplotlib package, Plotting Graphs, Controlling Graph, Adding Text, More Graph Types, Getting and setting values, Patches.

Total Hours: 45

Lab Exercises:
1. Basic Python Programs
2. Program using String Operations
3. Program on python Data structures
4. Working with data in python using pandas.
5. Perform various numpy operations and special functions.
6. Draw statistical graphics using seaborn
7. Implement k-means, logistic and time series algorithm using Scikit-learn
8. Visualization in python using matplotlib.

Total Hours: 30

Text Books:
1   T.W. Anderson, An Introduction to Multivariate Statistical Analysis, Wiley, 3rd Edition, 2003

2   J.D. Jobson, Applied Multivariate Data Analysis, Vol I & II, Springer, 2012

3   Magnus Lie Hetland, Beginning Python: From Novice to Professional,Apress, 2ndEdition, 2008

Reference Books:
1   Stanley A Mulaik, Foundations of Factor Analysis, CRC Press, 2nd Edition, 2009
2   Douglas C. Montogomery, Elizabeth A.Peck, G.Geoffrey Vining, Introduction to Linear Regression Analysis, Wiley,5th Edition,2012
3   Wes Mc Kinney, Python for Data Analysis, O'Reilly, 2018
4   Mark Lutz, Programming Python, Shroff Publishers, 3rd Edition, 2006
5   Tim Hall and J-P Stacey, Python 3 for Absolute Beginners,Apress, 2009

Web References:
1   https://www.edx.org/course/statistical-modeling-and-regression-analysis
2   https://www.cin.ufpe.br/~embat/Python%20for%20Data%20Analysis.pdf
3   https://www.kdnuggets.com/2016/07/statistical-data-analysis-python.html
4   https://people.duke.edu/~ccc14/sta-663/

Online Resources:
1   https://onlinecourses.nptel.ac.in/noc19_mg13/preview
2   https://nptel.ac.in/courses/110106064/
3   https://www.analyticsvidhya.com/blog/2016/01/complete-tutorial-learn-data-science-python-scratch-2/
4   https://www.datacamp.com/community/tutorials/python-statistics-data-science
5   https://github.com/cliburn/Computational-statistics-with-Python/tree/master/

Continuous Assessment								Total (A+B)	Total Continuous Assessment	End Semester Examination	Total
Theory				Practical							
Formative Assessment	Summative Assessment	Total	Total (A)	Formative Assessment	Summative Assessment	Total (B)					
80	120	200	100	75	25	100		200	50	50	100

Formative Assessment based on Capstone Model - Theory

Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (10%) [80 Marks]
C308.1	Understand	Quiz	20
C308.2	Apply	Assignment	20
C308.3	Apply	Presentation	20
C308.4	Apply	Case Study	20
C308.5	Apply		

Assessment based on Summative and End Semester Examination - Theory

Bloom's Level	Summative Assessment (15%) [120 Marks]		End Semester Examination (35%) [100 Marks]
	CIA1: (60 Marks)	CIA2: (60 Marks)	
Remember	20	10	10
Understand	20	20	30
Apply	60	70	60
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination – Practical

Bloom's Level	Continuous Assessment (25%) [100 Marks]		End Semester Examination (15%)
	FA: (75 Marks)	SA: (25 Marks)	

			[100 Marks]
Remember	10	10	10
Understand	30	30	30
Apply	60	60	60
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (50%)								End Semester Examination (50%)
CA 1 (100 Marks)			CA 2 (100 Marks)			Practical Exam (100 Marks)		Theory Examination (35%) Practical Examination (15%)
SA 1 (60M)	FA 1		SA 2 (60M)	FA 2		FA (75M)	SA (25M)	
	Component-I (20 Marks)	Component-II (20 Marks)		Component-I (20 Marks)	Component-II (20 Marks)			

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C308.1	3	2	2	1	1	-	2	2	-	-	2	-	-	1	2
C308.2	3	2	2	1	1	-	2	2	-	-	2	-	-	1	2
C308.3	3	2	2	1	2	1	2	3	1	1	3	1	2	2	2
C308.4	2	2	3	1	1	-	3	3	2	2	2	1	-	-	2
C308.5	2	2	3	1	2	1	3	3	2	2	3	1	2	2	2

Nature of Course: D (Theory Application)
Pre requisites: NIL
Course Objectives:

1	To gain knowledge of basic software engineering methods and practices, and their appropriate application.
2	To describe software engineering layered technology and Process frame work.
3	To identify the approaches to verification and validation using static and dynamic testing for software measurement and software risks.

Course Outcomes:

Upon completion of the course, students shall have ability to

C304.1	Recall software engineering principles and methodologies	[R]
C304.2	Explain project management and process improvement activities	[U]
C304.3	Analyse the user requirements and design an application using software engineering concepts	[A]
C304.4	Develop efficient, reliable, robust and cost-effective software solutions	[AP]
C304.5	Evaluate the applications by testing and debugging	[E]

Course Content:

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.

Total hours: 45

Lab Exercises:

Prepare the following documents for any one of the experiments and develop the software using software engineering methodology.
- Problem Analysis and Project Planning Thorough study of the problem
- Identify project scope, Objectives, infrastructure
- Software Requirement Analysis Describe the individual Phases/ modules of the project, Identify deliverables.
- Data Modelling Use work products – data dictionary, use case diagrams and activity diagrams, build and test class diagrams, sequence diagrams and add interface to class diagrams.
- Software Development and Debugging
- Software Testing Prepare test plan, perform validation testing, coverage analysis, memory leaks, develop test case hierarchy, Site check and site monitor
- Understand a given business scenario and identify product backlog, user stories and sprint tasks

1. Course Registration System
2. Quiz System
3. Online ticket reservation system
4. Remote computer monitoring
5. Student marks analyzing system
6. Expert system to prescribe the medicines for the given symptoms
7. ATM system
8. Platform assignment system for the trains in a railway station
9. Stock maintenance.

Total Hours: 30

Text Books:
1   Ian Sommerville, Software Engineering, Addison-Wesley, 2011.
2   Ivar Jacobson, Object Oriented Software Engineering: A Use Case Driven Approach, ACM Press, 1992.

Reference Books:
1.   Carlo Ghezzi, Jazayeri Mehdi, Mandrioli Dino, Fundamentals of Software Engineering, 2nd Edition, Pearson,2002.
2.   A Lexicon of Practice, Principles and Prejudices, Michael Jackson, Software Requirements and Specification, 1stEdition, 1995.
3.   Ivar Jacobson, Grady Booch, James Rumbaugh, The Unified Development Process, Addison Wesley, 1999.
4.   Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides, Design Patterns: Elements of Object-Oriented Reusable Software, 1st Edition, Addison Wesley, 1994.

5. Norman E. Fenton, Shari Lawrence Pfleeger, "Software Metrics: A Rigorous and Practical Approach", 2nd Edition, International Thomson Computer Press, 1997.

Web References:

1   http://www.site.uottawa.ca/school/research/lloseng/weblinks.html
2   https://www.geeksforgeeks.org/software-engineering/
3   http://www.rspa.com/index.html

Online Resources:

1   https://nptel.ac.in/courses
2   https://cosmolearning.org

Continuous Assessment									End Semester Examination	Total
Theory				Practical				Total Continuous Assessment		
Formative Assessment	Summative Assessment	Total	Total (A)	Formative Assessment	Summative Assessment	Total (B)	Total (A+B)	Total Continuous Assessment	End Semester Examination	Total
80	120	200	100	75	25	100	200	50	50	100

Formative Assessment based on Capstone Model - Theory			
Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (10%) [80 Marks]
C304.1	Remember	Quiz	**20**
C304.2	Understand	Presentation	**20**
C304.3	Analyse	Assignment	**20**
C304.4	Apply	Assignment	**20**
Assessment based on Summative and End Semester Examination - Theory			
Bloom's Level	Summative Assessment (15%) [120 Marks]		End Semester Examination (35%) [100 Marks]
	CIA1: (60 Marks)	CIA2: (60 Marks)	
Remember	20	10	10
Understand	30	20	20
Apply	50	50	50
Analyse	-	20	20
Evaluate	-	-	-
Create	-	-	-
Assessment based on Continuous and End Semester Examination - Practical			

Bloom's Level	Continuous Assessment (25%) [100 Marks]		End Semester Examination (15%) [100 Marks]
	FA: (75 Marks)	SA: (25 Marks)	
Remember	10	10	10
Understand	10	10	10
Apply	40	40	40
Analyse	20	20	20
Evaluate	20	20	20
Create	-	-	-

Assessment based on Continuous and End Semester Examination							
Continuous Assessment (50%)							End Semester Examination (50%)
CA 1 (100 Marks)			CA 2 (100 Marks)			Practical Exam (100 Marks)	Theory Examination (35%) Practical Examination (15%)
	FA 1			FA 2			
SA 1 (60M)	Component-I (20 Marks)	Component-II (20 Marks)	SA 2 (60M)	Component-I (20 Marks)	Component-II (20 Marks)	FA (75M)	SA (25M)	

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C304.1	3	2	2	1	-	-	2	2	-	-	1	-	3	1	1
C304.2	3	2	2	1	-	1	2	2	-	-	2	1	2	3	-
C304.3	3	2	2	1	-	1	2	3	-	-	1	-	3	2	1
C304.4	2	2	3	1	1	-	3	3	2	2	-	-	1	2	1
C304.4	1	1	2	1	1	1	1	1	1	2	2	1	1	2	1

22CB401 **INTRODUCTION TO INNOVATION, IP MANAGEMENT AND ENTREPRENEURSHIP** **3/0/0/3**

Nature of Course: C (Theory Concept)

Pre requisites: NIL

Course Objectives

The successful completion of the course will help students gain knowledge on:
1. How to identify and discover market needs and manage an innovation program
2. How to create, protect, assetize and commercialize intellectual property
3. Opportunities and challenges for entrepreneurs

Course Outcomes:

Upon completion of the course, students shall have ability to

C401.1	Summarize the life cycle and types of innovation.	[U]
C401.2	Interpret the needs, benefits and procedure of filing an IPR.	[U]
C401.3	Examine a business plan to ensure success of a start-up.	[AP]
C401.4	Devise an innovative idea, protect it through IPR and explore the scope of converting it to a startup.	[A]
C401.5	Analyze the importance of design within the venture development process.	[A]

Course Contents

Innovation: A primer on Innovation, IP Rights and Entrepreneurship, Types of Innovation (incremental, disruptive, etc.), Lifecycle of Innovation (idea, literature survey, PoT, PoC, etc.), Challenges in Innovation (time, cost, data, infrastructure, etc.), co-innovation and open innovation (academia, start-ups and corporates)

Intellectual Property Right: Types of IPR (patents, copyrights, trademarks, GI, etc.), Lifecycle of IP (creation, protection, assetization, monetization), Balancing IP risks & rewards (Right Access and Right Use of Open Source and 3rd party products, technology transfer & licensing), IP valuation (methods, examples, limitations).

Entrepreneurship: Opportunity identification in technology entrepreneurship (customer pain points, competitive context), Market research, segmentation & sizing, Product positioning & pricing, go-to-market strategy, Innovation assessment (examples, patentability analysis),. Startup business models (fund raising, market segments, channels, etc.), Innovation, Incubation & Entrepreneurship in Corporate Context, Technology-driven Social Innovation & Entrepreneurship, Manage innovation, IP and Entrepreneurship Programs- Processes, Governance and Tools

Case study – A technology innovation that resulted in an IP portfolio which was commercialized by an entrepreneur.

Total Hours: 45

Text Books:

1. Clayton M. Christensen, The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail, Crossing the Chasm, Harvard Business, 2013.
2. Van Lindberg, Intellectual Property and Open Source: A Practical Guide to Protecting Code, OReilly, 2008.
3. Saras D. Sarasvathy, Effectuation: Elements of Entrepreneurial Expertise, Edward Elgar Publishing Ltd, 2009.

Reference Books:

1. Carlota Perez, Technological Revolutions and Financial Capital: The Dynamics of Bubbles and Golden Ages, Edward Elgar Pub, 2003
2. Richard Razgaitis, Valuation and Deal making of Technology-Based Intellectual Property: Principles, Methods and Tools, John Wiley & Sons Inc, 2009.
3. Graham Richards, Spin-Outs: Creating Businesses from University Intellectual Property, Harriman House Publishing, 2009.

Web References:

1. http://www.carlotaperez.org/pubs?s=tf&l=en&a=technologicalrevolutionsandfinancialcapital
2. https://searchworks.stanford.edu/view/10018248
3. https://www.goodreads.com/book/show/18050143-zero-to-one

Online Resources:

1. https://www.goodreads.com/book/show/762542.The_Four_Steps_to_the_Epiphany
2. http://www.geoffreyamoore.com/books-by-geoffrey-moore/
3. https://onlinelibrary.wiley.com/doi/book/10.1002/9781118258316

Continuous Assessment			Total Continuous Assessment	End Semester Examination	Total
Formative Assessment	**Summative Assessment**	**Total**			
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component**	**FA (16%) [80 Marks]**
C401.1	Understand	Quiz	20
C401.2	Understand	Assignment	20

C401.3	Apply	Case Study	20
C401.4	Analyze	Technical presentation	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	40	20	30
Apply	40	20	20
Analyze	-	40	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks			**CA 2 : 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C401.1	1	2	2	3	1	1	3	1	1	1	3	1	1	3	1
C401.2	2	3	3	3	3	3	3	1	3	2	2	1	1	2	1
C401.3	2	2	3	3	3	1	3	1	1	2	1	1	1	2	1
C401.4	2	3	3	3	3	3	3	1	3	2	1	1	1	2	1
C401.5	1	1	3	2	2	1	2	1	2	2	1	1	1	2	1

22EN401   **BUSINESS COMMUNICATION AND VALUE SCIENCE III**   3/0/0/3

Nature of Course:	E (Theory Skill Based)
Pre requisites:	Business Communication and Value Science I,
	Business Communication and Value Science II

Course Objectives:

1   Develop technical writing skills
2   Introduce students to Self-analysis techniques like SWOT & TOWS.
3   Introduce students to key concepts of:
     a) Pluralism & cultural spaces
     b) Cross-cultural communication
     c) Science of Nation building.

Course Outcomes:

Upon completion of the course, students shall have ability to

C401.1	Apply and analyze the basic principles of SWOT and life positions.	[AP]
C401.2	Differentiate between the diverse cultures of India and analyze the cross-cultural communication.	[AP]
C401.3	Understand and apply the concepts of Global and glocal.	[C]
C401.4	Remember and apply the tools of technical writing and identify the best practices of technical writing.	[R]
C401.5	Understand Artificial intelligence and recognize its impact in daily life.	[U]

Course Contents:

Reunion: Recap activity on the earlier learning- Summarize the basic principles of SWOT and Life Positions- Apply SWOT in real life scenarios- Pat your back activity- strength will be written by others- Create your SWOT- SWOT Vs. TOWS The Balancing Act- Group Presentations on what are the strengths they have identified to survive in the VUCA World- Recognize how motivation helps real life- Motivation Stories -YouTube videos on Maslow's Theory-Leverage motivation in real life scenarios- Scenario based activity on identifying and leveraging motivation- Present their findings and approaches as groups. Explanation regarding the idea of motivation with the help of examples-Identify pluralism in cultural spaces- Rivers of India-Awareness and respect for pluralism in cultural spaces- Differentiate between the different cultures of India- Rhythms of India (Cultures in India).

Define the terms: global and glocal- Differentiate between global and glocal culture- Debate on Global and glocal impacts- Cross-cultural communication-Recognize the implications of cross-cultural communication- Apply cross cultural communication - Identify the common mistakes made in cross-cultural communication- Gender awareness- Gender awareness campaign-Differentiate between the roles and relations of different genders- Quiz Time- Role of science in nation building- Introduce the topic and discuss the role of scientists and mathematicians from ancient India- Summarize the role of science in nation building- Role of science post-independence.

Introduction to Technical Writing: Basic rules of technical writing through examples- Identify the best practices of technical writing- Practice activity on technical writing- Apply technical writing in real-life scenarios- Assessment on technical writing on certain topic- Define AI (Artificial

Intelligence)- "Voice of the Future" Activity- Recognize the importance of AI-AI in Everyday Life- Design your college in the year 2050- debate related to Artificial Intelligence in the presence of an external moderator- Applying technical writing in profession.

Activities: Apply SWOT in real life scenarios - Motivation in real life - Written Assessment (Role of science post-independence), project and group discussion

Total Hours: 45

Text Books:
1   Gerald.J.Alred, Charles T. Brusaw, Walter E. Oliu , Handbook of Technical Writing, Eleventh Edition, 672 pages, Macmillan Learning, 2015.
2   Richards C.Jack with Hull Jonathan and Proctor Susan, "Interchange", Fifth Edition, Cambridge University Press, 2017.

Reference Books:
1   Sanjay Kumar and Pushp Lata, Communication Skills, Second Edition, Oxford University Press, 2015.
2   Sullivan Jay, "Simply Said: Communicating Better at Work and Beyond", Wiley, 2016.

Web References:
1   Examples of Technical Writing for Students, Freelance Writing- Technical Writing. (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-technicalwriter/)
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://youtube.com/watch?v=9-NWhwskTO4&feature=share8
2   https://youtube.com/watch?v=bKPLNZH_si4&feature=share8
3   https://youtube.com/watch?v=RsK2zrYF4GQ&feature=share8
4   https://m.youtube.com/watch?v=dT_D68RJ5T8&feature=youtu.be
5   https://youtube.com/watch?v=BO7j-X87rM8&feature=share8

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component**	**FA (16%) [80 Marks]**
C401.1	Apply	Case Study	20
C401.2	Apply	Seminar	20
C401.3	Create	Assignment	20
C401.4& C401.5	Understand	Group Assignment	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	30	30	30
Apply	20	20	20
Analyze	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks			**CA 2 : 100 Marks**			
SA 1 60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C401.1	-	-	-	-	-	2	2	3	3	3	3	3	3	2	-
C401.2	-	-	-	-	-	2	-	2	3	2	2	3	-	-	-
C401.3	-	-	-	-	-	2	1	2	3	2	2	2	2	-	-
C401.4	-	-	-	-	-	-	-	2	-	3	-	2	-	-	-
C401.5	-	-	-	-	-	2	-	-	2	2	-	2	3	3	-

UNIVERSAL HUMAN VALUES 3/0/0/3
(Common to all branches)

Nature of Course   C (Theory Concept)
Pre-Requisites   Nil

Course Objectives:

1. Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
2. Understanding (or developing clarity)of the harmony in the human being, family, society and nature/existence.
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.
5. Helping the students to appreciate the essential complementarily between 'VALUES 'and' SKILLS 'to ensure sustained happiness and prosperity, which are the core aspirations of all human beings.
6. Highlighting plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

Course Outcomes:

Upon completion of the course, students shall have ability to

C201.1	Understand and take responsibilities in life and handle problems to attain Sustainable solutions while keeping human relationships and human nature in mind.	[U]
C201.2	Apply responsibilities towards their commitments (human values, human relationship and human society).	[AP]
C201.3	Apply what they have learnt to their own self indifferent day-to-day settings in real life, atleast a beginning would be made in this direction.	[AP]
C201.4	Analyze ethical and unethical practices, and formulate strategies to actualize a harmonious environment wherever they work.	[A]
C201.5	Understand the harmony in nature and existence, and workout mutually on fulfilling participation in nature.	[U]

Course Contents:

Course Introduction - Need, Basic Guidelines, Content and Process for Value Education, Understanding Harmony in the Human Being-Harmony in Myself!

Self-evaluation of the students- Pre-test of UHV‑ Purpose and motivation for the course. Self-Exploration–Its content and process- A look at basic Human Aspirations. Understanding Happiness and Prosperity correctly-Understanding the needs of Self('I') and 'Body'-Understanding the Body as an instrument of 'I'(being the doer, seer and enjoyer)-Understanding the characteristics and activities of 'I' and harmony in 'I' - Understanding the harmony of 'I' with the Body- Social activities – Waste Management - Water Conservation-Soil Pollution - Physical Health and related activities - Lectures by eminent persons- Literary activities.

Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship, Understanding Harmony in the Nature and Existence- Whole existence as Coexistence

Understanding values in human relationship - Understanding the harmony in the society (society being an extension of family): - Visualizing a universal harmonious order in society-Understanding the harmony in Nature.-Understanding Existence as Coexistence of mutually Interacting units in all-pervasive space. Holistic perception of harmony at all levels of existence-Buddy program- Relationships-Homesickness-

Managing peer pressure-Projects-Socially responsible engineers-Visit to local areas (orphanages, special children)- Physical activities (games).

Implications of the above Holistic Understanding of Harmony on Professional Ethics

Natural acceptance of human values- Definitiveness of Ethical Human Conduct- Basis for Humanistic Education-Humanistic Constitution and Humanistic Universal Order-Competence in professional ethics- Case studies of typical holistic technologies, management models and eco-friendly production systems - Strategy for transition from the present state to Universal Human Order-Sum up: Self-evaluation of the students-Post test of UHV.

Total Hours: 45

Text Books:
1   RR Gaur, R Sangal, GP Bagaria, Human Values and Professional Ethics, Excel Books, New Delhi, 2010
2   Rajni Setia, Priyanka Sharma, Human Values, Genius Publication, Jaipur, 2019.

Reference Books:
1   A.N.Tripathi, Human Values, New Age Intl. Publishers, New Delhi, 2004.
2   Mohandas Karamchand Gandhi, The Story of My Experiments with Truth.
3   Maulana Abdul Kalam Azad, India Wins Freedom.

Web References:
1   https://examupdates.in/professional-ethics-and-human-values/
2   http://hvpe1.blogspot.com/2016/06/notes-human-values-and-professional.html
3   https://www.yourmorals.org/schwartz.2006.basic%20human%20values.pdf

Online Resources:
1   https://nptel.ac.in/courses/109/104/109104068/
2   https://medium.com/the-mission/the-12-important-life-skills-i-wish-id-learned-in-school-f4593b49445b
3   https://www.thebalancecareers.com/life-skills-list-and-examples-4147222

Continuous Assessment			Total Continuous Assessment	End Semester Examination	Total
Formative Assessment	**Summative Assessment**	**Total**			
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component**	**FA (16%) [80 Marks]**
C201.1	Understand	Online Quiz	20
C201.2	Apply	Group Assignment	20
C201.3	Apply	Presentation	20
C201.4	Analyse		
C201.5	Understand	Seminar	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	10	10	10
Understand	10	20	20
Apply	40	40	40
Analyse	40	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks			**CA 2 : 100 Marks**			
SA 1 60 Marks	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C301.1	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-
C301.2	-	-	-	-	-	3	-	-	3	-	-	-	-	-	-
C301.3	-	-	-	-	-	3	-	3	-	-	-	-	-	-	-
C301.4	-	-	-	-	-	3	3	3	-	-	2	-	-	-	-
C301.5	-	-	-	-	-	3	3	-	-	-	-	-	-	-	-

22CB402   **DESIGN AND ANALYSIS OF ALGORITHMS**   **1/0/3/4**

Nature of Course: F (Theory Programming)

Pre requisites: Computer Programming, Data Structures.

Course Objectives:

1   To understand the techniques for analysing the computer algorithms

2   To learn the paradigms for designing the algorithms and the limitations of algorithmic power.

3   To analyze the efficiency of various algorithm design techniques / paradigms for the same problem.

Course Outcomes:
Upon completion of the course, students shall have ability to

C402.1	Recognize the general principles and good algorithm design techniques for developing efficient algorithms.	[U]
C402.2	Estimate the time and space complexities of algorithms.	[U]
C402.3	Apply the mathematical preliminaries to analysis and design stages of different types of algorithms.	[AP]
C402.4	Write efficient algorithms for various NP problems.	[AP]
C402.5	Compare the tractable and intractable problems.	[A]

Course Contents:

Introduction: Characteristics of Algorithm. Analysis of Algorithm: Asymptotic analysis of Complexity Bounds – Best, Average and Worst-Case behaviour; Performance Measurements of Algorithm, Time and Space Trade-Offs, Analysis of Recursive Algorithms through Recurrence Relations: Substitution Method, Recursion Tree Method and Masters' Theorem. **Fundamental Algorithmic Strategies:** Brute-Force, Heuristics and Greedy methodologies

Advanced Algorithmic Strategies: Dynamic Programming, Branch and Bound and Backtracking methodologies; Illustrations of these techniques for Problem-Solving, Bin Packing, Knapsack, and Travelling Salesman Problem. **Graph and Tree Algorithms:** Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS); Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Topological sorting, Network Flow Algorithm.

Tractable and Intractable Problems: Computability of Algorithms, 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, Introduction to Quantum Algorithms.

Total Hours: 45

Lab Exercises:

1. An array has exactly 'n' nodes. They are filled from the set {0, 1, 2, ….., n-1, n}. There are no duplicates in the list. Design an O(n) worst case time algorithm to find which one of the elementsfrom the above set is missing in the array.
2. Write a C program to solve given recursive function and analyze the time complexity of the algorithm. Implement Brute Force and analyze the time complexity of the algorithm and plot a graph of the time taken versus 'n' for Empirical Analysis.
3. Implement shortest path algorithm.
4. Implement knapsack algorithm.

5. Implement an algorithm for the Huffman-tree construction and analyse the time efficiency.
6. Implement Backtracking algorithm.
7. Implement Branch and Bound algorithm.
8. Implement Dynamic Programming algorithm.

Total Hours: 30

Text Books:
1. E. Horowitz and S. Sahni, Fundamental of Computer Algorithms, Computer Science Press, Inc. 1978.
2. A. Aho, J. Hopcroft and J. Ullman, The Design and Analysis of Computer Algorithms, 4th Edition, Pearson Education, 2009.

Reference Books:
1. Thomas H. Cormen, Charles E. Leiserson, R.L. Rivest, Introduction to Algorithms, Prentice Hall of India Publications, 3rd Edition, 2009.
2. Sara Baase and Allen Van Gelder, Computer Algorithms: Introduction to Design and Analysis, Pearson Publications, 3rd Edition, 2008.
3. D. E. Knuth, The Art of Computer Programming, Vol. 1, Vol. 2 and Vol. 3. Addision-Wesley, 1998.

Web References:
1. https://www.cs.usfca.edu/~galles/visualization/Algorithms.html
2. https://www.coursera.org/learn/introduction-to-algorithms
3. https://onlinecourses.nptel.ac.in/noc16_cs04/preview
4. https://www.edx.org/course/algorithms-iitbombayx-cs213-3x

Online Resources:
1. https://www.udemy.com/course/design-and-analysis-of-algorithm-/
2. https://nptel.ac.in/courses/106/106/106106131/
3. https://www.coursera.org/specializations/algorithms

Continuous Assessment									End Semester Practical Examination	Total
Theory				Practical			Total (A+B)	Total Continuous Assessment		
Formative Assessment	Summative Assessment	Total	Total (A)	Formative Assessment	Summative Assessment	Total (B)				
80	120	200	100	75	25	100	200	50	50	100

Formative Assessment based on Capstone Model - Theory			
Course Outcome	Bloom's Level	Assessment Component	FA (10%) [80 Marks]
C402.1	Understand	Quiz	20
C402.2	Understand	Quiz	20
C402.3	Apply	Assignment	20
C402.5	Analyze	Case Study / Tutorial	20

Assessment based on Summative Assessment - Theory

Bloom's Level	Summative Assessment (15%) [120 Marks]	
	CIA1: (60 Marks)	CIA2: (60 Marks)
Remember	20	10
Understand	40	10
Apply	40	50
Analyze	-	30
Evaluate	-	-
Create	-	-

Assessment based on Continuous and End Semester Examination - Practical

Bloom's Level	Continuous Assessment (25%) [100 Marks]		End Semester Examination (50%) [100 Marks]
	FA: (75 Marks)	SA: (25 Marks)	
Remember	20	20	20
Understand	50	50	50
Apply	30	30	30
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (50%)								End Semester Practical Examination (50%)
CA 1 (100 Marks)			CA 2 (100 Marks)			Practical Exam (100 Marks)		
SA 1 (60M)	FA 1		SA 2 (60M)	FA 2		FA (75M)	SA (25M)	
	Component-I (20 Marks)	Component-II (20 Marks)		Component-I (20 Marks)	Component-II (20 Marks)			

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C402.1	2	1	1	1	-	1	1	1	1	1	1	1	1	1	1
C402.2	2	1	1	1	1	1	1	-	1	1	1	-	1	1	1
C402.3	2	2	2	2	1	1	2	-	2	2	2	1	2	1	1
C402.4	2	2	2	2	1	1	2	1	2	2	2	1	2	1	1
C402.5	2	1	1	2	1	1	1	1	2	1	1	1	1	1	1

22MA408   **OPERATIONS RESEARCH**   **3/0/2/4**

Nature of Course: J (Problem Analytical)
Pre requisites: Probability and Statistics, Linear Algebra

Course Objectives:

1. To use appropriate techniques and optimization solvers to interpret the results obtained and translate solutions into directives for action.
2. To analyze and solve linear programming and network models arising from a wide range of applications
3. To manage inventory analysis in a scientific manner.

Course Outcomes:

Upon completion of the course, students shall have ability to

C408.1	Remember the principles of construction of mathematical models of conflicting situations	[R]
C408.2	Understand the optimization techniques to interpret the solutions	[U]
C408.3	Solve mathematical model (linear programming problem) for a physical situations	[AP]
C408.4	Solve the problem of transporting the products from origins to destinations with least transportation cost.	[AP]
C408.5	Compute the traffic intensity, blocked traffic and the utilization of some queueing systems	[AP]

Course Contents:

Introduction to OR and Linear Programming Problem: 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 - Some basic concepts and results of linear algebra – Vectors, Matrices, Linear Independence/Dependence of vectors, Rank, Basis, System of linear eqns. **Linear programming** – Examples from industrial cases, formulation & definitions, Matrix form. Implicit assumptions of LPP – Hyper plane, 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.

Scheduling Techniques and Network Models: 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 - for safety stock with known/unknown stock out situations, models under prescribed policy, Probabilistic situations.

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

Queuing Theory and Simulation Methodology: 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 Event System Simulation – clock, event list, Application in Scheduling, Queuing systems and Inventory systems

Total Hours: 45

Lab Exercises:
1. Introduction to OR online tools
2. To Solve LPP graphically Using PHP simplex tool
3. To Solve LPP by simplex method Using PHP simplex tool
4. To Solve LPP by simplex method Using EXCEL solver
5. To Solve transportation problem Using EXCEL solver and online tool
6. To Solve Assignment problem Using EXCEL solver and online tool
7. To Solve Travelling salesman problem Using EXCEL solver and online tool
8. To Determination of critical Paths, Estimation of Project time and its variance in PERT using online PERT calculator.

Total Hours: 30

Text Books:
1. Kanti Swarup, P.K.Gupta, Manmohan, Operations research, 2nd Edition, Sultan Chand and Sons, 2015.
2. Taha H.A, Operation Research, 10th Edition, Pearson Education, 2017.
3. J.W. Prichard and R.H. Eagle, Modern Inventory Management, Wiley, 1965.

Reference Books:
1. H.M. Wagner, Principles of OR with Application to Managerial Decisions, Prentice Hall, 1975.
2. F.S. Hiller and G.J. Lieberman, Introduction to Operations Research, McGraw Hill, 2001.
3. Thomas L. Saaty, Elements of Queuing Theory, McGraw Hill, 1961.
4. A. Ravi Ravindran, Operations Research and Management Science, Hand Book, CRC Press, 2008.

Web References:
1. http://nptel.ac.in/courses/111104079/
2. http://nptel.ac.in/video.php/subjectId=117105085
3. http://nptel.ac.in/syllabus/111105041/
4. http://freevideolectures.com/Course/3028/Econometric-Modelling/22#

Online Resources:
1. https://onlinecourses.nptel.ac.in/noc15_ec07/
2. https://onlinecourses.nptel.ac.in/noc16_ch03
3. https://nptel.ac.in/courses/111104027/

Continuous Assessment									End Semester Examination	Total
Theory				Practical			Total (A+B)	Total Continuous Assessment		
Formative Assessment	Summative Assessment	Total	Total (A)	Formative Assessment	Summative Assessment	Total (B)				
80	120	200	100	75	25	100	200	50	50	100

Formative Assessment based on Capstone Model - Theory			
Course Outcome	Bloom's Level	Assessment Component	FA(10%) [80 Marks]
C408.1	Apply	Quiz	20
C408.2	Apply	Assignment	20
C408.3	Understand	Presentation	20
C408.4	Apply	Group Assignment	20
C408.5	Apply		

Assessment based on Summative and End Semester Examination - Theory			
Bloom's Level	Summative Assessment (15%) [120 Marks]		End Semester Examination(35%) [100 Marks]
	CIA1: (60 Marks)	CIA2: (60 Marks)	
Remember	30	20	20
Understand	30	20	20
Apply	40	60	60
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination - Practical			
Bloom's Level	Continuous Assessment (25%) [100 Marks]		End Semester
	FA: (75 Marks)	SA: (25 Marks)	

			Examination (15%) [100 Marks]
Remember	20	20	20
Understand	30	30	30
Apply	50	50	50
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination							
Continuous Assessment (50%)							**End Semester Examination (50%)**
CA 1 (100 Marks)			**CA 2 (100 Marks)**			**Practical Exam (100 Marks)**	**Theory Examination (35%) Practical Examination (15%)**
SA 1 (60M)	**FA 1**		**SA 2 (60M)**	**FA 2**		**FA (75M)** / **SA (25M)**	
	Component-I (20 Marks)	**Component-II (20 Marks)**		**Component-I (20 Marks)**	**Component-II (20 Marks)**		

Course Outcome (CO)	**Programme Outcomes (PO)**												**Programme Specific Outcomes (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C408.1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
C408.2	3	2	-	-	1	-	-	-	-	-	-	-	-	-	-
C408.3	3	3	1	-	1	-	-	-	-	-	-	-	-	-	1
C408.4	3	3	1	1	1	-	-	-	-	-	-	-	-	-	1
C408.5	3	3	1	1	1	-	-	-	-	-	-	-	-	-	1

22CB403 **OPERATING SYSTEMS** **3/0/2/4**

Nature of Course: C (Theory Concept)

Pre requisites: Computer Programming

Course Objectives:

1	To recognize the fundamentals of operating systems to handle processes and threads and their communication.
2	To discuss the principles of concurrency and Deadlocks.
3	To identify the mechanisms involved in memory management, I/O management File systems and security issues.

Course Outcomes:
Upon completion of the course, students shall have ability to

C403.1	Identify the basic concepts and design issues of operating systems.	[R]
C403.2	Apply Process management concepts including scheduling, Inter process communication, deadlocks and multithreading concepts.	[AP]
C403.3	Apply concepts of memory management including Virtual Memory and Page Replacement to the issues that occur in Real time applications.	[AP]
C403.4	Identify issues related to IO hardware, file system and disk management	[U]
C403.5	Compare various operating systems with respect to characteristics and features	[A]

Course Contents:

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, and 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 and Memory Management: 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, communicating sequential process (CSP); Deadlocks - prevention, avoidance, detection and recovery. 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, 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, File and Disk Management: 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.

Total Hours: 45

Lab Exercises:
1. Analysis and Synthesis of Basic Linux Commands
2. Programs using Shell Programming
3. Implementation of Unix System Calls
4. Simulation and Analysis of Non pre-emptive and Pre-emptive CPU Scheduling Algorithms
5. Simulation of Producer – Consumer Problem using Semaphores and Implementation of Dining Philosopher's Problem to demonstrate Process Synchronization
6. Simulation of Banker's Algorithm for Deadlock Avoidance
7. Analysis and Simulation of Memory Allocation and Management Techniques
8. Implementation of Page Replacement Techniques
9. Simulation of Disk Scheduling Algorithms
10. Implementation of File organization Techniques
11. Design an efficient Traffic Control System to avoid traffic congestion in Metro Cities. Use Process Synchronization, Scheduling, Deadlock and Memory Management concepts to implement the system.

Total Hours: 30

Text Books:
1. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, Operating System Concepts, 10th Edition, John Wiley, 2018
2. William Stallings, Operating Systems –Internals and Design Principles, 8thEdition, Pearson Publications, 2014.
3. Maurice J. Bach, Design of the Unix Operating Systems, Prentice/Hall International., Inc,2016.

Reference Books:
1. Charles Patrick Crowley, Operating System: A Design-oriented Approach,2001.

2. Daniel Pierre Bovet, Marco Cesati, Understanding the Linux Kernel,2000.

Web References:
1. http://geeksforgeeks.org/Operating Systems
2. https://www.tutorialspoint.com/operating_system

Online Resources:
1. https://in.coursera.org/learn/os-power-user
2. https://nptel.ac.in/courses/106105214

Continuous Assessment									Total Continuous Assessment	End Semester Examination	Total
Theory				Practical			Total (A+B)				
Formative Assessment	Summative Assessment	Total	Total (A)	Formative Assessment	Summative Assessment	Total (B)					
80	120	200	100	75	25	100	200		50	50	100

Formative Assessment based on Capstone Model - Theory			
Course Outcome	Bloom's Level	Assessment Component	FA (10%) [80 Marks]
C403.1	Remember	Quiz	20
C403.2	Apply	Quiz	20
C403.4	Understand	Assignment	20
C403.5	Analyze	Case Study / Tutorial	20

Assessment based on Summative and End Semester Examination - Theory

Bloom's Level	Summative Assessment (15%) [120 Marks]		End Semester Examination (35%) [100 Marks]
	CIA1: (60 Marks)	CIA2: (60 Marks)	
Remember	20	-	10
Understand	20	20	10
Apply	60	40	40
Analyze	-	40	40
Evaluate	-	-	-
Remember	-	-	-

Assessment based on Continuous and End Semester Examination - Practical

Bloom's Level	Continuous Assessment (25%) [100 Marks]		End Semester Examination (15%) [100 Marks]
	FA: (75 Marks)	SA: (25 Marks)	
Remember	10	10	10
Understand	10	10	10
Apply	40	40	40
Analyze	40	40	40
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination								
Continuous Assessment (50%)								End Semester Examination (50%)
CA 1 (100 Marks)			CA 2 (100 Marks)			Practical Exam (100 Marks)		Theory Examination (35%) Practical Examination (15%)
	FA 1			FA 2				
SA 1 (60M)	Component-I (20 Marks)	Component-II (20 Marks)	SA 2 (60M)	Component-I (20 Marks)	Component-II (20 Marks)	FA (75M)	SA (25M)	

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C403.1	1	1	1	2	1	1	-	1	1	1	1	-	3	-	1
C403.2	3	3	3	2	1	2	1	1	3	3	2	-	3	-	1
C403.3	3	3	3	2	1	2	-	1	3	3	3	-	2	-	1
C403.4	1	1	1	2	1	1	1	1	1	1	3	-	1	-	1
C403.5	1	1	2	2	1	1	-	1	-	-	3	-	1	-	1