Sri Krishna College of Engineering and Technology

An Autonomous Institution, Affiliated to Anna University

Coimbatore – 641 008

DEPARTMENT OF INFORMATION TECHNOLOGY

CURRICULUM AND SYLLABI

B.TECH. INFORMATION TECHNOLOGY

REGULATION 2020

SRI KRISHNA COLLEGE OF ENGINEERING AND TECHNOLOGY

KUNIAMUTHUR, COIMBATORE-641008

DEPARTMENT OF INFORMATION TECHNOLOGY

Department Vision

To impart quality education by providing opportunities for shaping and transforming students into eminent and ethical IT professionals, researchers, innovators and entrepreneurs with requisite skill set to excel in the dynamic field of IT.

Department Mission

- To provide state of art computer education.
- To equip staff and students with the latest skills in the field
- To keep pace with new invention and technology development, thereby set the trend for the futuristic information technology education and research with ethical and moral values.

SRI KRISHNA COLLEGE OF ENGINEERING AND TECHNOLOGY

KUNIAMUTHUR, COIMBATORE-641008

DEPARTMENT OF INFORMATION TECHNOLOGY

PROGRAMME OUTCOMES

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

SRI KRISHNA COLLEGE OF ENGINEERING AND TECHNOLOGY KUNIAMUTHUR, COIMBATORE-641008

DEPARTMENT OF INFORMATION TECHNOLOGY

PROGRAMME EDUCATIONAL OBJECTIVES

PEO 1: Graduates will have a profound knowledge in the various programming languages and possess globally competent skill sets by inculcating continuous up gradation of their technical skills and personality traits.

PEO 2: Graduates will be able to analyze and find solutions to various applications and reconcile the dynamic trends in the field of Information Technology.

PEO 3: Graduates will contribute to the society by their ethical behaviour and effective teamwork.

PEO 4: Graduates will excel with different skills like effective communication, leadership qualities, and provide smart solutions in business environment

Mapping of PO's to PEO's

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

1	Reasonably agreed	**2**	Moderately agreed	**3**	Strongly agreed

SRI KRISHNA COLLEGE OF ENGINEERING AND TECHNOLOGY

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DEPARTMENT OF INFORMATION TECHNOLOGY

PROGRAMME SPECIFIC OUTCOMES

PSO 1:

Graduates will demonstrate multidisciplinary knowledge for problem solving by creating solutions for product based and application-based software for the advancement of the society.

PSO 2:

Graduates attain advance knowledge in Information and Communication Technologies (ICT) thereby creating real time solutions for different projects by using modern tools prevailing in the current trends.

PSO 3:

Graduates will exhibit state of the art technologies by applying their knowledge in various programming skills to overcome the demand of sustainable development.

R2020

SEMESTER I							
S No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credit**	**Ext/Int**	**Category**
THEORY CUM PRACTICAL							
1.	20MA101	Engineering Mathematics I	2/1/2	5	4	40/60	BSC
2.	20CH101	Engineering Chemistry	3/0/3	6	4.5	40/60	BSC
3.	20EN101	Technical Communication Skills	2/0/2	4	3	40/60	HSMC
4.	20IT101	Python Programming	3/0/2	5	4	40/60	PCC
5.	20CS101	Application Development Practices	2/0/2	4	3	40/60	PCC
PRACTICAL							
6.	20ME111	Engineering Graphics	1/0/3	4	2.5	40/60	ESC
MANDATORY COURSE							
7.	20MC101	Mandatory Course – I (Induction Programme)	3 Weeks			0/100	MC
			Total	**28**	**21**	**700**	

SEMESTER II							
S No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credit**	**Ext/Int**	**Category**
THEORY							
1.	20GE201	Universal Human Values	3/0/0	3	3	50/50	HSMC
2.	20CS201	C and Data Structures	3/0/0	3	3	50/50	PCC
THEORY CUM PRACTICAL							
3.	20MA201	Engineering Mathematics II	2/1/2	5	4	40/60	BSC
4.	20PH104	Physics	3/0/3	6	4.5	40/60	BSC
5.	20EE111	Basics of Electrical and Electronics Engineering	3/0/2	5	4	40/60	ESC
PRACTICAL							
6.	20ME103	Engineering Practices Laboratory	0/0/3	3	1.5	40/60	ESC
7.	20CS202	Data Structures Laboratory	0/0/3	3	1.5	40/60	PCC
MANDATORY COURSE							
8.	20MC102	Mandatory Course II (Environmental Sciences)	2/0/0	2	0	0/100	MC
			Total	**30**	**21.5**	**800**	

SEMESTER III							
S No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credit**	**Ext/Int**	**Category**
THEORY							
1.	20IT301	Computer Architecture	3/0/0	3	3	50/50	PCC
THEORY CUM PRACTICAL							
2.	20MA302	Mathematical Structures	2/1/2	5	4	40/60	BSC
3.	20EC311	Digital Logic and Design	3/0/2	5	4	40/60	ESC
4.	20IT302	Software Engineering and Management	3/0/2	5	4	40/60	HSMC
5.	20CS301	C++ and Advanced Data Structures	3/0/2	5	4	40/60	PCC
6.	20CS302	Operating Systems	3/0/2	5	4	40/60	PCC
MANDATORY COURSE							
7.	20MCXXX	Mandatory Course-III	2/0/0	2	0	0/100	MC
			Total	**30**	**23**	**700**	

SEMESTER IV							
S No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credit**	**Ext/Int**	**Category**
THEORY							
1.	20CS401	Database Management Systems	3/0/0	3	3	50/50	PCC
2.	20IT401	Computational Biology	3/0/0	3	3	50/50	ESC
3.	20IT402	Design and Analysis of Algorithms	3/0/0	3	3	50/50	PCC
THEORY CUM PRACTICAL							
4.	20MA404	Random Variables and Statistics	2/1/2	5	4	40/60	BSC
5.	20EC411	Fundamentals of Data and Mobile Communications	3/0/2	5	4	40/60	ESC
6.	20IT403	Web and Java Programming	3/0/2	5	4	40/60	PCC
PRACTICAL							
7.	20CS405	Database Management Systems Laboratory	0/0/3	3	1.5	40/60	PCC
MANDATORY COURSE							
8.	20MCXXX	Mandatory Course-IV	2/0/0	2	0	0/100	MC
			Total	**29**	**22.5**	**800**	

SEMESTER V							
S No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credit**	**Ext/Int**	**Category**
THEORY							
1.	20IT501	Formal Languages and Automata Theory	3/0/0	3	3	50/50	PCC
2.	20IT502	Data Communications and Computer Networks	3/0/0	3	3	50/50	ESC
3.	20IT9XX	Professional Elective-I	3/0/0	3	3	50/50	PEC
4.	20IT9XX	Professional Elective-II	3/0/0	3	3	50/50	PEC
5.	20XX0XX	Open Elective – I	3/0/0	3	3	50/50	OEC
THEORY CUM PRACTICAL							
6.	20MA501	Fourier Series and Computational Methods	2/1/2	5	4	40/60	BSC
PRACTICAL							
7.	20IT503	Computer Networks Laboratory	0/0/3	3	1.5	40/60	ESC
PROJECT WORK							
8.	20IT504	Mini Project – I	0/0/2	2	1	40/60	PW
MANDATORY COURSE							
9.	20MCXXX	Mandatory Course - V	2/0/0	2	0	0/100	MC
			Total	**27**	**21.5**	**900**	

SEMESTER VI							
S No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credit**	**Ext/Int**	**Category**
THEORY							
1.	20IT601	Machine Learning Techniques	3/0/0	3	3	50/50	PCC
2.	20CS601	Principles of Compiler Design	3/0/0	3	3	50/50	PCC
3.	20IT9XX	Professional Elective-III	3/0/0	3	3	50/50	PEC
4.	20IT9XX	Professional Elective-IV	3/0/0	3	3	50/50	PEC
5.	20XX0XX	Emerging Elective-I	3/0/0	3	3	50/50	EEC
THEORY CUM PRACTICAL							
6.	20IT602	Cloud Computing and its Applications	3/0/2	5	4	40/60	PCC
PRACTICAL							
7.	20IT603	Machine Learning Techniques Lab	0/0/3	3	1.5	40/60	PCC
PROJECT WORK							
8.	20IT604	Mini Project – II	0/0/2	2	1	40/60	PW
			Total	**25**	**21.5**	**800**	

SEMESTER VII							
S No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credit**	**Ext/Int**	**Category**
THEORY							
1.	20IT9XX	Professional Elective-V	3/0/0	3	3	50/50	PEC
2.	20IT9XX	Professional Elective-VI	3/0/0	3	3	50/50	PEC
3.	20XX0XX	Open Elective-II	3/0/0	3	3	50/50	OEC
4.	20XX0XX	Emerging Elective-II	3/0/0	3	3	50/50	EEC
THEORY CUM PRACTICAL							
5.	20IT701	Big Data Analytics	3/0/2	5	4	40/60	PCC
6.	20IT702	Embedded Systems and Internet of Things	3/0/2	5	4	40/60	PCC
EMPLOYABILITY ENHANCEMENT SKILLS							
7.	20EES01	Employability Enhancement Skills			2	0/100	EES
			Total	**22**	**22**	**700**	

SEMESTER VIII							
S No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credit**	**Ext/Int**	**Category**
PROJECT WORK							
1	20IT801	Project	0/0/24	24	12	40/60	PW
			Total	**24**	**12**	**100**	

HUMANITIES AND MANAGEMENT COURSES (10 credits)

S. No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	Credits	Category
1.	20EN101	Technical Communication Skills	2/0/2	4	3	HSMC
2.	20GE201	Universal Human Values	3/0/0	3	3	HSMC
3.	20IT302	Software Engineering and Management	3/0/2	5	4	HSMC

BASIC SCIENCE COURSES (29 Credits)

S. No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	Credits	Category
1.	20MA101	Engineering Mathematics I	2/1/2	5	4	BSC
2.	20CH101	Engineering Chemistry	3/0/3	6	4.5	BSC
3.	20MA201	Engineering Mathematics II	2/1/2	5	4	BSC
4.	20PH104	Physics	3/0/3	6	4.5	BSC
5.	20MA302	Mathematical Structures	2/1/2	5	4	BSC
6.	20MA404	Random Variables and Statistics	2/1/2	5	4	BSC
7.	20MA501	Fourier Series and Computational Methods	2/1/2	5	4	BSC

ENGINEERING SCIENCE COURSES (23.5 Credits)

S. No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	Credits	Category
1.	20ME111	Engineering Graphics	1/0/3	4	2.5	ESC
2.	20ME103	Engineering Practices Laboratory	0/0/3	3	1.5	ESC
3.	20EE111	Basics of Electrical and Electronics Engineering	3/0/2	5	4	ESC
4.	20EC311	Digital Logic and Design	3/0/2	5	4	ESC
5.	20EC411	Fundamentals of Data and Mobile Communications	3/0/2	5	4	ESC

6.	20IT401	Computational Biology	3/0/0	3	3	ESC
7.	20IT502	Data Communications and Computer Networks	3/0/0	3	3	ESC
8.	20IT503	Computer Networks Laboratory	0/0/3	3	1.5	ESC

PROFESSIONAL CORE COURSES (56.5 Credits)

S. No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	Credits	Category
1.	20CS101	Application Development Practices	2/0/2	4	3	PCC
2.	20IT101	Python Programming	3/0/2	5	4	PCC
3.	20CS201	C and Data Structures	3/0/0	3	3	PCC
4.	20CS202	Data Structures Laboratory	0/0/3	3	1.5	PCC
5.	20CS301	C++ and Advanced Data Structures	3/0/2	5	4	PCC
6.	20IT301	Computer Architecture	3/0/0	3	3	PCC
7.	20CS302	Operating Systems	3/0/2	5	4	PCC
8.	20CS401	Database Management Systems	3/0/0	3	3	PCC
9.	20IT402	Design and Analysis of Algorithms	3/0/0	3	3	PCC
10.	20IT403	Web and Java Programming	3/0/2	5	4	PCC
11.	20CS405	Database Management Systems Laboratory	0/0/3	3	1.5	PCC
12.	20IT501	Formal Languages and Automata Theory	3/0/0	3	3	PCC
13.	20CS601	Principles of Compiler Design	3/0/0	3	3	PCC
14.	20IT601	Machine Learning Techniques	3/0/0	3	3	PCC
15.	20IT602	Cloud Computing and its Applications	3/0/2	5	4	PCC
16.	20IT603	Machine Learning Techniques Lab	0/0/3	3	1.5	PCC
17.	20IT701	Big Data Analytics	3/0/2	5	4	PCC
18.	20IT702	Embedded Systems and Internet of Things	3/0/2	5	4	PCC

PROFESSIONAL ELECTIVE COURSES

S. No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	Credits	Category
Networking and Communications						
1.	20IT901	Game Theory and its Applications	3/0/0	3	3	PEC
2.	20IT902	Distributed Systems	3/0/0	3	3	PEC
3.	20IT903	Network Programming	3/0/0	3	3	PEC
4.	20IT904	Mobile AdHoc Networks	3/0/0	3	3	PEC
5.	20IT905	Advanced Mobile Communication	3/0/0	3	3	PEC
6.	20CS602	Cryptography and Network Security	3/0/0	3	3	PEC
7.	20CS902	Fault Tolerant Computing	3/0/0	3	3	PEC
8.	20CS907	Cyber Forensics	3/0/0	3	3	PEC
9.	20EC921	Wireless Sensor Networks	3/0/0	3	3	PEC
Data Science and Intelligent Systems						
1.	20IT911	Deep Learning Techniques	3/0/0	3	3	PEC
2.	20IT912	Data Visualization Techniques	3/0/0	3	3	PEC
3.	20IT913	Artificial Intelligence and its Applications	3/0/0	3	3	PEC
4.	20IT914	Blockchain Technology	3/0/0	3	3	PEC
5.	20IT915	Evolutionary Computing	3/0/0	3	3	PEC
6.	20IT916	Cognitive Science and Analytics	3/0/0	3	3	PEC
7.	20IT917	Data Warehousing and Data Mining	3/0/0	3	3	PEC
8.	20CS921	Speech and Natural Language Processing	3/0/0	3	3	PEC
9.	20CS922	Digital Image Processing	3/0/0	3	3	PEC

Software Development						
1.	20IT921	Data Analysis using R	3/0/0	3	3	PEC
2.	20IT922	Web Applications using Java	3/0/0	3	3	PEC
3.	20IT923	Open Source Systems	3/0/0	3	3	PEC
4.	20IT924	Industrial Ethics	3/0/0	3	3	PEC
5.	20IT925	Computer Graphics and Multimedia	3/0/0	3	3	PEC
6.	20IT926	Software Testing	3/0/0	3	3	PEC
7.	20CS911	Mobile Application Development	3/0/0	3	3	PEC
8.	20CS925	Design Patterns and Design Thinking	3/0/0	3	3	PEC
9.	20IT927	Professional Readiness for Innovation, Employability and Entrepreneurship	0/0/6	6	3	PEC

OPEN ELECTIVE COURSES

S. No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	Credits	Category
1.	20IT001	Mobile Applications Development using Android	3/0/0	3	3	OEC
2.	20IT002	PHP and MySQL	3/0/0	3	3	OEC
3.	20IT003	Blockchain Essentials	3/0/0	3	3	OEC
4.	20IT004	Cloud and Virtualization	3/0/0	3	3	OEC
5.	20IT005	Internet Programming	3/0/0	3	3	OEC
6.	20IT006	Introduction to Cyber Security	3/0/0	3	3	OEC

EMERGING ELECTIVE COURSES

S. No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	Credits	Category
1.	20IT007	Open-Source Deep Learning Frameworks	3/0/0	3	3	EEC
2.	20IT008	Kotlin for Cross-platform Application Development	3/0/0	3	3	EEC
3.	20IT009	Virtual and Augmented Reality	3/0/0	3	3	EEC
4.	20IT010	Computational Methods in Synthetic Biology	3/0/0	3	3	EEC
5.	20IT011	Principles of Industry 4.0	3/0/0	3	3	EEC
6.	20IT012	Autonomous Robotics	3/0/0	3	3	EEC

EMPLOYABILITY ENHANCEMENT SKILLS (2 Credits)

S. No	Course Code	Course Title	Credits	Category
1.	20EES01	Employability Enhancement Skills	2	EES

MANDATORY COURSES

S.No	Course Code	Course Title	Category
1.	20MC101	Induction Programme	MC
2.	20MC102	Environmental Sciences	MC
3.	20MC103	Soft Skills	MC
4.	20MC105	General Aptitude	MC
5.	20MC106	Life Skills and Ethics	MC
6.	20MC107	Stress Management	MC
7.	20MC108	Constitution of India	MC
8.	20MC109	Essence of Indian Traditional Knowledge	MC

SCHEME OF CREDIT DISTRIBUTION – SUMMARY

S. No	Stream	Credits/Semester									Credits	AICTE Norms
		I	II	III	IV	V	VI	VII	VIII			
1.	Humanities (HSMC)	3	3	4							10	**12**
2.	Basic Sciences (BSC)	8.5	8.5	4	4	4					29	**24**
3.	Engineering Sciences (ESC)	2.5	5.5	4	7	4.5					23.5	**29**
4.	Professional Core (PCC)	7	4.5	11	11.5	3	11.5	8			56.5	**49**
5.	Professional Electives (PEC)					6	6	6			18	**18**
6.	Open Electives (OEC)					3		3			6	**12**
7.	Emerging Elective (EEC)						3	3			6	
8.	Project Work (PW)					1	1		12		14	**15**
9.	Employability Enhancement Skills (EES)							2			2	
10.	Mandatory Course (MC)											**Non-Credit**
Total		21	21.5	23	22.5	21.5	21.5	22	12		**165**	
AICTE (CSE)		**17.5**	**20.5**	**23**	**22**	**21**	**22**	**18**	**15**			**159**

20MA101	ENGINEERING MATHEMATICS I *(COMMON TO MECH / MCT / CIVIL / ECE / EEE / CSE, IT / AI&DS)*	2/1/2/4

Nature of Course	J (Problem analytical)
Pre requisites	Concept of Differentiation and Matrices

Course Objectives:

1.	To develop the skill to use matrix algebra techniques that is needed by engineers for practical applications.
2.	To know about system of linear equations and its solution set and how to write down the coefficient matrix and augmented matrix of a linear system
3.	To familiarize with functions of several variables applicable in many branches of engineering.
4.	To find the solution of ordinary differential equations as most of the engineering problems are characterized in this form.

Course Outcomes:

Upon completion of the course, students shall have ability to

C101.1	Recall the concepts of matrices, ordinary and partial derivatives.	[R]
C101.2	Express square matrix in the diagonal form.	[U]
C101.3	Solve systems of linear equations numerically and to find inverse matrices.	[AP]
C101.4	Apply numerical techniques effectively to analyse and visualize data to solve basic engineering-related problems.	[AP]
C101.5	Find the extreme values of the given functions to solve the engineering problems.	[AP]
C101.6	Find the solution of second and higher order differential equations connected with electric circuits and simple harmonic motion.	[AP]

Course Contents:

MATRICES **14 Hours**

Definition – Types of matrices – Characteristic equation – Eigenvalues and eigenvectors of a real matrices and their properties (statement only) – Cayley-Hamilton theorem (statement only) – Verification and application to find inverse and powers of real matrices – Orthogonal transformation of a real symmetric matrix to diagonal form – Reduction of quadratic form to canonical form by Orthogonal transformation.

SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS **16 Hours**

Newton-Raphson method – Fixed point iteration method – Gauss-Elimination method – Gauss-Jordan method – Iterative methods of Gauss-Jacobi and Gauss-Seidel – Matrix Inversion by Gauss-Jordan method – Eigenvalue of a matrix by Power method and Jacobi method.

CALCULUS **18 Hours**

Concepts of limits and continuity – Functions of several variables – Total derivatives – Differentiation of implicit functions – Jacobians – Taylor series expansion – Maxima and Minima – Method of Lagrangian multipliers – Ordinary differential equations – Higher order linear differential equations with constant coefficients –Euler Cauchy's equations – Applications of ODE: Solving electrical circuits and simple harmonic motion.

Lab Component

1. Entering row vector, column vector, accessing blocks of elements in MATLAB.
2. Entering matrices, to locate matrix elements and Correcting any entry through indexing in MATLAB.
3. Sum, product, transpose, inverse, determinant and rank of a matrices using MATLAB.
4. Eigenvalues and eigenvectors of a matrix using MATLAB.
5. System of linear equations in MATLAB using Gaussian elimination.
6. System of linear equations in MATLAB using matrix inverse method.
7. System of linear equations in MATLAB using linsolve.
8. First and second derivative of single variable functions using MATLAB.
9. Maxima and Minima of a function using MATLAB.
10. Higher Order Equations of constant coefficients using MATLAB.

Total Hours: (48+12)	**60**

Text Books:	
1.	G.B. Thomas and R.L. Finney, Calculus and Analytic Geometry, 14th Edition, Pearson, Reprint, 2018
2.	Kreyszig. E, "Advanced Engineering Mathematics" Tenth Edition, John Wiley and Sons (Asia) Limited, Singapore 2018.
3.	Grewal. B.S, "Higher Engineering Mathematics", 43rd Edition, Khanna Publications, Delhi, 2018.
Reference Books:	
1.	Veerarajan. T, "Engineering Mathematics I", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2018.
2.	Glyn James, —Advanced Modern Engineering Mathematics, Pearson Education, 4th Edition, 2012.
3.	N.P.Bali and Dr.Manish Goyal, "A Text book of Engineering Mathematics" 9th Edition, Laxmi publications ltd, 2014.
Web References:	
1.	http://www.nptel.ac.in/courses/111105035
2.	http://www.nptel.ac.in/courses/122104017
3.	http://nptel.ac.in/courses/122102009
4.	http://nptel.ac.in/courses/111107063
Online Resources:	
1.	https://www.coursera.org/learn/linearalgebra2
2.	https://www.coursera.org/learn/differentiation-calculus
3.	https://www.coursera.org/learn/single-variable-calculus
4.	https://alison.com/courses/Algebra-Functions-Expressions-and-Equations

Assessment Methods & Levels (based on Blooms' Taxonomy)

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment				End Semester Examination (Theory) [40 marks]
	Theory			Practical& Project	
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	Rubric based CIA [30 Marks]	
Remember	20	20	20	20	20
Understand	30	30	30	30	30

Apply	50	50	50	50	50
Analyse	-	-	-	-	-
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Course Outcomes (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						2				3	2	1
C101.2	2	2	2						1				3	2	1
C101.3	1	2	2										3	2	1
C101.4	2	2	2						2				3	1	2
C101.5	2	3	2						2				3	2	1
C101.6	2	3	2						2				3	2	1

20CH101	ENGINEERING CHEMISTRY *(COMMON TO ALL I YEAR B.E. / B.Tech.)*	3/0/3/4.5

Nature of Course	: E (Theory skill based)
Pre requisites	: NIL

Course Objectives:

1	To make the students conversant with water treatment, boiler feed water techniques.
2	To learn the effect of corrosion in materials and the methods for prevention of corrosion.
3	To understand the principles and applications of electrochemistry and to learn electroanalytical methods.
4	To understand the basic concepts, synthesis, and applications of nanomaterials.
5	To explore the synthesis and properties of important engineering plastics, energy sources and drug molecules.
6	To understand the concepts of photophysical and photochemical processes in spectroscopy.

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

C101.1	Recall the requirements of water treatment procedures and boiler feed water for industries.	[R]
C101.2	Apply the various corrosion control techniques in real time industrial environments.	[AP]
C101.3	Understand the principle and working of reference electrodes and conductivity meters as an analyzer.	[U]
C101.4	Understand the basic concepts and applications of Nanochemistry.	[U]
C101.5	Use the knowledge of polymers, various energy sources and storage devices in engineering field.	[AP]
C101.6	Understand the principle and working of certain analytical techniques, and synthesis of some common drug molecules.	[U]

Course Contents:

Water Chemistry and Corrosion: **15 Hours**

Water treatment-characteristics of water-hardness-types and estimation by EDTA method with numerical problems. Boiler feed water–requirements-disadvantages of hard water. Domestic water treatment-disinfection methods (chlorination, Ozonation, UV treatment)-demineralization process–desalination-reverse osmosis. Corrosion-types–mechanism of dry and wet corrosion-galvanic corrosion-differential aeration corrosion-protective coatings-electroplating of gold-electroless plating of nickel.

Electrochemistry and Energy Sources: **15 Hours**

Electrochemical cells-electrolytic cell-reversible and irreversible cells - Free energy and emf, cell potentials, Nernst equation and applications. Oxidation and reduction potentials-standard hydrogen electrode, saturated calomel electrode, glass electrode-pH measurement. Nanochemistry-Basics-Comparison of molecules, nanomaterials and bulk materials; Types –nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: Electrochemical deposition and electro spinning. Applications of nanomaterials in science and technology. Energy Sources-Fuel

cells (H_2-O_2). Storage Devices-Batteries- Alkaline-Lead acid, Nickel cadmium and Lithium-ion batteries.

Polymer Chemistry, Spectroscopic Techniques and Synthesis of Drug Molecules:

15 Hours

Introduction-monomers and polymers-classification of polymers-Polymerization-types. Mechanism of addition polymerization (free radical mechanism). Plastics-classification-preparation, properties and uses of Nylon 6,6, Nylon 6, PVC, Bakelite and PET. Moulding methods- moulding of plastics for Car parts, bottle caps (Injection moulding), Pipes, Hoses (Extrusion moulding), Mobile Phone Cases, Battery Trays (Compression moulding) and PET bottles (Blow moulding). Spectroscopy-Beer Lambert's law, principle, instrumentation, and applications of Electronic spectroscopy (UV-visible), Vibrational and rotational spectroscopy (IR) and Flame emission spectroscopy (FES). Synthesis of a commonly used drug molecule-Asprin, p-nitroaniline from acetanilide.

Field work:

Industrial visit- Water treatment plant / Sewage treatment plant / Reverse osmosis plant

Lab Components:

1.	Estimation of hardness of water by EDTA method	[E]
2.	Estimation of alkalinity of water sample	[E]
3.	Determination of chloride content in given water sample	[E]
4.	Estimation of dissolved oxygen in water	[E]
5.	Potentiometry- determination of redox potentials and emf's	[E]
6.	Conductometric titration-mixture of acids vs NaOH	[E]
7.	Determination of strength of strong acid by pH metry	[E]
8.	Corrosion rate of mild steel in acid medium	[E]
9.	Electroplating of nickel over copper	[E]
10.	Spectrophotometry-Estimation of iron in water	[E]
11.	Separation of mixture of amino acids by thin layer chromatography	[E]
12.	Synthesis of Nylon 66	[E]
	Total Hours: (45+30)	**75**

Understanding the concepts by simple Demonstrations/Experiments:

1.	To observe the hardness of given water sample by soap solution test
2.	To view the colour of the different medium of given water sample using litmus paper test
3.	To detect the chlorine content in tap water using simple chemical method
4.	To know the presence of dissolved oxygen in given water sample using glucose by redox principle
5.	To illustrate the rate of corrosion in steel nails using acid medium

Text Books:

1.	Dara S.S, Umare S.S, "Engineering Chemistry", First revised Edition, S. Chand & Company Ltd., New Delhi 2015.
2.	Jain P. C. & Monica Jain., "Engineering Chemistry", 16th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2015.
3.	Fundamentals of Molecular Spectroscopy, 4th Edition, C. N. Banwell Publishing McGraw-Hill Book Company (P) Ltd, England, 1994.

4.	Physical Chemistry, 11th Edition by P. W. Atkins Publishing Oxford University Press (P) Ltd, United Kingdom, 2018.
5.	Nanochemistry, 2nd Edition by K. Klabunde, G. Sergeev Springer Publisher, 2013.
6.	N.Krishna Murthy, Vallinayagam D., "Engineering Chemistry" 3rd Edition, PHI Learning Pvt Ltd.,2014.
7.	Sunita Rattan, "A Text Book of Engineering Chemistry", Student Edition, SK Kataria Publishers, 2013.
8.	R.V.Gadag, A.Nithyananda Shetty "Engineering Chemistry" 3rd Edition PHI Learning Pvt Ltd., 2014.
Reference Books:	
1.	Shikha Agarwal., "Engineering Chemistry and Applications", Cambridge University press, 2016.
2.	Liliya.,Bazylak.I., Gennady.E., Zaikov., Haghvi.A.K., "Polymers and Polymeric Composites" CRC Press,2014.
3.	Lefrou., Christine., Fabry., Pierre., Poignet., Jean-claude., "Electrochemistry - The Basics, with examples" 2012, Springer.
4.	Zaki Ahmad, Digby Macdonald, "Principles of Corrosion Engineering and Corrosion Control", Elsevier Science, 2nd Edition 2012.
5.	Perez, Nestor, "Electrochemistry and Corrosion Science", Springer, 2016.
6.	Sengupta, Amretashis, Sarkar, Chandan Kumar, "Introduction to Nano: basics to Nanoscience and Nanotechnology", Springer Publisher, 2015.
7.	Ghazi A.Karim. "Fuels, Energy and the Environment", CRC Press, Taylor and Francis group, 2012.
Web References:	
1.	http://www.analyticalinstruments.in/home/index.html
2.	www.springer.com › Home › Chemistry › Electrochemistry
3.	https://www.kth.se/.../electrochem/welcome-to-the-division-of-applied-electrochemistry
4.	www.edx.org/
5.	https://www.ntnu.edu/studies/courses
6.	www.corrosionsource.com/
Online Resources:	
1 2 3 4 5 6	nptel.ac.in/courses/105104102/hardness.htm https://ocw.mit.edu/courses/chemistry nptel.ac.in/courses/105106112/1_introduction/5_corrosion.pdf https://alison.com - Spectroscopic technique, Colorimetry https://ocw.mit.edu/courses/chemistry nptel.ac.in/courses/113108051

Assessment Methods & Levels (based on Blooms' Taxonomy)					
Summative assessment based on Continuous and End Semester Examination					
Bloom's Level	**Continuous Assessment**				**End Semester Examination (Theory) [40 marks]**
	Theory			**Practical**	
	CIA-I [10 marks]	**CIA-II [10 marks]**	**Term End Examination [10 marks]**	**Rubric based CIA [30 Marks]**	
Remember	30	30	30	10	20
Understand	60	50	40	20	50
Apply	10	20	30	40	30
Analyse	-	-	-	30	-
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Course Outcomes (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	2	1	1				1						1	1	3
C101.2	2	2	2				2						2	1	3
C101.3	3	2	3				2						1	1	2
C101.4	2	2	3				3		1				2	1	2
C101.5	2	2	2				2						2	1	2
C101.6	2	2	2				2						3	1	1

20EN101	TECHNICAL COMMUNICATION SKILLS *(COMMON TO MECH / MCT / IT / CIVIL / CSE)*	2/0/2/3

Nature of Course	E (Theory Skill Based)
Pre requisites	Basics of English Language

Course Objectives:

1	To enhance learners' LSRW skills.
2	To develop effective communication skills.
3	To facilitate learners to acquire effective technical writing skills.
4	To prepare learners for placement and competitive exams.
5	To facilitate effective language skills for academic purposes and real-life situations.

Course Outcomes:

Upon completion of the course, students shall have ability to

C101.1	Remember language skills for technical communication.	[R]
C101.2	Apply communication skills in corporate environment.	[AP]
C101.3	Understand and communicate effectively in personal and professional situation.	[AP]
C101.4	Understand and analyse a variety of reading strategies to foster comprehension and to construct meaningful and relevant connections to the text.	[U]
C101.5	Apply technical writing skills to write letters, emails and prepare technical documents.	[AP]
C101.6	Apply language skills with ease in academic and real-life situations.	[AP]

Course Contents:

Listening and Speaking **17 Hours**

Introduction to Effective Communication- Basics of English Language - Importance of LSRW Skills - Self Introduction - Introducing Others - **Listening** to Short Conversations or Monologues - Listening to Speeches / Talks - Listening and Responding -- Longer Listening Tasks -Recognise Functions **Speaking**- Speaking about Giving Directions / Instruction - Talk about Preferences-Agree and Disagree - Giving Opinions - Speaking Practices by Giving Examples, Reasons and Additional Information- Short Talk on Business Topics- Non Verbal Communication- Presentation using Digital Tools- Effectiveness of Narration- Leadership, Conflict and Persuasion.

Reading **13 Hours**

Reading Short Texts - Skimming and Scanning - Comparing Facts and Figures - Reading and Understanding Specific Information in a Text - Cloze Reading - Identifying Reasons and Consequences Through Reading Practices - Comprehension - Collocations.

Grammar and Writing **15 Hours**

Parts of Speech- Tenses – Subject Verb Agreement - Sentence Structures - Connectives - Modal Verbs - Question Formation - If Conditionals- Active and Passive - Impersonal Passive Voice - Vocabulary Building - Business Vocabulary -- Synonyms, Antonyms – British and American Words - One Word Substitution- Identifying Common Errors.

Writing Formal Letters (Accepting and Declining Invitations) - Writing Business Letters (Calling for Quotation, Seeking Clarification, Placing an Order and Complaint Letter) - Email Writing –

Memo - Circular - Agenda and Minutes of the Meeting - Job Application Letter - Resume Writing - Paragraph Writing – Proof Reading and Editing--Technical Instructions and Recommendations- Jumbled Sentences - Technical Definitions - Report Phrases - Report Writing - Technical Proposal - Transcoding (Bar Chart, Flow Chart).		
Lab Components		
1	Listening Comprehension	[E]
2	Pronunciation, Intonation, Stress and Rhythm	[E]
3	Situational Dialogues	[E]
4	Formal Presentation	[E]
5	Group Discussion	[E]
6	Interview Skills- Online and Offline	[E]
	Total Hours:	**60**
Text Books:		
1	Practical English Usage. Michael Swan. OUP. 1995.	
2	Remedial English Grammar. F.T. Wood. Macmillan.2007	
3	On Writing Well. William Zinsser. Harper Resource Book. 2001	
4	Dr. Sumanth S, English for Engineers, Vijay Nicole Imprints Private Limited 2015.	
Reference Books:		
1	Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.	
2	Communication Skills. Sanjay Kumar and Pushp Lata. Oxford University Press. 2011.	
3	Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press	
Web References:		
1	http://www.academiccourses.com/Courses/English/Business-English	
2	https://**steptest**.in	
Online Resources:		
1 2 3	https://www.coursera.org/specializations/business-english http://www.academiccourses.com/Courses/English/Business-Englishhttps://scoop.eduncle.com/one-word-substitution-list	

Assessment Methods & Levels (based on Blooms' Taxonomy)

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment				End Semester Examination (Theory) [40 marks]
	Theory			Practical	
	CIA-I [10 marks]	CIA-II [10 marks]	Term End Examination [10 marks]	Rubric based CIA [30 Marks]	
Remember	20	20	20	20	20
Understand	40	40	40	40	40
Apply	40	40	40	40	40
Analyse	-	-	-	-	-
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Course Outcomes (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									2	3		2	1	2	1
C101.2									3	3		1	1	2	2
C101.3								2	2	2		1	1	2	1
C101.4								1	1	2			2	1	1
C101.5								1	3	3		2	2	2	1
C101.6								1	3	3		2	1	2	1

20IT101	PYTHON PROGRAMMING *(COMMON TO CSE / IT / ECE / EEE / MCT)*	3/0/2/4
Nature of Course	F (Theory Programming)	
Pre requisites	Nil	
Course Objectives:		
1.	To understand and execute Python script using types and expressions.	
2.	To understand the difference between expressions & statements and to understand the concept of assignment semantics.	
3.	To utilize high level data types such as lists and dictionaries.	
4.	To import and utilize a module and to perform read & write operations on files.	
Course Outcomes		
Upon completion of the course, students shall have ability to		
C101.1	Recognize the general principles and good Algorithmic Problem Solving	[R]
C101.2	Read, write, execute by hand simple Python programs.	[U]
C101.3	Structure simple Python programs for solving problems.	[U]
C101.4	Decompose a Python program into functions.	[AP]
C101.5	Represent compound data using Python lists, tuples and dictionaries.	[AP]
C101.6	Read and write data from / to files in Python Programs.	[AN]

Course Contents:

ALGORITHMIC PROBLEM SOLVING, DATA, EXPRESSIONS, STATEMENTS: 15 Hours

Algorithms, Building Blocks of Algorithms (Statements, State, Control Flow, Functions), Notation (Pseudo Code, Flow Chart, Programming Language), Algorithmic Problem Solving, Simple strategies for developing algorithms (Iteration, Recursion). Illustrative Problems: Find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range. Python Interpreter and Interactive Mode; Values and Types: Int, Float, Boolean, String and List; Variables, Expressions, Statements, Tuple Assignment, Precedence of Operators, Comments; Modules and Functions, Function Definition and Use, Flow of Execution, Parameters and Arguments; Illustrative Programs: Exchange the values of two Variables, Circulate the values of n variables, distance between two points.

CONTROL FLOW, FUNCTIONS: 15 Hours

Conditionals: Boolean Values and Operators, Conditional (If), Alternative (If-Else), Chained Conditional (If-Elif-Else); Iteration: State, While, For, Break, Continue, Pass; Fruitful Functions: Return Values, Parameters, Local and Global Scope, Function Composition, Recursion; Strings: String Slices, Immutability, String Functions and Methods, String Module; Lists as Arrays. Sets -Set Operations, Classes. Illustrative Programs: Sum an array of numbers.

LISTS, FILES, MODULES, PACKAGES: 15 Hours

Lists: List Operations, List Slices, List Methods, List Loop, Mutability, Aliasing, Cloning Lists, List Parameters; Tuples: Tuple Assignment, Tuple as Return Value; Dictionaries: Operations and Methods; Advanced List Processing - List Comprehension; Files and Exception: Text Files, Reading

and Writing Files, Format Operator; Command Line Arguments, Errors and Exceptions, Handling Exceptions, Modules, Packages; Numpy and Numpy Operations, Pandas and pandas operations, Matplotlib: types of plots. Case study: Analyze the academic performance of students and plot a graph.	
Total Hours:	**45**
Laboratory Component:	
S. No	**List of Experiments**
1.	Compute the GCD of two numbers.
2.	Find the square root of a number (Newton's method).
3.	Exponentiation (power of a number).
4.	Find the maximum of a list of numbers.
5.	Linear search and Binary search.
6.	Selection sort, Insertion sort.
7.	Merge sort.
8.	First n prime numbers.
9.	Multiply matrices.
10.	Programs that take command line arguments (word count).
11.	Plotting datasets.
12.	File handling and plotting.
Total Hours:	**30**
Text Books:	
1.	Allen B. Downey, "Think Python: How to Think Like a Computer Scientist'', 2nd Edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/).
2.	Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python" – Revised and updated for Python 3.2, Network Theory Ltd., 2011.
3.	Tony Gaddis, "Starting out with Python'', 2nd edition, Addison Wesley, Pearson, 2012
Reference Books:	
1.	Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach", Pearson India Education Services Pvt. Ltd., 2016.
2.	Timothy A. Budd, "Exploring Pythonll", Mc-Graw Hill Education (India) Private Ltd., 2015.
3.	John V Guttag, "Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press, 2013.
Web References:	
1.	http://nptel.ac.in/courses/106106145/
2.	https://www.codecademy.com/learn/learn-python
3.	https://www.coursera.org/learn/python-data-analysis#syllabus

Online Resources:	
1.	https://www.programiz.com/python-programming
2.	https://www.fullstackpython.com/best-python-resources

Tentative Assessment Methods & Levels (based on Revised Bloom's Taxonomy

Summative assessment based on Continuous and End Semester Examination

Revised Bloom's Level	Continuous Assessment				End Semester Examination (Theory) [40 marks]
	Theory			Practical	
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]	Rubric based CIA [30 Marks]	
Remember	30	30	20	-	20
Understand	40	30	30	30	30
Apply	30	40	50	70	50
Analyse					
Evaluate					
Create					

Course Outcomes (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	3	3	3	3	3	1	1			1	1	3	3	3
C101.2	3	3	3	3	3	3	1	1			1	1	3	3	3
C101.3	3	3	3	3	3	3	1	1			1	1	3	3	3
C101.4	3	3	3	3	3	3	1	1			1	1	3	3	3
C101.5	3	3	3	3	3	3	1	1			1	1	3	3	3
C101.6	3	3	3	3	3	3	1	1			1	1	3	3	3

20CS101	APPLICATION DEVELOPMENT PRACTICES *(COMMON TO CSE / IT)*	2/0/2/3
Nature of Course	F (Theory Programming)	
Pre requisites	Nil	
Course Objectives:		
1.	To impart the knowledge of web application development platforms.	
2.	To develop the front end user interface using HTML, CSS.	
3.	To recognize the user experience design methodologies like Java script, JSON and JQuery for responsive web design.	
Course Outcomes		
Upon completion of the course, students shall have ability to		
C101.1	Identify working model and learn basic web concepts to develop Static and Dynamic web pages.	[R]
C101.2	Create web pages that demonstrate proficiency in the use of HTML.	[AP]
C101.3	Present a professional document using Cascaded Style Sheets	[U]
C101.4	Use knowledge of HTML and CSS code to create personal and/or business websites following current professional and/or industry standards.	[AP]
C101.5	Apply static and dynamic web page design techniques to construct an interactive web page using Client side technologies.	[AP]
C101.6	Implement dynamic web page with validation and event handling mechanisms.	[AP]

Course Contents:

INTRODUCTION TO HTML **15 Hours**

Basic Web Concepts – Web based Client/Server model – Web Protocols – Working of web browser – Browser & Server Communication – Basics of HTML – Elements and Attributes of HTML – HTML Layouts – HTML forms – HTML Lists and Tables – HTML Media – Getting started with HTML5 – HTML Graphics

INTRODUCTION TO CSS **15 Hours**

Basics of CSS – HTML Style attributes – CSS Syntax – CSS Selectors – Three ways to insert CSS – Element based CSS – CSS Layouts – CSS Image Gallery – Gradients and Shadows – 2D and 3D transforms with CSS – CSS Pagination and Columns – Basics of Responsive UI Design – Basics of CSS frameworks

CLIENT SIDE PROGRAMMING **15 Hours**

Java Script: An introduction to JavaScript – Data Types – Conditionals and Loops – Functions – Classes and Objects – Inbuilt Methods – Arrays – Regular Expressions – Arrow Functions – Debugging in browsers – JS HTML DOM – JS Browser BOM – Introduction to AJAX and JSON – JS vs JQuery – Why JS Frameworks

Laboratory Component:		
S. No	**List of Experiments**	
1.	Design a web page using HTML basic tags	
2.	Develop web site with suitable contents and links	
3.	Design web pages using lists and tables	
4.	Build a web client-side Login, Registration form and Dashboard with dropdown menus.	
5.	Develop a HTML form and validation using HTML5 features.	
6.	Create a website using HTML □ To embed an image map in a web page. □ To fix the hot spots. □ Show all the related information when the hot spots are clicked.	
7.	Apply style specification in HTML page using CSS.	
8.	Simple programs using Java Script	
9.	Develop dynamic web application using HTML, CSS and JavaScript.	
10.	Develop responsive web application using JSON and JQuery	
	Total Hours:	**60**
Text Books:		
1.	Thomas a Powell, “HTML & CSS: The Complete Reference”, 5th Edition, Tata McGraw Hill Education Private Limited, 2010.	
2.	Russ Ferguson, “Beginning JavaScript: The Ultimate Guide to Modern JavaScript Development”, Apress Publishers, 3rd Edition, 2019.	
3.	Jon Duckett, “HTML and CSS: Design and build websites”, John Wiley & Sons, 2011.	
4.	David Flanagan, “JavaScript: The Definitive Guide”, 5th Edition, O’Reilly, 2011	
Reference Books:		
1.	Deitel Deitel Goldberg, “Internet and World Wide Web – How to program”, 5th Edition, Prentice Hall Publishers, 2012.	
2.	Robert W Sebesta, “Programming the World Wide Web”, 7th Edition, Pearson Education Inc., 2014.	
Web References:		
1.	https://developer.mozilla.org/en-US/docs/Web/HTML	
2.	https://developer.mozilla.org/en-US/docs/Web/CSS	
3.	https://developer.mozilla.org/en-US/docs/Web/JavaScript	
Online Resources:		
1.	https://www.coursera.org/learn/html-css-javascript-for-web-developers	
2.	https://online-learning.harvard.edu/subject/javascript	

Tentative Assessment Methods & Levels (based on Revised Bloom's Taxonomy					
Summative assessment based on Continuous and End Semester Examination					
Revised Bloom's Level	**Continuous Assessment**				**End Semester Examination (Theory) [40 marks]**
	Theory			**Practical**	
	CIA-1 [10 marks]	**CIA-2 [10 marks]**	**CIA-3 [10 marks]**	**Rubric based CIA [30 Marks]**	
Remember	40	20	10	10	20
Understand	30	30	30	30	30
Apply	30	50	60	60	50
Analyse					
Evaluate					
Create					

Course Outcomes (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	3	2	2	2				2			2	3	3	1
C101.2	3	3	2	2	2				2			2	2	3	1
C101.3	3	3	2	2	2				2			2	3	3	1
C101.4	3	3	2	2	2				2			2	2	3	1
C101.5	3	3	2	2	2				2			3	3	3	1
C101.6	3	3	2	2	2				2			3	3	3	1

20ME111	ENGINEERING GRAPHICS	1/0/3/2.5
Nature of Course	Practical application	
Pre-Requisites	Basic Drawing and Computer Knowledge	

Course Objectives:

1.	To know the method to construct the conic curves used in engineering applications.
2.	To develop an understanding of Isometric to orthographic views and vice versa.
3.	To learn the basic projection of straight lines and plane surfaces.
4.	To develop the imagination of solids inclined to one reference plane.
5.	To know the development of surfaces used in various fields.

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

C111.1	Understand the basic concepts of Engineering Graphics.	[U]
C111.2	Sketch isometric, orthographic projections and projection of lines and planes.	[AP]
C111.3	Develop lateral surfaces of solids including prisms and pyramids.	[AP]
C111.4	Construct projections of lines, planes, solids and isometric views using modelling software.	[A]

Course Contents:

Conic curves and special curves – Isometric projections, Isometric to orthographic projection- Orthographic to Isometric projection - Projection of lines and plane surfaces-Projection of solids-Development of surfaces-Introduction to perspective projection.

S.No	List of Experiments	CO Mapping	RBT
1	Introduction to drafting software.	C111.1	U
2	Construction of conic curves (Ellipse, Parabola and Hyperbola)	C111.1	U
3	Construction of special curves (Cycloid and Involutes)	C111.1	U
4	Isometric to orthographic projections – manual sketches	C111.2	Ap
5	Isometric to orthographic projections – software sketches	C111.4	A
6	Projection of lines - inclined to HP, VP and Both HP & VP	C111.4	A
7	Projection of plane surfaces (Hexagon, Pentagon and circle) – inclined to any one of the principle planes	C111.4	A
8	Projection of solids (Prism and Pyramid) – inclined to HP	C111.3	Ap
9	Projection of solids (Cone and Cylinder) – inclined to VP	C111.3	Ap
10	Development of surfaces (Prism, Pyramid, Cone and Cylinder)	C111.4	A
11	Introduction to perspective projection	C111.2	U

Total Hours: 45

Reference Books:

1	Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 50th Edition, 2014.
2	K. V. Natarajan, “A Text Book of Engineering Graphics", Dhanalakshmi Publishers, 2018.
3	Gopalakrishna K.R., “Engineering Drawing” (Vol. I&II combined), Subhas Stores, Bangalore, 2011.
4	Venugopal K. and Prabhu Raja V., “Engineering Graphics”, New Age International (P) Limited, 2013.

Web References:

1	http://nptel.ac.in/courses/112102101/
2	www.solidworks.com

Tentative Assessment Methods & Levels (based on Bloom's Taxonomy)		
Summative assessment based on Continuous and End Semester Examination		
Bloom's Level	**Rubric based Continuous Assessment [60 marks]**	**End Semester Examination [40 marks]**
Remember	30	30
Understand	30	30
Apply	20	20
Analyze	20	20
Evaluate	0	0
Create	0	0
Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)		

Course Outcomes (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C111.1	2	2	1				2	2	3			2	3	2	
C111.2	2	2	1				2	2	3			2	3	2	
C111.3	2	2	1				2	2	3			2	3	2	
C111.4	2	2	1				2	2	3			2	3	2	

20MC101	INDUCTION PROGRAMME *(FOR ALL BRANCHES OF B.E / B.TECH PROGRAMMES)*	1/0/0/0
Nature of Course	Induction Programme	
Pre requisites	Nil	
Course Objectives:		
1.	To have broad understanding of society and relationships	
2.	To nurture the character and fulfil one's responsibility as an engineer, a citizen and a human being	
3.	To incorporate meta skills and values	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C101.1	Explore academic interest and activities	[AP]
C101.2	Work for excellence	[AP]
C101.3	Promote bonding and give a broader view of life and character	[AP]

Course Contents:

PHYSICAL ACTIVITY: Research over the past years has shown Yoga to have stress-relieving powers on students, paving the way for improved academic performance with the practice of asanas, meditation and breathing exercises. To prove these words Yoga classes has been planned in this module.(CO mapping: C101.1, C101.2, C101.3)

CREATIVE ARTS (students can select any one of their choice): Cultural development supports students to understand, feel comfortable with, value and appreciate the potential enrichment of cultural diversity. They should challenge discrimination, whether based on cultural or racial difference. Students should experience cultural traditions embedded in arts, crafts, language, literature, theatre, song, music, dance, sport, Science, technology and travel. Students should develop an appreciation of beauty both in experiencing artistic expression and by exploring their own creative powers. To inculcate those skills they are given a chance to exhibit their talents through painting, sculpture, pottery, music, dance, craft making and so on. .(CO mapping: C101.1, C101.2, C101.3)

UNIVERSAL HUMAN VALUES: Moral development involves supporting students to make considered choices around their behaviour and the values that provide a framework for how they choose to live. Moral development is also learning about society's values, understanding the reasons for them, how they are derived and change; and how disagreements are resolved. Students must consider the consequences of personal and societal decisions on the wider community – local and global- and on the environment and future generations. To acquire this the students are exposed to training to enhance their soft skills. .(CO mapping: C101.1, C101.2, C101.3)

LITERARY AND PROFICIENCY MODULES: Social development helps students to work effectively together, developing the inter-personal skills required to relate positively with their peers and people of all ages. Students must also understand how to participate productively in a diverse and plural society and learn about, and how to effectively engage with societal institutions and processes. They should understand that a person may have different roles and responsibilities within society. To reach this the following aspects are given in the form of Reading, writing, speaking – debate, role play etc.Communication and computer skills. (CO mapping: C101.1, C101.2, C101.3)

LECTURES BY EMINENT PEOPLE: Teaching with Lectures. ... It is essential to see lectures as a means of helping students learn to think about the key concepts of a particular subject, rather than primarily as a means of transferring knowledge from instructor to student. During the induction period students will attend to Guest lectures by subject experts.(CO mapping: C101.1, C101.2, C101.3)

VISIT TO LOCAL AREAS: Traveling is in fact a way of learning to learn. You are out of your comfort zone and so you must learn to be able to adapt to a new learning environment in a very short time. It also helps in your overall learning as well. In the induction period students will be taken to different places near college to learn new things. Eg. Meditation centre /orphanage/Hospital. (CO mapping: C101.1, C101.2, C101.3)

FAMILIARIZATION TO DEPARTMENT/BRANCH INNOVATION: Hod's of different branches will present about their department followed by department visit to view various facilities available at their department, new innovations from students and faculties etc.(CO mapping: C101.1, C101.2, C101.3)

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	3	3	3	3	3	3			1
C101.2						3	3	3	3	3	3	3			1
C101.3						3	3	3	3	3	3	3			1

20GE201	UNIVERSAL HUMAN VALUES *(COMMON TO ALL BRANCHES)*	3/0/0/3

Nature of Course	C (Theory Concept)
Pre requisites	Interpersonal Communication and Value Sciences

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 behaviour and mutually enriching interaction with Nature

Course Outcomes:

Upon completion of the course, students shall have ability to

C201.1	Understand about themselves and their surroundings (family, society, nature).	[U]
C201.2	Understand and to become more responsible in life, and in handling problems with sustainable solutions while keeping human relationships and human nature in mind.	[U]
C201.3	Apply sensitivity to their commitment towards what they have understood (human values, human relationship and human society).	[AP]
C201.4	Apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.	[AP]
C201.5	Analyse between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work.	[AN]
C201.6	Understand the harmony in nature and existence, and work out mutually on fulfilling participation in the nature.	[U]

Course Contents:

Course Introduction - Need, Basic Guidelines, Content and Process for Value Education, Understanding Harmony in the Human Being - Harmony in Myself! 15 Hours

Purpose and motivation for the course. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration. Continuous Happiness and Prosperity- A look at basic Human Aspirations. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario. Method to fulfil the above human aspirations: understanding and living in harmony at various levels. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'. Understanding the needs of Self ('I') and 'Body' - happiness and physical Facility. Understanding the Body as an instrument of 'I' (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: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail. Programs to ensure Sanyam and Health.

Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship, Understanding Harmony in the Nature and Existence - Whole existence as Coexistence **15 Hours**

Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship. Understanding the meaning of Trust; Difference between intention and Competence. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family. Understanding the harmony in the Nature. Interconnectedness and mutual fulfilment among the four orders of nature recyclability and self-regulation in nature. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space. Holistic perception of harmony at all levels of existence.

Implications of the above Holistic Understanding of Harmony on Professional Ethics **15 Hours**

Natural acceptance of human values. Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems. Case studies of typical holistic technologies, management models and production systems. Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations. Sum up.

Total Hours:	**45**

Text Books:	
1	Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010
2	Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
Reference Books:	
1	Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
2	The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
3	India Wins Freedom - Maulana Abdul Kalam Azad.
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

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C201.1	Understand	Group Discussion	5
C201.2	Understand	Book Review	5
C201.3 & 4	Apply	Role Play	5
C201.5 & 6	Apply	Formal Presentation	5

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			
	CIA-I [10 marks]	**CIA-II [10 marks]**	**CIA-III [10 marks]**	**Term End Assessment [50 marks]**
Remember	20	20	20	20
Understand	40	40	40	40
Apply	40	40	40	40
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

Course Outcomes (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	2	2	2			3	3	3	2	2		2	1	1	1
C201.2	2	2	2			3	3	3	2	2		2	1	1	1
C201.3	2	2	2			3	3	3	2	2		2	1	1	1
C201.4	2	2	2			3	3	3	2	2		2	1	1	1
C201.5	2	2	2			3	3	3	2	2		2	1	1	1
C201.6	2	2	2			3	3	3	2	2		2	1	1	1

20CS201	C AND DATA STRUCTURES *(COMMON TO CSE / IT)*	3/0/0/3

Nature of Course:	F (Theory Programming)

Course Objectives:

1	To learn the features of C
2	To handle functions, pointers, structures, unions and files using C
3	To manipulate linear and non-linear data structures
4	To explore the applications of linear and non-linear data structures
5	To familiarize the concepts of hashing.

Course Outcomes:

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

C201.1	Develop C programs for any real-world technical application using basic programming constructs, arrays and strings	[AP]
C201.2	Apply advanced features of C in solving problems	[AP]
C201.3	Design applications using sequential and random access file processing	[AP]
C201.4	Demonstrate operations like insertion, deletion, searching, traversing etc. on linear and non-linear data structures	[AP]
C201.5	Apply appropriate hash functions that result in a collision free scenario for data storage and retrieval.	[AP]
C201.6	Choose appropriate data structure for any real world data set.	[A]

Course Contents:

C PROGRAMMING **15 Hours**

Basic Features: Introduction - Data Types – Variables – Operations – Expressions and Statements – Conditional and Iterative Statements – Functions – Recursive Functions – Arrays – Single and Multi-Dimensional Arrays- Strings.

Advanced Features: Structures – Union – Enumerated Data Types – Pointers: Pointers to Variables, Arrays and Functions – File Handling – Storage classes - Preprocessor Directives.

LINEAR DATA STRUCTURES – LIST, STACK, QUEUE **15 Hours**

Abstract Data Types (ADTs) – List ADT – Array based implementation – Linked list implementation – Singly linked lists – Circularly linked lists – Doubly linked lists – Application of lists – Polynomial Manipulation. Stack ADT – Operations – Applications – Evaluating arithmetic expressions – Conversion of Infix to postfix expression – Queue ADT – Operations – Circular Queue – Priority Queue – Applications of queues.

NON-LINEAR DATA STRUCTURES **15 Hours**

Trees – Binary Trees – Tree Traversals – Expression Trees – Binary Search Tree – Hashing - Hash Functions – Separate Chaining – Open Addressing – Linear Probing– Quadratic Probing – Double Hashing – Rehashing.

Total Hours:	**45**

Text Books:

1	Yashavant Kanetkar, “Let us C”, 15th Edition, BPB Publications, 2017
2	Reema Thareja, “Programming in C”, 2nd Edition, Oxford University Press, 2016.
3	Pradip Dey and Manas Ghosh, “Programming in C”, 2nd Edition, Oxford University Press, 2011.

4	Mark Allen Weiss, “Data Structures and Algorithm Analysis in C”, Pearson Education India, 3rd Edition 2013.

Reference Books:

1	Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, “Fundamentals of Data Structures in C”, 2nd Edition, University Press, 2008
2	Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, “Data Structures and Algorithms”, Pearson Education, 1983.
3	Robert Kruse, C.L.Tondo, Bruce Leung, Shashi Mogalla , “Data Structures and Program Design in C”, 2nd Edition, Pearson Education, 2007
5	Jean-Paul Tremblay and Paul G. Sorenson, “An Introduction to Data Structures with Applications”, 2nd Edition, Tata McGraw-Hill, 1991.
6	Seymour Lipschutz, “Data Structures by Schaum series”, 2nd Edition, Tata McGraw Hill, 2013.

Web References:

1	http://www.nptel.ac.in
2	https://visualgo.net/en

Online Resources:

1	https://www.youtube.com/watch?v=-CpG3oATGIs
2	http://lcm.csa.iisc.ernet.in/dsa/dsa.html
3	http://utubersity.com/?page_id=878
4	http://freevideolectures.com/Course/2519/C-Programming-and-Data-Structures
5	http://freevideolectures.com/Course/2279/Data-Structures-And-Algorithms

Assessment Methods & Levels (based on Blooms’Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C201.1, C201.2, C201.3	Apply	Quiz	5
C201.4, C201.5	Apply	Programming Assignment	5
C201.6	Analyze	Mini Project	10

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment (30)			End Semester Examination [50 marks]
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]	
Remember	20	20	20	20
Understand	20	40	40	40
Apply	60	40	40	40
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

Course Outcomes (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	3	2	3							2	2	2	2
C201.2	3	3	3	2	3							2	2	2	2
C201.3	3	3	3	3	3							2	2	2	2
C201.4	3	3	3	2	3							2	2	3	3
C201.5	3	3	3	3	3							3	3	2	1
C201.6	3	3	3	3	3							2	3	3	2

20MA201	ENGINEERING MATHEMATICS II (COMMON TO MECH / MCT / CIVIL / ECE / EEE / CSE / IT / AIDS)	2/1/2/4

Nature of Course	J (Problem analytical)
Pre requisites	Concepts of Differentiation and Integration.

Course Objectives:

1.	To gain knowledge in integrals, which are needed in engineering applications.
2.	To develop logical thinking and analytical skills in evaluating multiple integrals.
3.	To acquaint with the concepts of vector calculus needed for problems in all engineering disciplines.
4.	To impart the knowledge of Laplace transform, to find solutions of initial value problems for linear ordinary differential equations.

Course Outcomes:

Upon completion of the course, students shall have ability to

C201.1	Determine the area and volume by applying the techniques of double and triple integrals.	[R]
C201.2	Finding the values of integrals through different numerical methods.	[U]
C201.3	Differentiate and integrate a vector-valued functions to solve real world applications.	[AP]
C201.4	Calculate grad, div, curl and use Gauss, Stokes and Greens theorem to simplify the calculations of integrals.	[AP]
C201.5	Apply Laplace transform techniques in system modelling, digital signal processing, process control, solving boundary value problems.	[AP]
C201.6	Apply Laplace transform methods for solving linear differential equations.	[AP]

Course Contents:

INTEGRAL CALCULUS **18 Hours**

Definite integrals: Evaluation of definite integrals using Bernoulli's formula –Multiple Integrals: Double integration in Cartesian coordinates – Area as double integral –Change of order of Integration – Triple integration in Cartesian co-ordinates –Volume as triple integral – Beta and Gamma functions – Relation between Beta and Gamma Functions – Evaluation of Integrals using Beta and Gamma Functions – Numerical integration: Trapezoidal rule and Simpson's rule for single and double integrals.

VECTOR CALCULUS **14 Hours**

Vector differential operator – Gradient of a scalar point function - Directional derivatives – Divergence and Curl of a vector point function – Irrotational and solenoidal vector fields – Simple problems – Vector integration – Green's theorem in a plane, Gauss divergence theorem and Stoke's theorem (theorems statements only) – Simple applications involving cubes and rectangular parallelepipeds.

LAPLACE TRANSFORM **16 Hours**

Convergence of Laplace transform – Transform of some standard functions – Unit step function – Unit Impulse function – Properties – Initial and final value theorem – Inverse Laplace transform – Partial fraction method – Convolution theorem – Application of Laplace transform for solving second order ordinary differential equation.

Lab Components:

1. Double integrals evaluation in cartesian coordinates using MATLAB.
2. Triple integral calculations using MATLAB in cartesian and cylindrical coordinates.
3. Double integral evaluation in MATLAB by Trapezoidal rule.
4. Evaluation of gradient, curl and divergence in MATLAB.
5. Line integral over a vector field using MATLAB
6. Applying Green's theorem to solve integrals in MATLAB.
7. Relation between Laplace transform of function and its derivative using MATLAB.
8. Laplace transform of Dirac delta and Heaviside functions in MATLAB.
9. Solving Differential Equations in MATLAB using Laplace Transform.
10. Inverse Laplace Transform of symbolic expressions using MATLAB.

Total Hours: (48+12)	**60**

Text Books:	
1	G.B.Thomas and R.L.Finney, Calculus and Analytic Geometry, 14th Edition, Pearson, Reprint, 2018.
2	Kreyszig. E, "Advanced Engineering Mathematics" Tenth Edition, John Wiley and Sons (Asia) Limited, Singapore 2018.
3	Grewal. B.S, "Higher Engineering Mathematics", 43rd Edition, Khanna Publications, Delhi, 2014.
Reference Books:	
1	Veerarajan. T, "Engineering Mathematics II", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2018.
2	Glyn James, —Advanced Modern Engineering Mathematics, Pearson Education, 4th Edition, 2012.
3	N.P.Bali and Dr.Manish Goyal, "A Text book of Engineering Mathematics" 9th Edition, Laxmi publications Ltd, 2014.
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.

Assessment Methods & Levels (based on Blooms' Taxonomy)

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	**Continuous Assessment**				**End Semester Examination (Theory) [40 marks]**
	Theory			**Practical& Project**	
	CIA-I [10 marks]	**CIA-II [10 marks]**	**CIA-III [10 marks]**	**Rubric based CIA [30 Marks]**	
Remember	20	20	20	20	20
Understand	30	30	30	30	30
Apply	50	50	50	50	50

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

Course Outcomes (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	2	1	2										3	2	1
C201.2	2	3	2										3	2	1
C201.3	3	3	2										3	2	1
C201.4	3	3	2										3	1	2
C201.5	3	3	2						2				3	2	1
C201.6	3	3	2						2				3	2	1

20PH104	PHYSICS *(COMMON TO CSE / IT / AI&DS)*	3/0/3/4.5

Nature of Course	: E (Theory skill based)
Prerequisites	: Nil

Course Objectives:

1.	To learn the fundamental concepts of physics and apply this knowledge to both scientific and engineering problems.
2.	To make the students enrich basic knowledge in various fields such as Laser, Optical fibers, Photonics, Superconductors and quantum mechanics of physics and apply the same in computing fields.

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

C104.1	Recall and interpret the basic concepts of lasers and various types of optical fibers for articulating in engineering applications.	[R]
C104.2	Describe and conduct experiments in photonic materials.	[U]
C104.3	Acquire basic understanding and fundamental concepts of superconductors.	[R]
C104.4	Discuss the dual nature of radiation and matter.	[U]
C104.5	Solve Schrodinger's equations on finite and infinite potential well problems.	[AP]
C104.6	Apply quantum idea for understanding the working of quantum computing.	[AP]

Course Contents:

Laser and Fiber optics **15 Hours**

Laser: Characteristics of laser – Principle of spontaneous emission and stimulated emission – Einstein's theory of matter radiation interaction and A and B coefficients (derivation) – Population inversion – Pumping – Nd-YAG and CO_2 laser – Applications: Laser printer, Data storage and Bar code scanner. ***Fiber optics:*** Light propagation through fibers, acceptance angle, numerical aperture – Types of fibers: step index, graded index, single mode and multimode – Optical fibers for computing applications – PC to PC communication and fiber optics in computer networking.

Photonics and Superconductors **15 Hours**

Photonics: Introduction to photonic materials – Photonic crystals – Liquid crystal display (LCD) Light sources: Light emitting diode (LED) – Photo dependence resistor – Photo detectors: PIN, avalanche – Photo voltaic effect, Solar cell – Applications of photonic materials in computing – optical computing. ***Superconductors:*** Properties of Superconductors: effect of magnetic field, Meissner effect, effect of current,thermal properties, isotope effect, Josephson effects and its applications – Type–I and Type–II Superconductors – BCS theory – High T_C superconductors – Application of Superconductors: magnetic levitation, SQUID and cryotron.

Quantum Mechanics and Quantum computing **15 Hours**

Quantum Mechanics: Planck's quantum theory (derivation) – Matter waves, de-Broglie wavelength, Heisenberg's uncertainty principle – Schrödinger's wave equation: time independent and time dependent – Physical significance of wave function – Particle in a one-dimensional potential box – Electron microscope: SEM and TEM – Postulates of quantum mechanics. ***Quantum computing*****:** Introduction to quantum computing – qubits, entanglement, decoherence and quantum supermacy, differences in quantum and classical computation.

Lab Component		30 Hours
1	Particle size determination and measurement of d-spacing in CD using Laser.	[U]
2	Determination of wavelength, angle of divergence and coherence length of laser source.	[U]
3	Determination of numerical aperture and acceptance angle parameter of optical fiber using Laser source.	[U]
4	Characteristics curves of solar cell.	[U]
5	Characteristics curve of light dependent resistor (LDR).	[U]
6	Determination of bandgap of semiconductor.	[U]
7	Determination and verification of Stefan law.	[U]
8	Determination of Planck's constant using electroluminescence.	[U]
9	Determination of entangled photons using spectrometer.	[U]
10	Determination of wavelength of mercury spectrum – Spectrometer	[U]
	Life Skills Experiments	
1	How does a fuel (gas/liquid) pump nozzle shut off?	
2	How does a circuit breaker work?	
3	How to Check Earthing at Home?	
	Total Hours: (45+30)	**75**

Text Books:	
1	Rajendran, V "Engineering Physics" Mc Graw Hill Publications ltd, New Delhi, 2016.
2	David Halliday, Robert Resnick, Jearl Walker "Fundamentals of Physics", 11th Edition, Wiley, 2018.
3	Eleanor Rleffel and Wolfgang Polak, "Quantum computing a gentle introduction", 1st Edition, The MIT press, 2012.
Reference Books:	
1	William T. Silfvast "Laser Fundamentals" Cambridge University Press, 2012
2	Fedor Mitschke "Fiber Optics physics and Technology", 2nd Edition, Springer, 2017.
3	Chakrabarti P. "Optical Fiber Communication", McGraw Hill Education, 2015.
4	Kasap**,** Safa**,** Capper, "Handbook of Electronic and Photonic Materials" 2nd Edition, Springer, 2017.
5	Balkan**,** Naci, Erol**,** Ayşe, "Semiconductors for Optoelectronics", 1st Edition Springer, 2020.
6	Bhattacharya D. K. and Poonam Tandon, "Engineering Physics", Oxford University press, 2014
7	David J. Griffiths, "Introduction to Quantum Mechanics", 2nd Edition, Cambridge university press, 2017.
8	Chris Bernhardt, "Quantum Computing for Everyone" The MIT press, 2019

Web References/Online Resources

1	https://www.eatm.in/upload/srit__unit_i_laser.pdf
2	http://www.crectirupati.com/sites/default/files/lecture_notes/OFC%20NOTES.pdf
3	https://ocw.mit.edu/courses/materials-science-and-engineering/3-46-photonic-materials-and-devices-spring-2006/lecture-notes/
4	https://nptel.ac.in/courses/115/101/115101012/
5	https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-763-applied-superconductivity-fall-2005/lecture-notes/
6	http://wcchew.ece.illinois.edu/chew/course/QMALL20121005.pdf
7	https://nptel.ac.in/courses/115/101/115101107/
8	https://www.technologyreview.com/2019/01/29/66141/what-is-quantum-computing/
9	https://www.quantum-inspire.com/kbase/what-is-a-qubit/

10	https://www.cl.cam.ac.uk/teaching/0910/QuantComp/notes.pdf

Assessment Methods & Levels (based on Blooms' Taxonomy)					
Summative assessment based on Continuous and End Semester Examination					
Bloom's Level	**Continuous Assessment**				**End Semester Examination (Theory) [40 marks]**
	Theory			**Practical**	
	CIA-I [10 marks]	**CIA-II [10 marks]**	**CIA-III [10 marks]**	**Rubric based CIA [30 Marks]**	
Remember	30	20	30	20	30
Understand	60	60	60	40	60
Apply	10	20	10	30	10
Analyse	-	-	-	10	-
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Course Outcomes (CO)	**Programme Outcomes (PO)**												**Programme Specific Outcomes (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C104.1	2	1	1										2	1	2
C104.2	1	1	1										2	1	2
C104.3	2	1	2										2	1	2
C104.4	2	1	2										2	1	2
C104.5	3	2	3						1				2	1	2
C104.6	3	2	3						1				3	1	1

20EE111	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING *(COMMON TO CSE / MECH / CIVIL / IT)*	3/0/2/4

Nature of Course: G (Theory analytical)

Course Objectives:

1.	To equip students with a basic understanding of Electrical circuits
2.	To learn the working principle of transformers
3.	To understand the DC and AC Machine working principles and to have a knowledge on selection of machine for specific types of applications.
4.	To give a comprehensive exposure to electrical installations.
5.	To equip students with an ability to understand basics of analog and digital electronics.

Course Outcomes:

Upon completion of the course, students shall have ability to

C111.1	Analyze the concepts in ac circuit and dc circuits.	[A]
C111.2	Understand the working principle of single phase and three phase transformers.	[U]
C111.3	Understand the working principle of DC and AC machines.	[U]
C111.4	Utilize the basic components for electrical installations.	[AP]
C111.5	Understand the basic concepts of Analog and Digital Electronics.	[U]

Course Contents:

DC Circuits and AC Circuits **15 Hours**

DC Circuits - Electrical circuit elements (R, L and C), voltage and current sources, Kirchhoff's current and voltage law, analysis of simple circuits with dc excitation, Mesh, Nodal Analysis Superposition, Thevenin's Theorem, Maximum power transfer theorem and Norton's Theorem. **AC Circuits** - Representation of sinusoidal waveforms, peak and rms values, Phasor representation, real power, reactive power, apparent power, power factor. Analysis of single phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel). Three phase balanced circuits, voltage and current relations in star and delta connections.

Electrical Machines and Installations **15 Hours**

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections (Qualitative only). Construction and working principle of DC motor. Construction and working principle of Synchronous motor and three phase Induction motor. Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption.

Basics of Analog and Digital Electronics **15 Hours**

Semiconductor, PN junction diode, Zener diode, rectifier- Half wave, full wave and Bridge rectifier, Introduction to Number system, basic Boolean laws, reduction of Boolean expressions and implementation with logic gates.

Total Hours:	**45**

Lab Component

1.	Familiarization of Electrical Elements, Sources, Measuring Devices and Verification of ohm's law	C111.1	[R]
2.	Estimation of voltage and current by KVL and KCL in Electric Circuits	C111.1	[U]
3.	Determination of mesh current and node voltage by Mesh and Nodal Analysis	C111.1	[U]

4.	Application of Superposition theorems, thevenin's and maximum power transfer theorem in electrical circuits	C111.1	[AP]
5.	Measurement of three phase power	C111.2	[A]
6.	Demonstration of cut-out sections of machines: dc machine (Commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winding - slip ring arrangement) and single-phase induction machine	C111.3	[U]
7.	Load test on dc shunt motor.	C111.3	[AP]
8.	Demonstration of components of LT Switch Gears	C111.4	[U]
9.	Construction of bridge rectifier with and without filters	C111.5	[U]
10.	Verification of logic gates.	C111.5	[R]
			Total Hours: 30

Text Books:	
1	Fitzgerald. A.E., Charles KingselyJr, Stephen D.Umans, 'Electric Machinery', Tata McGraw Hill, 6th Edition 2015.
2	Vincent. Del. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 2nd Edition, 2015.
3	E. Hughes, "Electrical and Electronics Technology", Pearson, 10th Edition, 2011.
4	Donald. A, Neamen, Electronic Circuit Analysis and Design, 2nd Edition reprint, Tata Mc Graw Hill, 2013.
5	M. Morris Mano, 'Digital Logic and Computer Design', Prentice Hall of India, 6th Edition, 2017.
Reference Books:	
1	Charles A.Gross, Thaddeus A.Roppel, "Fundamentals of Electrical Engineering", CRC press, 2012.
2	D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 5th Edition 2012.
3	Theodore F. Bogart, Jeffery S. Beasley and Guilermo Rico, 'Electronic Devices and Circuits', Pearson Education, 6th Edition, 2019.
Web References:	
1	http://nptel.ac.in/course.php?disciplineId=108
2	https://ocw.mit.edu/courses/find-bytopic/#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	https://www.edx.org/course/electricity-magnetism-part-1-ricex-phys102-1x-1
2	https://www.mooc-list.com/course/fundamentals-electrical-engineering-coursera
3	https://nptel.ac.in/course.php

Summative assessment based on Continuous and End Semester Examination					
Bloom's Level	**Continuous Assessment**				**End Semester Examination (Theory) [40 marks]**
	Theory			**Rubrics Based Practical Assessment [30 Marks]**	
	CIA-I [10 Marks]	**CIA-II [10 Marks]**	**Term End Examination [10 Marks]**		
Remember	50	50	40	40	40
Understand	50	50	40	40	40
Apply		-	20	20	20
Analyse	-	-	-	-	-
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Course Outcomes (CO)	**Programme Outcomes (PO)**												**Programme Specific Outcomes (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C111.1	1	2	1										3	1	1
C111.2	2	2	2									1	3	1	1
C111.3	1	2	2						2				3	1	1
C111.4	2	1	1					1	1			1	3	1	2
C111.5	2	2	2									1	3	3	1

20ME103	ENGINEERING PRACTICES LABORATORY	0/0/3/1.5
Nature of Course	Practical application	
Pre-Requisites	Nil	

Course Objectives:

1.	To learn the use of basic hand tools and to know the need for safety in work place and to gain hands on experience in Carpentry, Sheet metal, Plumbing, Welding and Foundry.
2.	To learn about basic electrical devices, meters and electronics devices and to gain knowledge about the fundamentals of various electrical and electronic gadgets their working and trouble shooting.

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

C103.1	Identify and solve the basic engineering problems at home and in workplace.	[AP]
C103.2	Develop the surfaces and make simple components like tray and funnel.	[C]
C103.3	Make simple metal joints using welding equipment and wooden joints using carpentry tools.	[AP]
C103.4	Prepare pipe connections and sand moulds.	[AP]
C103.5	Understand the fundamentals of hot forging and injection moulding.	[U]
C103.6	Examine and troubleshoot electrical and electronic circuits.	[A]

Course Contents:

GROUP A (CIVIL & MECHANICAL)

Manufacturing Methods –Sheet metal operations - Welding - arc welding, gas welding, Study of TIG & MIG welding. Study of foundry, Demonstration of Smithy and Injection moulding - Carpentry work using power tools - Plumbing components and pipelines

List of Experiments:

S.No	List of Experiments	CO Mapping	RBT
1	Preparation of butt joints and lap joints using arc welding	C103.3	[AP]
2	Sheet metal Forming and Bending, Model making – Trays and funnels.	C103.2	[AP]
3	Preparation of wooden joints by sawing, planning and cutting.	C103.3	[AP]
4	Making basic pipe connections involving the fittings like valves, taps, coupling, unions, reducers, elbows and other components used in household fittings.	C103.4	[AP]
5	Demonstration of foundry operations like mould preparation for solid and split piece pattern.	C103.4	[U]
6	Demonstration of Smithy operations	C103.5	[AP]
7	Demonstration of assembly of pump / Demonstration of Injection moulding	C103.5	[AP]

GROUP B (ELECTRICAL AND ELECTRONICS ENGINEERING)

List of Experiments:

Basic Circuit Elements: Resistor, inductor, capacitor. Introduction to measuring equipments: Moving iron meter, moving coil meter, Wattmeter, Energy meter, CRO, Multi-meter. Digital logic circuits, PCB design, fuse, relay, circuit breaker, wire, Earthing, fan, fluorescent lamp, iron box, mixer grinder, study of FM radio and mobile phone.

S.No	List of Experiments	CO Mapping	RBT
1	Study and identification of electronic components with specification.	C103.6	[A]
2	Testing of CRO and Electronic components using Multimeter.	C103.6	[A]
3	Generation and measurement of signals using CRO.	C103.6	[A]
4	Familiarisation of digital basic gate IC's.	C103.6	[A]
5	Soldering practice-components devices and circuits- using general purpose PCB.	C103.6	[A]

6	Demonstration of meters and electrical components.	C103.6	[A]
7	Safety precautions with electrical components.	C103.6	[A]
8	Residential house wiring.	C103.6	[A]
9	Measurement of power and energy.	C103.6	[A]
10	Trouble shooting of electrical equipments.	C103.6	[A]

Total Hours: 45

Reference Books:

1	Serope Kalpakjian and Steven R. Schmid, “Manufacturing Engineering and Technology”, Pearson Education, Inc. 2009 (Second Indian Reprint).
2	Hajra Choudhury, “Elements of Workshop Technology”, Vol. I & II, Media Promotors Pvt Ltd., 2014.
3	Suyambazhagan S, ‘Engineering practices’ PHI Learning private limited, New Delhi,2012.
4	D. P. Kothari and I. J. Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, 2010.
5	E. Hughes, “Electrical and Electronics Technology”, Pearson, 2010.

Web References:

1	www.nptel.ac.in
2	www.sme.org
3	http://www.allaboutcircuits.com/education/

Tentative Assessment Methods & Levels (based on Bloom’s Taxonomy)

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Rubric based Continuous Assessment [60 marks]	End Semester Examination [40 marks]
Remember	10	10
Understand	10	10
Apply	40	40
Analyze	20	20
Evaluate	10	10
Create	10	10

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

Course Outcomes (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	3	3		3		3		3	2			2	3	2
C103.2	3	3	3		3		3		3	2			2	3	1
C103.3	2	1	3	2	3			3	2			1	2	2	1
C103.4	3	3	3		3		3		3	2			2	1	1
C103.5	3	3	3		3		3		3	2			2	1	1
C103.6	3	3	3		3		3		3	2			2	3	3

20CS202	DATA STRUCTURES LABORATORY *(COMMON TO CSE / IT)*	0/0/3/1.5

Nature of Course:	D (Practical Programming)

Course Objectives:

1.	To write C programs using functions, pointers, structures and unions.
2.	To access files using C.
3.	To implement linear and tree data structures.
4.	To introduce concepts of hashing.

Course Outcomes:

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

C202.1	Develop C programs using basic programming constructs, arrays and strings	[AP]
C202.2	Apply advanced features of C in solving problems	[AP]
C202.3	Demonstrate the file operations on binary and text files	[AP]
C202.4	Write functions to implement linear and tree data structure operations in C and present the data flow neatly	[AP]
C202.5	Apply appropriate hash functions that result in a collision free scenario for data storage and retrieval	[AP]
C202.6	Identify, implement and use appropriate linear data structures for accessing elements in the given data set and document the process	[A]

Course Contents:

1. Practice of C Programming using Branching and Iterative constructs.
2. Programs using Functions
3. Programs using arrays and strings.
4. Programs using Structures and Pointers.
5. Programs using Files.
6. Implementation of Singly, doubly and Circular Linked List.
7. Implementation of Stack using Arrays
8. Implementation of Stack using Linked List.
9. Implementation of Stack applications.
10. Implementation of Queue using Arrays
11. Implementation of Queue using Linked List.
12. Implementation of Priority Queue.
13. Implementation of Queue applications.
14. Implementation of Binary Search Tree.
15. Implementation of hashing techniques

Total Hours:	**45**

Text Books:

1	Yashavant Kanetkar, “Let us C”, 15th Edition, BPB Publications, 2017
2	Reema Thareja, “Programming in C”, 2nd Edition, Oxford University Press, 2016
3	Mark Allen Weiss, “Data Structures and Algorithm Analysis in C”, Pearson Education India, 3rd Edition 2013.
4	Pradip Dey and Manas Ghosh, “Programming in C”, 2nd Edition, Oxford University Press, 2011.

Reference Books:

1	Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, “Fundamentals of Data Structures in C”, 2nd Edition, University Press, 2008
2	Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, “Data Structures and Algorithms”, Pearson Education, 1983.

3	Robert Kruse, C.L.Tondo, Bruce Leung, ShashiMogalla , “Data Structures and Program Design in C”, 2nd Edition, Pearson Education, 2007
5	Jean-Paul Tremblay and Paul G. Sorenson, “An Introduction to Data Structures with Applications”, 2nd Edition, Tata McGraw-Hill, 1991.
6	Seymour Lipschutz, “Data Structures by Schaum series”, 2nd Edition, Tata McGraw Hill, 2013.
Web References:	
1	http://www.nptel.ac.in
2	https://visualgo.net/en
Online Resources:	
1	http://lcm.csa.iisc.ernet.in/dsa/dsa.html
2	http://utubersity.com/?page_id=878
3	http://freevideolectures.com/Course/2519/C-Programming-and-Data-Structures
4	https://www.youtube.com/watch?v=-CpG3oATGIs

Assessment Methods & Levels (based on Blooms’Taxonomy)

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Rubric based Continuous Assessment (60)	End Semester Examination (40)
Remember	-	-
Understand	-	-
Apply	70	60
Analyse	30	40
Evaluate	-	-
Create	-	-

Course Outcomes (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	3	2	3				2	2		3	2	2	2
C202.2	3	3	3	2	3				2	2		3	2	2	2
C202.3	3	3	3	3	3				2	2		3	2	2	2
C202.4	3	3	3	2	3				2	2		3	2	2	2
C202.5	3	3	3	3	3				2	2		3	3	2	2
C202.6	3	3	3	3	3				2	2		3	3	2	2

20MC102	ENVIRONMENTAL SCIENCES	2/0/0/0

Nature of Course	Theory Concept
Pre requisites	Basics in Environmental Studies

Course Objectives:

1	To learn the integrated themes on various natural resources.
2	To gain knowledge on the type of pollution and its control methods.
3	To have an awareness about the current environmental issues and the social problems.

Course Outcomes:

Upon completion of the course, students shall have ability to

C102.1	Recall and play an important role in transferring a healthy environment for future generation.	[R]
C102.2	Understand the importance of natural resources and conservation of biodiversity.	[U]
C102.3	Understand and analyze the impact of engineering solutions in a global and societal context.	[U]
C102.4	Apply the gained knowledge to overcome pollution problems.	[AP]
C102.5	Apply the gained knowledge in various environmental issues and sustainable development.	[AP]

Course Contents:

Module 1: Natural Resources **10 Hours**

Introduction-Forest resources: Use and abuse, case study-Major activities in forest-Water resources-over utilization of water, dams-benefits and problems. Mineral resources-Use and exploitation, environmental effects of mining- case study–Food resources- World food problems, case study. Energy resources -Renewable and non-renewable energy sources Land resources- Soil erosion and desertification – Role of an individual in conservation of natural resources.

Module 2: Environmental Pollutions **10 Hours**

Definition – causes, effects and control measures of: a. Air pollution-Acid rain - Green house effect-Global warming- Ozone layer depletion – case study- Bhopal gas tragedyb. Water pollution c. Solid waste management-Recycling of plastics-Pyrolysis method- causes, effects and control measures of municipal solid wastes d. Noise pollution. e. Nuclear hazards-case study-Chernobyl nuclear disaster-Role of an individual in prevention of pollution.

Module 3: Social issues and the Environment **10 Hours**

Sustainable development-water conservation, rain water harvesting, E-Waste Management – Environmental ethics: 12 Principles of green chemistry-Scheme of labelling of environmental friendly products (Eco mark) – Emission standards – ISO 14001 standard. HIV AIDS.

Total Hours:	**30**

Text Books:

1	Anubha Kaushik and C P Kaushik “Perspectives in Environmental Studies” 4th Edition, New age International (P) Limited, Publisher Reprint 2014. New Delhi
2	Rajagopalan, R, “Environmental Studies-From Crisis to Cure”, Oxford University Press 2015.

Reference Books:

1	Tyler Miller, Jr, “Environmental Science”, Brooks/Cole a part of Cengage Learning, 2014.
2	William Cunningham and Mary Cunningham, “Environmental Science”, 13th Edition, McGraw Hill,2015.

3	Gilbert M. Masters, “Introduction to Environmental Engineering and Science”, Third Edition, Pearson Education, 2014.
Web References:	
1	http://nptel.ac.in/courses/104103020/20
2	http://nptel.ac.in/courses/120108002
3	http://nptel.ac.in/courses/122106030
4	http://nptel.ac.in/courses/120108004/
5	http://nptel.ac.in/courses/122102006/20
Online Resources:	
1	https://www.edx.org/course/subject/environmental-studies
2	www.environmentalscience.org

Assessment Methods & Levels (based on Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:40)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C102.1	Remember	Quiz	**5**
C102.2	Understand	Mini project based on environmental aspect	**15**
C102.3	Understand	Class Presentation	**10**
C102.4 C102.5	Apply	Group Assignment	**10**

Summative assessment based on Continuous Assessment

Revised Bloom’s Level	Term End Assessment [60 marks]
Remember	30
Understand	40
Apply	30
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
C102.1						2	2						2		
C102.2						2	2						2		
C102.3						2	2							2	
C102.4						3	3						2		
C102.5						3	3						2		

20IT301	COMPUTER ARCHITECTURE *(COMMON TO CSE / IT)*	3/0/0/3
Nature of Course	C (Theory Concept)	
Pre requisites	Nil	
Course Objectives:		
1.	To study the concepts of the basic structure and operation of a digital computer.	
2.	To learn the working of different types of arithmetic operations.	
3.	To understand the different types of control and the concept of pipelining.	
4.	To learn the working of different types of memories.	
5.	To understand the different types of communication with I/O devices and standard I/O interfaces.	
Course Outcomes		
Upon completion of the course, students shall have ability to		
C301.1	Recall the design of the various units of digital computers that store and process information via instructions.	[R]
C301.2	Illustrate the functionality of all components and connectivity to the Central Processing Unit.	[U]
C301.3	Interpret the logic design of fixed-point add, subtract, multiply and divide hardware and instantiating the concepts of fast adders, high speed multiplier, booth multiplier and carry save addition techniques.	[U]
C301.4	Classify the hazards of pipelining technique and use in high performance processors.	[U]
C301.5	Use various memory components and memory mapping techniques including Cache and virtual memory for increasing the memory bandwidth and high performance.	[AP]
C301.6	Choose different ways of communication with I/O devices using various interconnection networks including bus structures.	[AP]

Course Contents:

Architecture Fundamentals and Memory Organization: **15 Hours**

Organization of the Von Neumann Machine - Basic Operational Concepts of a Machine - Memory Locations and Addresses – Instruction Format - Instruction Sets, Addressing Modes and Assembly Language. Memory Organization**:** Basic Concepts, Semiconductor RAMs, ROMs, Cache memories, Performance Consideration, Virtual Memory and Memory Management requirements – Secondary storages. Case Study: DDR4 and Dual Inline Memory Module (DIMM)

Processor Design: **15 Hours**

Arithmetic Unit: Addition and Subtraction of Signed Numbers – Design of Fast Adders – Multiplication of Signed Numbers, Fast Multiplication, Integer Division, Floating Point Numbers and Operations**.** Control Unit: Execution of a Complete Instruction - Hardwired Control and Micro Programmed Control. Pipelining: Basic Concepts, Data Hazards, Instruction Hazards, Influence on Instruction Sets, Data Path and Control Consideration and Superscalar Operation. Case study: Intel's x86 Core2 and i7 microarchitectures

Interfacing and Communication: **15 Hours**

I/O fundamentals: Handshaking, Buffering; I/O techniques: Programmed I/O, Interrupt-Driven I/O, DMA, Buses, Bus Protocols, Local and Geographic Arbitration. Interrupt Structures, Vectored and Prioritized, Interrupt Overhead, Interrupts and Reentrant Code. Multicore Architecture: Multicore Processors, Centralized and Distributed Shared Memory Architecture, Parallel Computers.

Total Hours	**45**

Text Books:	
1.	Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Naraig Manjikian, “Computer Organization and Embedded Systems”, McGraw- Hill, 6th Edition 2017.
2.	John P. Hayes, “Computer Architecture and Organization”, McGraw-Hill, 3rd Edition, 2017.
3.	William Stallings, “Computer Organization and Architecture Designing for Performance”, 10th Edition, Pearson Education 2016.
Reference Books:	
1.	David A. Patterson and John L. Hennessy, “Computer Organization and Design: The Hardware/Software Interface”, Elsevier, 5th Edition, 2013.
2.	John L. Hennessy and David A. Patterson, “Computer Architecture: A Quantitative Approach”, Morgan Kaufmann, 5th Edition, 2011.
3.	M. J. Flynn, “Computer Architecture: Pipelined and Parallel Processor Design”, Narosa Publishing House 2013.
Web References:	
1.	https://www.cs.cmu.edu/~fp/courses/15213-s07/lectures/27-multicore.pdf
2.	https://fdocuments.in/document/intel-core-i7-processor.html
3.	https://www.intel.com/content/dam/www/public/us/en/documents/manuals/64-ia-32-architectures-software-developer-instruction-set-reference-manual-325383.pdf
Online Resources:	
1.	https://www.coursera.org/learn/comparch
2.	https://www.eguardian.co.in/computer-architecture-mcqs/
3.	http://nptel.ac.in/courses/106102062/

Tentative Assessment Methods & Levels (based on Revised Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks: 20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C301.1	Remember	Assignment	10
C301.2, C301.3	Understand	Online Quiz	3
C301.4, C301.5	Understand, Apply	Online Quiz	3
C301.6	Apply	Case Study	4

Summative assessment based on Continuous and End Semester Examination

Revised Bloom’s Level	Continuous Assessment			End Semester Examination (Theory) [50 marks]
	Theory			
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]	
Remember	20	20	10	10
Understand	80	40	40	40
Apply	-	40	50	50
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

Course Outcomes (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	2	3	1		1								1	2	2
C301.2	1	2	2		2								2	1	1
C301.3	3	3	3	3	3								3	3	1
C301.4	1	1	2		1								1	1	1
C301.5	2	1	2	2	1								2	1	2
C301.6		2	2		2								1	1	1

20MA302	MATHEMATICAL STRUCTURES *(COMMON TO CSE/ IT/ AI & DS)*	2/1/2/4

Nature of Course	J (Problem analytical)
Prerequisites	Higher secondary mathematics

Course Objectives:

1.	To study the concepts needed to test the logic of a program.
2.	To learn the working on class of functions which transform a finite set into another finite set which relates to input and output functions in computer science.
3.	To use number theory in computer networks and security.
4.	To acquire thorough knowledge of fundamental notions from lattice theory and properties of lattices.

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

C302.1	Recall the basic concepts of logic, Sets, Relations, Functions and Number theory.	[R]
C302.2	Acquire critical thinking skills by understanding the logical structure of the language.	[U]
C302.3	Use the concepts of Discrete Mathematics in software development and hardware design.	[AP]
C302.4	Demonstrate the fundamental Concepts of sets, relations, mathematical functions and all of its properties.	[AP]
C302.5	Apply discrete mathematics in formal representation of various computing constructs and algebraic structures. Apply Euclid's algorithm and backwards substitution.	[AP]
C302.6	Apply integrated approach to number theory.	[AP]

Module 1: Propositional and Predicate Calculus **15 hours**

Propositional Calculus: Basic concepts – Propositions - Connectives– Truth tables – Tautologies and Contradictions –Contrapositive – Logical equivalences and Implications – Normal forms – Principal conjunctive and Disjunctive normal forms– Rules of inference – Validity of arguments – **Predicate Calculus**: Statement function – Variables – Free and bound variables – Quantifiers– Universe of discourse – Theory of inference – The rules of universal specification and generalization – Validity of arguments.

Module 2: Set Theory **15 hours**

Sets: Basic sets - Operations on Sets – Law on Sets - Cartesian product of sets – **Relations**: Types of relations and their properties– Relational matrix and graph of a relation – Equivalence relations – Partial ordering -**Functions:** Classification of functions–Composition of functions–Inverse function- **Counting**: Permutations and Combinations.

Module 3: Lattices and Number Theory **15 hours**

Lattices: Partially ordered sets - Hasse diagram - Lattices and their properties - **Number Theory:** Division algorithm -Base-b representations- Number patterns -Prime and composite numbers-GCD-Euclidean algorithm-Fundamental theorem of arithmetic-LCM-Wilson's Theorem-Fermat's Theorem-Tau and Sigma Function.

Total Hours:	**45**

Course Outcomes: (Laboratory) Upon the completion of the course, students shall have ability to	
C302.1	Construct mathematical arguments using logical connectives and quantifiers.
C302.2	Verify the correctness of an argument using propositional and predicate logic and truth tables.
C302.3	Understand the basic principles of sets and operations in sets.
C302.4	Demonstrate the ability to solve problems using counting techniques and combinatorics in the context of discrete probability.
C302.5	Evaluate the problems in Number Theory.
C302.6	Evaluate quotients and remainders from division Algorithm.

Laboratory Component:

S. No	List of Experiments	CO Mapping	RBT
1.	Generate the truth table for mathematical logic using suitable mathematical software.	C302.1	[AP]
2.	Assign the truth table actions to decisions using suitable mathematical software	C302.2	[AP]
3.	Examine the logical validity of the arguments using suitable mathematical software.	C302.2	[AP]
4.	Using logical operators to test truth values of statements in suitable mathematical software	C302.2	[AP]
5.	Verification of DeMorgan's law using suitable mathematical software	C302.3	[AP]
6.	Set operations using suitable mathematical software.	C302.3	[AP]
7.	Compute permutations functions using suitable mathematical software.	C302.4	[AP]
8.	Compute combinations functions using suitable mathematical software.	C302.4	[AP]
9.	Compute prime and composite numbers using suitable mathematical software.	C302.5	[AP]
10.	Compute Least common multiple of two integers using suitable mathematical software.	C302.5	[AP]
11.	Compute Greatest common divisor of two integers using suitable mathematical software.	C302.5	[AP]
12.	Compute Quotient and remainder of two integers by division algorithm using suitable mathematical software.	C302.6	[AP]

Text Books:

1	Tremblay J.P and Manohar R, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw–Hill Pub. Co. Ltd, New Delhi, 30th Reprint, 2011
2	Kenneth H. Rosen, "Discrete Mathematics and its Applications", Tata McGraw – Hill Pub. Co. Ltd., New Delhi, 7th Edition, 2017.
3	Koshy. T, "Elementary Number Theory with Applications", Elsevier Publications, New Delhi, 2nd Edition, 2007.

Reference Books:

1	Ralph. P. Grimaldi, "Discrete and Combinatorial Mathematics: An Applied Introduction", 5th Edition, Pearson Education Asia, New Delhi, 5th Edition, 2019.
2	Bernard Kolman, Robert C. Busby, Sharan Cutler Ross, "Discrete Mathematical Structures", Pearson Education Pvt Ltd., 6th Edition, New Delhi, 2017.
3	Thomas Koshy, "Discrete Mathematics with Applications", Elsevier Publications, 2004.
4	David Houcque, "Introduction to MATLAB for Engineering Students", 2005.

Web References:	
1	https://nptel.ac.in/courses/111/107/111107058/
2	https://nptel.ac.in/courses/106/106/106106094/
3	https://nptel.ac.in/courses/106/106/106106183/
4	https://nptel.ac.in/courses/111/101/111101137/
Online Resources:	
1	http://discrete.openmathbooks.org/dmoi3.html
2	https://www.csie.ntu.edu.tw/~sylee/courses/dm/resources.htm
3	https://www.maa.org/press/ebooks/resources-for-teaching-discrete-mathematics

Assessment Methods & Levels (based on Blooms' Taxonomy)

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment				End Semester Examination (Theory) [40 marks]
	Theory			Practical& Project	
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	Rubric based CIA [30 Marks]	
Remember	20	20	20	20	20
Understand	30	30	30	30	30
Apply	50	50	50	50	50
Analyse	-	-	-	-	-
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Course Outcomes (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	1		1	1								2	1	1
C302.2	2	2		2	2								2	1	1
C302.3	3	3		3	3								2	2	1
C302.4	3	3		3	3								3	2	1
C302.5	3	3		3	3								3	2	1
C302.6	3	3		3	3								3	2	1

20EC311	DIGITAL LOGIC AND DESIGN *(COMMON TO CSE / IT)*	3/0/2/4
Nature of Course	G (Theory analytical)	
Pre requisites	Nil	
Course Objectives:		
1.	To understand how computers operate at the most basic level.	
2.	To gain familiarity to the principles of combinational logic and the design of combinational circuits.	
3.	To understand the basics of sequential logic devices and the design of sequential circuits.	
4.	To learn the process of modeling the combinational and sequential logic circuits using Verilog.	
5.	To understand the concepts of programmable logic devices.	
Course Outcomes		
Upon completion of the course, students shall have ability to		
C311.1	Identify and encode information in binary and to manipulate Boolean functions using Boolean algebra.	[U]
C311.2	Interpret and minimize Boolean functions and implement them using digital logic gates.	[U]
C311.3	Illustrate and design different combinational logic circuits.	[A]
C311.4	Analyze and design various sequential circuits.	[A]
C311.5	Construct Verilog models for digital logic circuits.	[AP]
C311.6	Implement digital logic circuits using programmable logic devices.	[AP]

Course Contents:

Introduction: **15 Hours**

Number Systems - Binary codes – Binary Arithmetic - Boolean algebra - Boolean functions – Minimization of Boolean Functions using Karnaugh Maps - Implementation of Logic Circuits using Gates (Two Level / Multi level Implementation).

Combinational Logic: **15 Hours**

Analysis and Design Procedures-Circuits for Arithmetic Operations- Multiplexer-Demultiplexer - Decoder-Encoders- and their use in Logic Synthesis-Verilog Modelling for Combinational Circuits.

Synchronous Sequential Logic & Programmable Logic devices: **15 Hours**

Latches-Flip flops - Analysis and Synthesis of Clocked Sequential Circuits – Registers - Shift Registers-Ripple Counters-Synchronous Counters-Special Counters- Verilog Modelling for Sequential circuits - Finite State Machines, PROM, PGA, PLA, PAL, PLS, FPGA.

Total Hours:	**45**

Laboratory Component:

S. No	List of Experiments
1.	Realization of Boolean Functions using Logic Gates.
2.	Analysis and Synthesis of Combinational Logic Circuits.
3.	Code Converter.
4.	Parity Generator and Checker.
5.	Two-bit magnitude comparator.

6.	Arithmetic Circuits.
7.	Multiplexer.
8.	Design and Implementation of Multiplier.
9.	Many game shows use a circuit to determine which of the contestants ring in first. Design a circuit to determine which of two contestants rings in first. It has two inputs S1and S0 which are connected to the contestants' buttons. The circuit has two outputs Z1 and Z0 which are connected to LEDs to indicate which contestant rang in first. There is also a reset button that is used by the game show host to asynchronously reset the flip flops to the initial state before each question. If contestant 0 rings in first, the circuit turns on LED 0. Once LED 0 is on, the circuit leaves it on regardless of the inputs until the circuit is asynchronously reset by the game show host. If contestant 1 rings in first, the circuit turns on LED 1 and leaves it on until the circuit is reset. If there is a tie, both LEDs are turned on. The circuit requires four states: reset, contestant 0 wins, contestant 1 wins, and tie. One way to map the states is to use state 00 for reset, state 01 for contestant 0 wins, state 10 for contestant 1 wins, and state 11 for a tie. With this mapping, the outputs are equal to the current state, which simplifies the output equations.
10.	Design and Implementation of Shift Registers.
11.	Design and Implementation of Synchronous Counters.
12.	Design a simplified traffic-light controller that switches traffic lights on a crossing where a north-south (NS) street intersects an east-west (EW) street. The input to the controller is the WALK button pushed by pedestrians who want to cross the street. The outputs are two signals NS and EW that control the traffic lights in the NS and EW directions. When NS or EW are 0, the red light is on, and when they are 1, the green light is on. When there are no pedestrians, NS=0, EW=1 for a minute, follow by NS=1 and EW=0 for 1 minutes, and soon, when WALK button is pushed, NS and EW both become 0 for a minute when the present minute expires. After that the NS and EW signals continue alerting. For this traffic-light controller a) Develop a state diagram. (Hint: can be done using 3 states) b) Draw the state transition table. c) Encode the states using minimum number of bits. d) Derive the logic schematic for a sequential circuit which implements the state transition table.
13.	Verilog modeling of Adders, Subtractors, Multiplexers, Decoders, and Flip Flops.
	Total Hours: **30**

Text Books:	
1.	M.Morris R.Mano, Michael D.Ciletti, “Digital Design: With an Introduction to the Verilog HDL, VHDL, and System Verilog”, 6th Edition, Pearson, 2018.
2.	C.H.Roth Jr., Larry L.Kinney, “Fundamentals of Logic Design”, 7th Edition, Cengage Learning, 2014.
Reference Books:	
1.	John F. Wakerly, “Digital Design: Principles and Practices”, 5th Edition, Pearson, 2018.
2.	Donald P Leach, Albert Paul Malvino, Goutam Saha, “Digital Principles and Application”,8th Edition, McGraw Hill education (India) Private Limited, 2015.
3.	Clive Woods, Brian Holdsworth, “Digital Logic Design”, 4th Edition, O’Reilly Media, 2002.
4.	Donald D. Givone, “Digital Principles and Design”, 7th Edition, McGraw-Hill, 2010.
Web References:	
1.	https://www.xilinx.com/support/documentation/university/Vivado-eaching /HDLDesign/2013x/Nexys4/Verilog/docs-pdf/Vivado_tutorial.pdf.
Online Resources:	
1.	https://www.edx.org/course/computation-structures-part-1-digital-mitx-6-004- 1x-0
2.	https://swayam.gov.in/course/1392-digital-circuits-and-systems
3.	http://www.nesoacademy.org/electronics-engineering/digital-electronics/digital

4.	http://www.digital.iitkgp.ernet.in/dec/index.php

Tentative Assessment Methods & Levels (based on Revised Bloom's Taxonomy

Summative assessment based on Continuous and End Semester Examination

Revised Bloom's Level	Continuous Assessment				End Semester Examination (Theory) [40 marks]
	Theory			Practical	
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]	Rubric based CIA [30 Marks]	
Remember	-	-	-	-	-
Understand	50	10	20	-	10
Apply	50	50	40	30	50
Analyse	-	40	40	20	40
Evaluate	-	-	-	20	-
Create	-	-	-	30	-

Course Outcomes (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C311.1	3	3	3	3								2	3	2	1
C311.2	2	3	3	2	2							2	3	1	1
C311.3	3	3	3	2	3							2	3	3	1
C311.4	2	3	3	3	2								2	2	2
C311.5	2	2	3	1	2								3	3	2
C311.6	3	3	3	3	3							1	3	1	2

20IT302	SOFTWARE ENGINEERING AND MANAGEMENT *(COMMON TO CSE / IT / AI & DS)*	3/0/2/4
Nature of Course	H (Theory Technology)	
Pre requisites	Nil	
Course Objectives:		
1.	To discuss the essence of agile development methods.	
2.	Carry out all stages of an agile software process in a team, to produce working software.	
3.	Ability to understand and apply Scrum framework.	
4.	Use test driven development (TDD) to ensure software quality.	
Course Outcomes		
Upon completion of the course, students shall have ability to		
C302.1	Identify the driving forces and adopt Agile approaches to software development.	[R]
C302.2	Interpret the various Agile development practices.	[U]
C302.3	Demonstrate and develop the working model facilitated by unit tests using Test Driven Development.	[AP]
C302.4	Apply design principles and refactoring to achieve Agility.	[AP]
C302.5	Illustrate automated build tools, version control and continuous integration using JIRA and Jenkins.	[AP]
C302.6	Apply Risk based testing activities within an Agile project.	[AP]

Course Contents:

Traditional SDLC Models: **15 Hours**

Waterfall model, Incremental model, Iterative model, RAD model **Fundamentals of Agile:** The Genesis of Agile, Introduction and background, Agile Manifesto and Principles, Extreme Programming, Feature Driven development, Lean Software Development, Pair Programming, Agile Tools, Project Management – CMM.

Agile Scrum Framework: **15 Hours**

Introduction to Scrum, Project phases, Agile Estimation, Planning game, Product backlog, Sprint backlog, Iteration planning, User story definition, Characteristics and content of user stories, Acceptance tests and Verifying stories, Project velocity, Burn down chart, Sprint Scrum Team, **Agile Testing:** The Agile lifecycle and its impact on testing, Test-Driven Development (TDD), xUnit framework and tools for TDD, Testing user stories - acceptance tests and scenarios, Behavior-driven development (BDD), Planning and managing testing cycle, Exploratory testing, Risk based testing, Regression tests, Test Automation, Tools to support the Agile tester.

Agile Software Design and Development: **15 Hours**

Agile design practices, Role of design Principles including Single Responsibility Principle, Open Closed Principle, Liskov Substitution Principle, Interface Segregation Principles, Dependency Inversion Principle in Agile Design, Need and significance of Refactoring, Refactoring Techniques, Continuous Integration, Automated build tools, Version control. **Industry Trends:** Market scenario and adoption of Agile, Agile in Distributed teams, Business benefits, Challenges in Agile, Risks and Mitigation, Agile projects on Cloud, Balancing Agility with Discipline, Agile rapid development technologies.

Case Study: DevOps, SAFe

Total Hours:	**45**

Laboratory Component:	
S. No	**List of Experiments**
1.	Draw basic UML diagrams (use case, Activity, class, interaction, State charts, Component and Deployment diagram)
2.	Develop DFD model (level-0, level-1)
3.	Understand given Business scenario and identify User Stories, Product Backlog and Sprint tasks.
4.	Do the estimation for identified user stories.
5.	Fill user stories, sprint schedule and sprint tasks in an Agile tool such as AgileFant/Jira.
6.	Write unit tests aligned to xUnit framework for TDD.
7.	Refactor a given design for next sprint requirements.
8.	Execute continuous integration using an automated tool such as Jenkins.
Total Hours:	**30**

Text Books:	
1.	Ken Schawber, Mike Beedle, "Agile Software Development with Scrum", Pearson Education, 2nd Edition, 2014.
2.	Janet Gregory, Lisa Crispin, "Agile Testing Condensed: A Brief Introduction", Addison Wesley, 2019.

Reference Books:	
1.	Robert C. Martin, "Agile Software Development, Principles, Patterns and Practices", Prentice Hall, 2nd Edition, 2014.
2.	Alistair Cockburn, "Agile Software Development: The Cooperative Game (Agile Software Development Series)" 2nd Edition, Kindle Edition.
3.	Mike Cohn, "User Stories Applied: For Agile Software", Addison Wesley, 2nd Edition, 2016.

Web References:	
1.	https://www.coursera.org/specializations/agile-development
2.	https://www.edx.org/learn/agile
3.	https://nptel.ac.in/courses/106/105/106105182/

Online Resources:	
1.	http://www.agilenutshell.com/
2.	https://www.atlassian.com/agile/scrum
3.	https://www.youtube.com/user/AgileMikeCohn
4.	https://www.youtube.com/channel/UCL1yMVRMh3vxitPiVaXfkoA

Tentative Assessment Methods & Levels (based on Revised Bloom's Taxonomy

Summative assessment based on Continuous and End Semester Examination

Revised Bloom's Level	Continuous Assessment				End Semester Examination (Theory) [40 marks]
	Theory			Practical	
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]	Rubric based CIA [30 Marks]	
Remember	25	20	30	30	30
Understand	25	30	30	20	30
Apply	50	50	40	50	40
Analyse	-	-	-	-	-
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Course Outcomes (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	1	1								2	1	2	1
C302.2	3	3	3	3	2							2	3	3	2
C302.3	3	3	3	3								2	3	3	2
C302.4	3	3	3	3	3							2	3	3	2
C302.5	3	2	3	3	3							1	3	3	2
C302.6	1	2	1	1								2	1	2	1

20CS301	C++ AND ADVANCED DATA STRUCTURES *(COMMON TO CSE / IT)*	3/0/2/4
Nature of Course	F (Theory Programming)	
Pre requisites	C and Data Structures	
Course Objectives:		
1.	To learn object-oriented concepts using C++.	
2.	To understand various non-linear data structures-Tree, Graph.	
3.	To apply efficient data structures in solving real-world problems.	
Course Outcomes		
Upon completion of the course, students shall have ability to		
C301.1	Construct and apply C++ program to solve the given problems using basic programming constructs.	[R]
C301.2	Understand and Apply the object-oriented concepts for implementing data structures.	[AP]
C301.3	Represent and manipulate data using nonlinear data structures like trees and graphs to design algorithms for various applications.	[U]
C301.4	Illustrate and compare various data structures for solving real time problems.	[AP]

Course Contents:

Module 1: **15 Hours**

C++ PROGRAMMING: An overview of C++ - Data Types, Variables, Operators, Expressions and Statements-Functions and Arrays- C++ Class Overview- Class Definition, Objects, Class Members, Access Control, Constructors and destructors, parameter passing methods, Inline functions, static class members, this pointer, friend functions, dynamic memory allocation and deallocation (new and delete) - Inheritance basics, base and derived classes, inheritance types, runtime polymorphism using virtual functions, abstract classes - Generic Programming - Function and class templates.

Module 2: **15 Hours**

Search trees: Overview- Binary Search Trees, **AVL Trees:** Definition, Height of an AVL Tree, Operations – Insertion, Deletion and Searching, **Introduction to Red –Black and Splay Trees, B-Trees**, B-Tree of order m, B-Tree insertion, deletion and searching. Case study on AVL Tree Operations.

Module 3: **15 Hours**

Graphs: Definition – Representation of Graph – Types of graph –Breadth-first traversal – Depth-first traversal – Topological Sort – Dijkstra's Algorithm – Minimum Spanning Tree - Bi-connectivity – Cut vertex – Euler circuits – Applications of graphs. **Recent trends:** Pattern matching, Tries, Tree Map, Hash map. Case study on google page ranking algorithm.

Total Hours:	**45**

Laboratory Component:		
S. No	**List of Experiments**	
1.	Basic C++ programs.	
2.	Implementation of classes and objects.	
3.	Implementation of Inheritance and polymorphism.	
4.	Implementation of class and function templates.	
5.	Implementation of Search Trees: a) BST b) AVL trees c) Red-black Trees d) B-Trees	
6.	Represent a Graph ADT and perform BFS and DFS.	
7.	Perform topological sorting in graph.	
8.	Implement a Minimum Spanning tree Algorithm in graph.	
9.	Implement Tries and Pattern matching.	
	Total Hours:	**30**

Text Books:	
1.	Herbert Shildt, “The Complete Reference C++”, 4th Edition, TMH, 2017.
2.	Mark Allen Weiss, “Data Structures and Algorithm Analysis in C++”, Pearson Education India, 3rd Edition, 2013.
3.	Debasis Samanta, “Classic Data Structures”, Prentice Hall of India, 2nd Edition, 2014.
Reference Books:	
1.	Bjarne Stroustrup, “The C++ programming language”, Addison Wesley, 4th Edition, 2013.
2.	Seymour Lipschutz, “Data Structures by Schaum Series”, 2nd Edition, Tata McGraw Hill, 2013.
3.	Narasimha Karumanchi, “Data Structures and Algorithms Made Easy: Data Structures and Algorithmic Puzzles”, 5th Edition, Career Monk, 2016.
4.	Michael Goodrich, Roberto Tamassta, Michael H.Gold Wasser “Data structures and algorithms in Java”, 6th Edition, 2014.
Web References:	
1.	https://nptel.ac.in/
2.	https://visualgo.net/en
3.	https://www.codechef.com/
Online Resources:	
1.	https://www.coursera.org/learn/c-plus-plus-a
2.	https://www.coursera.org/learn/c-plus-plus-b
3.	https://www.coursera.org/specializations/data-structures-algorithms
4.	https://nptel.ac.in/courses/106/102/106102064/
5.	https://www.hackerrank.com/domains/data-structures

Tentative Assessment Methods & Levels (based on Revised Bloom's Taxonomy					
Summative assessment based on Continuous and End Semester Examination					
Revised Bloom's Level	**Continuous Assessment**				**End Semester Examination (Theory) [40 marks]**
	Theory			**Practical**	
	CIA-1 [10 marks]	**CIA-2 [10 marks]**	**CIA-3 [10 marks]**	**Rubric based CIA [30 Marks]**	
Remember	40	20	10	10	20
Understand	30	30	30	30	30
Apply	30	50	60	60	50
Analyse					
Evaluate					
Create					

Course Outcomes (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	3	2	2	2				2			2	3	2	2
C301.2	3	3	2	2	2				2			2	3	2	2
C301.3	3	3	2	2	2				2			2	3	2	2
C301.4	3	3	2	2	2				2			2	3	2	2

20CS302	OPERATING SYSTEMS *(COMMON TO CSE / IT)*	3/0/2/4

Nature of Course	G - Theory Analytical
Pre requisites	Nil

Course Objectives:

1.	To describe the structure and functions of Operating System.
2.	To describe the mechanisms of Operating Systems to handle processes and threads.
3.	To explore the various scheduling policies and to provide solutions for critical section and deadlock problems.
4.	To identify the mechanisms involved in Memory management and its schemes.
5.	To analyze the File systems, Device Management and security issues.

Course Outcomes:

Upon completion of the course, students shall have ability to

C302.1	Identify the basic concepts and operations of operating systems.	[U]
C302.2	Illustrate the Process management concepts including scheduling, Inter process communication, deadlocks and multithreading in real world problems.	[AP]
C302.3	Apply concepts of memory management including Virtual Memory and Page Replacement to the issues that occur in Real time applications.	[AP]
C302.4	Analyze the concepts related to file system interface, implementation, disk management, protection and security mechanisms.	[A]
C302.5	Learning principles of Multicore operating systems	[U]

Course Contents

Introduction: **15 Hours**

Need for Operating Systems - Computer Systems - OS Operations - Abstract view of OS - Virtualization - Computing Environments - OS Services - OS Structures - System Calls - Building and Booting OS - Process - Threads - Multithreading.

Process and Memory Management: **15 Hours**

Process Scheduling - Process Co-ordination – Inter process communication - Synchronization - Semaphores - Monitors - Hardware Synchronization - Deadlocks - Methods for Handling Deadlocks. Memory Management Strategies - Contiguous and Non-Contiguous allocation - Virtual memory Management - Demand Paging - Page Placement and Replacement Policies.

File and Device Management: **15 Hours**

File-System Interface: File concept - Access methods - Directory Structure - Directory organization- File system mounting - File Sharing and Protection; File System Implementation: File System Structure- Directory implementation- Allocation Methods- Free Space Management; Mass Storage Structure - Disk Scheduling - Disk Management - I/O Systems - System Protection and Security.

Case Study: - Multicore systems: Basic System and Processor Architecture- Multi-core Processors - Moving to Multi-core Intel Architecture- Scalar Optimization & Usability- Parallel Optimization Using Threads.

Total Hours:	**45**

Laboratory Component:

S. No	List of Experiments
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-Preemptive and Preemptive CPU Scheduling Algorithms.
5.	i. Simulation of Producer – Consumer Problem using Semaphores. ii. 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.
Total Hours:	**30**

Text Books:

1.	Abraham Silberschatz, Peter B. Galvin, Greg Gagne, "Operating System Concepts" 10th Edition, John Wiley, 2018.
2.	D.M Dhamdhere, "Operating Systems"- A Concept based Approach, 3rd Edition, McGraw Hill, 2017.

Reference Books:

1.	Andrew S. Tanenbaum, Modern Operating Systems 5th Edition, Pearson Education, 2016.
2.	William Stallings, "Operating Systems – Internals and Design Principles", 8th Edition, Pearson Publications, 2014.

Web References:

1.	http://geeksforgeeks.org/Operating Systems
2.	https://www.cs.uic.edu/~jbell/CourseNotes/OperatingSystems/

Online Resources:

1.	https://www.coursera.org/learn/os-power-user
2.	https://nptel.ac.in/courses/106108101/
3.	https://learn.saylor.org/course/CS401

Tentative Assessment Methods & Levels (based on Revised Bloom's Taxonomy					
Summative assessment based on Continuous and End Semester Examination					
Revised Bloom's Level	**Continuous Assessment**				**End Semester Examination (Theory) [40 Marks]**
	Theory			**Practical**	
	CIA – 1 [10 Marks]	**CIA – 2 [10 Marks]**	**CIA – 3 [10 Marks]**	**Rubric based CIA [30 Marks]**	
Remember	20	20	20	10	20
Understand	30	20	20	30	20
Apply	50	60	30	30	30
Analyze	-	-	30	30	30
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Course Outcomes (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	2	2	2						2	2		2	2	2	2
C302.2	3	3	3						3	3		3	3	3	3
C302.3	3	3	3						3	3		3	3	3	3
C302.4	3	3	3						3	3		3	3	3	3
C302.5	3	3	3						3	3		3	3	3	3

20CS401	DATABASE MANAGEMENT SYSTEMS *(COMMON TO CSE / IT / AI&DS)*	3/0/0/3

Nature of Course	G (Theory Analytical)
Pre requisites	Nil

Course Objectives:

1	To distinguish the different types of data models and use ER diagram to conceptualize the database system.
2	To illustrate the implementation of relational database design concepts using SQL
3	To employ the normalisation concepts to improve the database design.
4	To explain the techniques for query evaluation and optimization.
5	To discuss the various concurrency control techniques and recovery schemes for transaction processing

Course Outcomes:

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

C401.1	Differentiate database system with file system and design ER diagram for the real-world scenarios.	[U]
C401.2	Convert the ER-model to relational tables, populate relational database and formulate SQL queries on data.	[AP]
C401.3	Apply different normal forms to retrieve the data efficiently by removing anomalies	[AP]
C401.4	Demonstrate the different storage structures and accessing techniques.	[U]
C401.5	Apply the techniques for query optimization and evaluation of algebraic expressions.	[AP]
C401.6	Examine the concepts of Transaction processing, concurrency locking protocols and understand the basics of NoSQL.	[A]

Course Contents:

Data Modeling and Relational Query Language **20 Hours**

Introduction– File systems vs Database systems- Users of database systems- Three level DBMS Architecture and Data Abstraction- Data Independence-Database system architecture –Introductions to data models –Hierarchical Model-Network model-Object oriented model- Entity–Relationship mode-Relational Model –Relational Algebra – Relational Calculus – Fundamental operations - SQL constructs - DDL,DML,TCL,DCL - Keys and Integrity constraints – Views – Joins - Writing optimized queries - Introduction to PL/SQL – Procedures – Functions – Triggers - Cursor.

Relational Database Design, Storage Techniques and Query Processing **15 Hours**

Introduction – Functional Dependency-Types of functional dependency-Closure- Undesirable Properties of Relations –Normal forms (1NF, 2NF 3NF & BCNF)- Desirable properties of Decompositions -Indexing and Index types – B+ Tree- Hashing – Static Hashing – Dynamic Hashing- Introduction to Query Processing – Steps in query processing – Query Optimization techniques - Issues in query optimization.

Transactions and Advanced concepts **10 Hours**

Transaction Concepts – Transaction model – ACID Properties – Serializability- Concurrent transactions - Concurrency control – Lock based protocols- Failure classification - Recovery schemes - Distributed databases - Introduction to NoSQL - NoSQL categories – MongoDB

Total Hours:	**45**

Text Books:	
1.	Abraham Silberschatz, Henry F. Korth, S. Sudharshan, “Database System Concepts”, 7th Edition, Tata McGraw Hill, March 2019.
2.	Gupta G K, “Database Management Systems”, Tata McGraw Hill Education Private Limited, New Delhi, 2011.
Reference Books:	
1.	Ramez Elmasri, Shamkat, B.Mavathe, “Database Systems”, 6th Edition, Pearson Education, 2013.
2.	Michael McLaughlin, “Oracle Database 12c PL/SQL Programming”, Tata McGraw Hill Education Private Limited, New Delhi, 2014.
3.	Gaurav Vaish, “Getting Started with NoSQL”, Packt Publishing, March 2013.
Web References:	
1.	http://www.sqlcourse.com/
2.	http://www.edureka.co/mongodb
3.	https://alison.com/courses/IT-Management-Software-and-Databases
Online Resources:	
1.	https://www.coursera.org/learn/database-management
2.	https://www.udemy.com/database-management-system/
3.	http://www.nptelvideos.in/2012/11/database-management-system.html

Assessment Methods & Levels (based on Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C401.1, C401.5, C401.6	Apply	Quiz	5
C401.2, C401.3, C401.4	Apply	Assignment	10
C401.6	Analyze	Case Study	5

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment (30)			End Semester Examination [50 marks]
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]	
Remember	30	20	20	20
Understand	30	40	20	20
Apply	40	40	20	40
Analyse	-	-	40	20
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

Course Outcomes (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	2								2	2	2	2	2
C401.2	2	2	2								2	2	2	2	2
C401.3	2	2	2								2	2	2	2	2
C401.4	2	3	3								2	2	2	3	2
C401.5	3	3	3								2	3	3	2	2
C401.6	3	3	2								3	3	2	3	2

20IT401	COMPUTATIONAL BIOLOGY *(COMMON TO CSE / IT)*	3/0/0/3
Nature of Course	D (Theory Application)	
Pre requisites	Nil	
Course Objectives:		
1.	To familiarize the students with the basic organization of organisms and subsequent building to a living being.	
2.	To gain insights from varied backgrounds of engineering, computer science, and the life sciences.	
3.	To provide basic knowledge on nature inspired computing techniques.	
Course Outcomes:		
Upon completion of the course, students shall have ability to		
C401.1	Define biological cell structure and its functions.	[R]
C401.2	Describe protein structure and its synthesis.	[U]
C401.3	Summarize different biological databases.	[U]
C401.4	Interpret different prediction strategies on biological data.	[AP]
C401.5	Demonstrate the application of evolutionary computing and artificial neuro and immune systems.	[AP]
C401.6	Apply swarm intelligence and ant colony optimization techniques.	[AP]

Course Contents:

Introduction Databases, Tools and Uses **15 Hours**

Introduction: Methods of Science-Living Organisms: Cells and Cell theory, Cell Structure and Function, Genetic information, protein synthesis, and protein structure, Cell metabolism – Homoeostasis - Cell growth, reproduction, and differentiation. Applications of Bioinformatics, importance of biological databases, Types of biological databases, analysis packages.

Biochemistry, Immune System, Predictive methods **15 Hours**

Biological Diversity-Chemistry of life: chemical bonds-Biochemistry and Human biology-Protein synthesis - Stem cells and Tissue engineering, Nervous system-Immune system- General principles of cell signaling. predictions Gene strategies, protein prediction strategies, molecular visualization tools.

Nature Inspired Computing Techniques **15 Hours**

Artificial neural networks :Biological motivation - Design principles, Scope of artificial neural networks, Current trends and open problems, Evolutionary computing: Biological motivation, Design principles, Scope of evolutionary computing , Current trends and open problems Swarm intelligence: biological motivation, basic ant colony optimization algorithm, basic particle swarm optimization algorithm, Scope of swarm intelligence, Current trends and open problems Artificial immune systems: Biological motivation, Design principles, Scope of artificial immune systems, Current trends and open problems.

Total Hours:	**45**

Text Books:

1.	S.C.Rastogi, Namita Mendiratta, Parag Rastogi, “Bioinformatics: Methods and Applications (Genomics, Proteomics and Drug Discovery)”, PHI Learning Pvt. Ltd, 2013.
2.	S. ThyagaRajan, N. Selvamurugan, M. P. Rajesh, R. A. Nazeer, Richard W. Thilagaraj, S. Barathi, and M. K. Jaganathan, “Biology for Engineers”, Tata McGraw-Hill, New Delhi, 2012.
3.	Leandro Nunes de Castro, "Fundamentals of Natural Computing, Basic Concepts, Algorithms and Applications", Chapman & Hall/ CRC, Taylor and Francis Group, 2007.

Reference Books:	
1.	Andreas D Baxevanis B, F Francis, "Bioinformatics- A practical guide to analysis of Genes & Proteins", John Wiley, 3rd edition, 2009.
2.	C S V Murthy," Bioinformatics", Himalaya Publishing House, 1st Edition, 2016.
3.	David W. Mount, "Bioinformatics sequence and genome analysis", Cold spring harbor laboratory press, 2004.
4.	S. Ignacimuthu, S.J., "Basic Bioinformatics", Narosa Publishing House, 2013.
5.	Jeremy M. Berg, John L. Tymoczko and Lubert Stryer, "Biochemistry," W.H. Freeman and Co. Ltd., 6th Edition, 2006.
6.	Robert Weaver, "Molecular Biology," McGraw-Hill, 5th Edition, 2012.
7.	Floreano D. and Mattiussi C., "Bio-Inspired Artificial Intelligence: Theories, Methods, and Technologies", MIT Press, Cambridge, MA, 2008.
Web References:	
1.	https://www.coursera.org/specializations/bioinformatics
2.	https://nptel.ac.in/courses/102/106/102106068/
Online Resources:	
1.	https://ocw.mit.edu/courses/health-sciences-and-technology/hst-508-genomics-and-computational-biology-fall-2002
2.	https://dspace.mit.edu/bitstream/handle/1721.1/103560/6-047-fall-2008/contents/lecture-notes/index.htm
3.	https://www.cs.helsinki.fi/bioinformatiikka/mbi/courses/08-09/itb/lectures/itb0809-slides-p1-431.pdf
4.	https://nptel.ac.in/courses/121/106/121106008/
5.	https://courses.cs.washington.edu/courses/cse466/05sp/pdfs/lectures/10-EvolutionaryComputation.pdf

Tentative Assessment Methods & Levels (based on Revised Bloom's Taxonomy

Summative assessment based on Continuous and End Semester Examination

Revised Bloom's Level	Continuous Assessment			End Semester Examination (Theory) [50 marks]
	Theory			
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]	
Remember	50	30	20	30
Understand	50	50	40	30
Apply		20	40	40
Analyse				
Evaluate				
Create				

Assessment Methods & Levels based on Bloom's Taxonomy

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C401.1	Remember	Online quiz	5
C401.2, C403.3	Understand	Case Study	5
C401.4, C401.5, C401.6	Apply	Assignment on Tools and Packages	10

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

Course Outcomes (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	3	3	3	3	1	1	1	1			1	1	2	2	2
C401.2	3	3	3	3	1	1	1	1			1	1	2	2	2
C401.3	3	3	3	3	1	1	1	1			1	1	2	2	2
C401.4	3	3	3	3	1	1	1	1			1	1	2	2	2
C401.5	3	3	3	3	1	1	1	1			1	1	3	2	2
C401.6	3	3	3	3	1	1	1	1			1	1	3	2	2

20IT402	DESIGN AND ANALYSIS OF ALGORITHMS *(COMMON TO CSE / IT)*	3/0/0/3
Nature of Course	F (Theory Programming)	
Pre requisites	C++ and Advanced Data Structures	

Course Objectives:

1.	To understand the techniques for analyzing the computer algorithms.
2.	To learn the paradigms for designing the algorithms.
3.	To analyze the efficiency of various algorithm design techniques / paradigms for the same problem.
4.	To understand the limitations of algorithmic power.

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.	[R]
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	Analyze efficient algorithms for various problems.	[AN]
C402.5	Distinguish the time and space complexities of different types of algorithms.	[AN]
C402.6	Differentiate between different data structures and pick an appropriate data structure for a design situation.	[AN]

Course Contents:

Fundamentals of Algorithm Analysis: **15 Hours**

Notion of an Algorithm – Importance & role of algorithms in computing – General steps in Algorithmic problem solving – Analysis of Algorithm efficiency: Analysis Framework or Parameters, Asymptotic Notations and Basic Efficiency Classes, Mathematical Analysis for Non- Recursive and Recursive Algorithms, Empirical Analysis of Algorithm. Brute Force Approach: Selection Sort - Bubble Sort - Sequential Search - String Matching - Boyer Moore algorithm.

Advanced Design Paradigms: **15 Hours**

Decrease and Conquer Technique: Insertion sort - Topological sort. Divide and Conquer Technique: Merge sort - Quick sort - Binary search - Strassen's Matrix Multiplication. Dynamic Programming: Knapsack Problem and Memory functions - Optimal Binary Search Trees - Warshall's and Floyd's Algorithms- Matrix chain multiplication problem. Greedy Technique: Prims Algorithms - Kruskal's Algorithm - Dijkstra's Algorithm - Huffman Trees and Codes – Sparse Matrix - Bloom Filter.

Limitations and Coping with the Limitations of Algorithm Power: **15 Hours**

Lower - Bound Arguments -P, NP and NP-Complete Problems. Backtracking: n-Queen Problem - Hamiltonian Circuit Problem - Subset Sum Problem. Branch and Bound Technique: Assignment Problem - Knapsack Problem - Travelling Salesman Problem. Approximation Algorithms: Vertex-cover problem - Travelling Salesman Problem.

Total Hours:	**45**

Text Books:

1.	Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Pearson Publications, 3rd Edition, 2012.
2.	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", MIT Press, 3rd Edition, 2009.

Reference Books:	
1.	Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, “Computer Algorithms/ C++”, 2nd Edition, Universities Press, 2019.
2.	Sara Baase and Allen Van Gelder, “Computer Algorithms: Introduction to Design and Analysis”, Pearson Publications, 3rd Edition, 2008.
Web References:	
1.	https://www.cs.usfca.edu/~galles/visualization/Algorithms.html
2.	https://www.coursera.org/learn/introduction-to-algorithms
3.	https://timroughgarden.org/videos.html
Online Resources:	
1.	https://onlinecourses.nptel.ac.in/noc19_cs47/preview
2.	https://www.csa.iisc.ac.in/~barman/daa18/E0225.html
3.	https://freevideolectures.com/course/2281/design-and-analysis-of-algorithms

Tentative Assessment Methods & Levels (based on Revised Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks: 20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C402.1, C402.2	Remember, Understand	Quiz	10
C402.3	Apply	Quiz	
C402.4, C402.5	Analyze	Tutorial	10
C402.6	Analyze	Tutorial	

Summative assessment based on Continuous and End Semester Examination

Revised Bloom’s Level	Continuous Assessment – Theory			End Semester Examination (Theory) [50 marks]
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]	
Remember	50		10	10
Understand	50		10	10
Apply	-	50	40	40
Analyse	-	50	40	40
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

Course Outcomes (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	3	2	2		2						2	1	3	2	1
C402.2	3	2	3		2							1	3	2	1
C402.3	3	3	3		2						1	1	3	2	1
C402.4	3	2	3		2							1	3	2	2
C402.5	3	2	2	1	2							2	3	2	2
C402.6	3	2	2									1	3	2	2

20MA404	RANDOM VARIABLES AND STATISTICS *(COMMON TO CSE / IT / AI & DS)*	2/1/2/4

Nature of Course	J (Problem analytical)
Pre requisites	Concepts of basic differentiation and Integration

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 acquire skills in handling situations involving more than one random variable
4	To learn the concept of testing hypothesis using statistical analysis
5	To apply the Analysis of variance classifications in one way and two way

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

C404.1	Recall the concepts of basic probability	[R]
C404.2	Understand how to handle situations involving random variable	[U]
C404.3	Applying different pattern of standard distributions in real life problems.	[AP]
C404.4	Use distribution in cluster analysis of similar binary variables	[AP]
C404.5	Derive the logic and attain the knowledge of hypothesis testing.	[AP]
C404.6	Apply the analytical comparisons using ANOVA.	[AP]

Course Contents:

Probability and Random Variables **15 hours**

Probability: Probability concepts - Addition and Multiplication law of probability – Conditional probability - Total probability theorem - Bayes theorem – **Random Variables:** One dimensional random variable - Discrete random variables -Probability mass function - Continuous random variables - Probability density function- Moment generating Function.

Standard Distributions **15 hours**

Standard distributions: Discrete distributions - Binomial – Poisson – Geometric – Continuous distributions - Uniform – Exponential - Normal distributions –**Two dimensional random variables**: Joint distributions - Marginal and conditional distributions – Covariance – Correlation- Regression- Applications of two dimensional random variables in Machine learning.

Statistics **15 hours**

Mean, median, mode and standard deviation for raw, discrete and continuous data - Testing of Hypothesis: Large sample - Z test -Test of significance - Proportions - Small sample test – t test and F test for single mean – difference of means and variance - Chi-square test for goodness of fit and independence of attributes. **Analysis of variance**: One way and two way classifications.

Total Hours:	**45**

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

C404.1	Understand the use of R for Big Data analytics.
C404.2	Demonstrate the Data frame from vectors.
C404.3	Analyze and interpret results from correlation and regression.

C404.4	Understand the basic concepts of distributions and find an appropriate distribution for analyzing data specific to an experiment.
C404.5	Explore the types of plots and to represent with the help of functions.
C404.6	Understand to perform the extensive hypothesis tests for one and two samples.

Laboratory Component:

S. No	List of Experiments	CO Mapping	RBT
1.	To perform importing and exporting data using suitable Mathematical software.	C404.1	[AP]
2.	To perform with Vectors and Matrices using suitable Mathematical software.	C404.2	[AP]
3.	To plot Data frames using suitable Mathematical software.	C404.2	[AP]
4.	To Compute Summary Statistics, plotting and visualizing data using Tabulation and Graphical Representations using suitable Mathematical software.	C404.5	[AP]
5.	To solve correlation and simple linear regression model to real dataset using suitable Mathematical software.	C404.3	[AP]
6.	To Fit the following probability distribution: Binomial distribution using suitable Mathematical software.	C404.4	[AP]
7.	To Fit the following probability distribution: Poisson distribution using suitable Mathematical software.	C404.4	[AP]
8.	To Fit the following probability distribution: Normal distribution using suitable Mathematical software.	C404.4	[AP]
9.	To test of hypothesis for One sample mean and proportion from real-time problems using suitable Mathematical software.	C404.6	[AP]
10.	To test of hypothesis for Two sample mean and proportion from real time problems using suitable Mathematical software.	C404.6	[AP]
11.	To perform the t test for independent and dependent samples using suitable Mathematical software.	C404.6	[AP]
12.	To perform Chi-square test for goodness of fit test and Contingency test to real dataset using suitable Mathematical software.	C404.6	[AP]

Text Books:

1.	Gupta, S.C., &Kapoor, V.K., “Fundamentals of Mathematical Statistics”, Sultan Chand & sons, 2000, Reprint 2014.
2.	Peebles Jr. P.Z., “Probability Random Variables and Random Signal Principles”, Tata McGraw-Hill Publishers, Fourth Edition, New Delhi, 2016 (Chapters 6, 7 and 8).
3.	Palaniammal, S., “Probability and Random Processes”, Prentice hall of India, New Delhi, 2014.

Reference Books:

1.	Ross, S., “A First Course in Probability”, Ninth edition, Pearson Education, Delhi, 2014.
2.	Henry Stark and John W. Woods “Probability and Random Processes with Applications to Signal Processing”, Third Edition, 2001.
3.	Richard A. Johnson, Irwin Miller, John Freund, “Miller & Freund's Probability and Statistics for Engineers”, Ninth Edition, 2016.
4.	R for Everyone: Advanced Analytics and Graphics, Jared P. Lander.
5.	Hands-on Programming with R, Garrett Grolemund.

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#
5.	http://nptel.ac.in/courses/111104079/
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/

Assessment Methods & Levels (based on Blooms' Taxonomy)

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment				End Semester Examination (Theory) [40 marks]
	Theory			Practical& Project	
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	Rubric based CIA [30 Marks]	
Remember	20	20	20	20	20
Understand	30	30	30	30	30
Apply	50	50	50	50	50
Analyse	-	-	-	-	-
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Course Outcomes (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C404.1	1	1			3								1		
C404.2	2	2			3								1		
C404.3	3	3			3										
C404.4	3	3			3								1		
C404.5	3	3			3										
C404.6	3	3			3								1		

20EC411	FUNDAMENTALS OF DATA AND MOBILE COMMUNICATIONS	3/0/2/4
Nature of Course:	H (Theory Technology)	
Prerequisites:	Nil	

Course Objectives:

1.	To understand the key modules of digital communication systems with emphasis on digital modulation techniques.
2.	To introduce the principles of basics of source and channel coding/decoding and Spread Spectrum Modulation.
3.	To enable the students to understand the mobile radio communication principles, types and to study the recent trends adopted in cellular and wireless systems and standards.

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

C411.1	Review the knowledge of basic communication systems and its principles.	[U]
C411.2	Analyze the digital communication system with spread spectrum modulation.	[A]
C411.3	Apply the error control codes like Linear Block codes, Hamming codes, Cyclic codes, Convolutional codes, Vitterbi Decoder.	[AP]
C411.4	Describe the cellular concept and capacity improvement Techniques.	[U]
C411.5	Understand the latest trends in wireless communication.	[U]

Course Contents:

Base band transmission: **15 Hours**
Basics of communication systems, Need for modulation, Sampling theorem, Pulse code modulation (PCM), Delta Modulation, Data transmission using analog carrier (BFSK, BPSK, QPSK). Comparison of various digital Communication system

Error control coding: **15 Hours**
Channel Coding theorem – Linear Block codes – Hamming codes – Cyclic codes – Convolutional codes – Vitterbi Decoder

Introduction to Wireless Communication: **15 Hours**
Cellular concept, System design fundamentals, Coverage and Capacity improvement in Cellular system. Multiple access techniques: FDMA, TDMA and CDMA, OFDM. Latest trends: GSM 4G(LTE), WLAN technology, IEEE 802.11- Wi-Fi and HiperLAN, RFID technology.

Total Hours: 45

Lab Component:

S. No.	List of Experiments
1.	Simulation of Amplitude modulation and Frequency modulation
2.	Simulation of Amplitude Shift Keying
3.	Simulation of Frequency Shift Keying
4.	Simulation of Phase Shift Keying
5.	Simulation of Binary Frequency Shift keying
6.	Simulation of Binary Phase Shift keying
7.	Simulation of Quadrature Phase Shift keying

8.	Line Coding Techniques
9.	Error Control Coding
	Total Hours: 30
Text Books:	
1.	S. Haykin, “Digital Communications”, John Wiley, 2nd Edition, 2014
2.	T.S. Rappaport, “Wireless Communication Principles”, 2nd Edition, Pearson, 2010.
3.	A.F.Molisch, “Wireless Communications”, Wiley, 2nd Edition, 2010.
4.	Jochen Schiller, “Mobile Communications”, Addison Wesley, 2nd Edition, 2011.
Reference Books:	
1.	P.Muthu Chidambaranathan, “Wireless Communications”, PHI, 2010
2.	A.Goldsmith, “Wireless Communications”, Cambridge University Press, 2005.
3.	J.G.Proakis, “Digital Communication” , Tata McGraw – Hill, 4th Edition, 2014.
4.	R.E.Zimer, R.L.Peterson, “Introduction to Digital Communication”, PHI, 3rd Edition, 2001.
5.	Holger Karl and Andreas Willig, “Protocols and Architectures for Wireless Sensor Networks”, John Wiley, 3rd Edition, 2005.
6.	B.Sklar, “Digital Communications: Fundamentals & Applications”, Pearson Education, 2nd Edition, 2001
Web References:	
1.	https://ieeexplore.ieee.org/document/8246822
2.	https://nptel.ac.in/courses/117102059/
3.	https://ocw.mit.edu/courses/aeronautics-and-astronautics/16-36-communication-systems-engineering-spring-2009/lecture-notes/
Online Resources:	
1.	https://ce.uci.edu/areas/engineering/networks/
2.	http://scpd.stanford.edu/search/publicCourseSearchDetails.do?method=load&courseId=12075
3.	https://www.edx.org/course/system-view-communications-signals-hkustx-elec1200-1x-1
4.	https://www.udemy.com/introduction-to-wireless-communications/

Summative assessment based on Continuous and End Semester Examination					
Bloom’s Level	**Continuous Assessment**				**End Semester Examination [40 marks]**
	CIA-I [10 marks]	**CIA-II [10 marks]**	**CIA-III [10 marks]**	**PRACTICAL RUBRIC BASED CIA(30)**	
Remember	-	-	-	-	-
Understand	50	30	50	30	40
Apply	30	30	40	30	30
Analyse	20	40	10	30	30
Evaluate	-	-	-	10	-
Create	-	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)															
Course Articulation Matrix															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C411.1	3	3	3	3								2	3	1	2
C411.2	3	3	3	3								2	3	1	2
C411.3	2	3	3	2								2	3	1	1
C411.4	3	3	3	2	3							2	3	3	1
C411.5	2	2	3	1	2								2	2	2

20IT403	WEB AND JAVA PROGRAMMING	3/0/2/4
Nature of Course	F (Theory Programming)	
Pre requisites	Nil	

Course Objectives:

1.	To learn the structure of the internet and the Web.
2.	To understand the basic concepts of Java like Inheritance, Interfaces, multithreading concepts.
3.	To know the fundamental concepts of I/O functionality to code basic file operations, Exception handling and Event handling.
4.	To study and explore the basics of client and server-side programming.

Course Outcomes:

Upon completion of the course, students shall have ability to

C403.1	Describe web concepts, protocols and client server architectures.	[U]
C403.2	Identify and reproduce the features of Object-oriented programming.	[R]
C403.3	Use and experiment exception handling, multithreading and event handling concepts.	[AP]
C403.4	Illustrate and develop a webpage using HTML, XML and Java Script.	[AP]
C403.5	Interpret process application with server-side java programming like Servlets, JSP.	[AP]
C403.6	Analyze web page development using AJAX framework and its interactions.	[AN]

Course Contents:

Basic Web Concepts: **15 Hours**

Overview of Internet - Internet Addressing - Web Browsers – Servers – Protocols - Web Application Architectures, Development – HTML – DHTML – XHTML - Scripting Languages -Databases - Search Engines - Web Services - Collective intelligence -TCP, UDP, HTTP, SMTP - Remote Method Invocation.

Client and Server-Side Programming: **15 Hours**

CSS - Java Script - Objects in Java Script – XML – DTD - XML Schema - Document Object Model - XML Parsers - AJAX Framework - AJAX with PHP - AJAX with Databases – JDBC -Handling Form Data – Validation - Querying databases - Session management.

Java Fundamentals: **15 Hours**

Overview of Java – Objects, Classes and Methods – Arrays – Constructors - Access Specifier - Static members - String Handling - Method Overloading - Method Overriding -Nested and Inner Classes - Inheritance Types – Interfaces - Final Classes and Methods -Abstract Classes – Packages - Exception Handling – Multithreading – Collections - The Stream Classes – Servlets - JSP.

Total Hours	**45**

Laboratory Component:

S. No	List of Experiments
1.	Client-Side Scripts for validating web form controls using DHTML.

2.	Programs using XML Schema.
3.	Programs using AJAX.
4.	Programs using Classes and Methods.
5.	Sort the strings in ascending order using constructors.
6.	Design a package to perform bank transactions.
7.	Programs using interface.
8.	Stack implementation using Exception handling.
9.	Programs using Multithreading.
10.	Library Management System using inheritance.
	Total Hours **30**

Text Books:	
1.	Herbert Schildt, “Java: The Complete Reference”, 9th Edition, Mc-Graw Hill, 2014.
2.	Paul Deitel, “Internet & World Wide Web: How to Program”, Pearson, 5th Edition, 2012.
3.	Atul Kahate, “XML and Related Technologies”, Pearson India, 1st Edition, 2009.
4	Bryan Basham, Kathy Sierra, Bert Bates, “Head First Servlets and JSP”, O’Reilly Media, 2011.
Reference Books:	
1.	Cay S. Horstmann, “Core Java, Volume I - Fundamentals”,11th Edition, Pearson, 2020.
2.	Cay S. Horstmann, “Core Java, Vol 2 - Advanced Features”, 11th Edition, Pearson, 2020.
3	Robert W. Sebesta, “Programming the World Wide Web”, Pearson, 8th Edition, 2014.
Web References:	
1.	https://nptel.ac.in/courses/106/105/106105191
2.	https://www.codecademy.com/learn/learn-java
3.	https://www.coursera.org/specializations/java-programming
Online Resources:	
1.	https://www.programiz.com/java-programming

Tentative Assessment Methods & Levels (based on Revised Bloom’s Taxonomy

Summative assessment based on Continuous and End Semester Examination

Revised Bloom’s Level	**Continuous Assessment**				**End Semester Examination (Theory) [40 marks]**
	Theory			**Practical**	
	CIA-1 [10 marks]	**CIA-2 [10 marks]**	**CIA-3 [10 marks]**	**Rubric based CIA [30 Marks]**	
Remember	30	30	20	-	20
Understand	40	30	30	30	30
Apply	30	30	50	70	40
Analyse		10			10
Evaluate					
Create					

Course Outcomes (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	3	3	3	3	3	3	1	1			1	1	3	3	3
C403.2	3	3	3	3	3	3	1	1			1	1	3	3	3
C403.3	3	3	3	3	3	3	1	1			1	1	3	3	3
C403.4	3	3	3	3	3	3	1	1			1	1	3	3	3
C403.5	3	3	3	3	3	3	1	1			1	1	3	3	3
C403.6	3	3	3	3	3	3	1	1			1	1	3	3	3

20CS405	DATABASE MANAGEMENT SYSTEMS LABORATORY *(COMMON TO CSE / IT / AI&DS)*	0/0/3/1.5

Nature of Course	M (Practical Application)
Pre requisites	Nil

Course Objectives:

1.	To learn the fundamentals of data models to conceptualize and depict a database system using ER diagram.
2.	To discuss the implementation of Relational database using structured query language
3.	To practice the procedural extensions such as Procedures, functions, triggers and cursors.
4.	To develop an application using front end and back-end tools.

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

C405.1	Design an ER diagram for real world applications.	[AP]
C405.2	Interpret and query a database using SQL-DDL, DML Commands.	[AP]
C405.3	Employ PL/SQL blocks such as stored procedures, functions, triggers and cursors.	[AP]
C405.4	Implement and evaluate a real database application using front end and back end.	[AP]
C405.5	Create a document database using NoSQL.	[AP]

Course Contents:

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 Simple queries.
6. Implementation of Nested queries.
7. Implementation of Join and Set operators.
8. Implementation of virtual tables using Views.
9. Practice of named PL/SQL blocks (Procedure, Function).
10. Implementation of Triggers using PL/SQL.
11. Implementation of cursors using PL/SQL.
12. Application Development using front end tools and database connectivity.
13. Study of MongoDB.
14. Document Database creation using MongoDB.
15. Study of Cloud Storage.

Total Hours:	**45**

Text Books:	
1	Gupta G K, “Database Management Systems”, Tata McGraw Hill Education Private Limited, New Delhi, 2011.
2	Peter rob, Carlos Coronel, “Database Systems – Design, Implementation and Management”, 9th Edition, Thomson Learning, 2009.
3	Michael McLaughlin, “Oracle Database 12c PL/SQL Programming”, Tata McGraw Hill Education Private Limited, New Delhi, 2014.
4	Gaurav Vaish, “Getting Started with NoSQL”, Packt Publishing, March 2013.
Reference Books:	
1	Jonathan Gennick, SQL Pocket Guide, 3rd Edition, O'Reilly Media, Inc., Nov 2010.
2	Ramez Elmasri, Shamkant B. Navathe, “Fundamentals of Database Systems”, 4th Edition, Pearson / Addision wesley, 2007.
3	Rosenzweig ,”Oracle PL/SQL”, Pearson Education India; 5th Edition, 2015.
Web References:	
1	www.tutorialspoint.com/dbms/
2	https://www.javatpoint.com/dbms-tutorial
3	https://www.w3schools.com/sql/
Online Resources:	
1	https://nptel.ac.in/courses/106/106/106106093/
2	https://www.coursera.org/learn/intro-sql

Assessment Methods & Levels (based on Blooms’ Taxonomy)

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Rubric based Continuous Assessment (60)	End Semester Examination (40)
Remember	20	20
Understand	20	20
Apply	60	60
Analyse	-	-
Evaluate	-	-
Create	-	-

Course Outcomes (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C405.1	3	3	3		3			2	3	2		3	2	3	3
C405.2	3	3	3		3			2	3	2		3	2	3	3
C405.3	3	3	3		3			2	3	2		3	2	3	3
C405.4	3	3	3		3			2	3	2		3	2	3	3
C405.5	3	3	3		3			2	3	2		3	2	3	3

20IT501	FORMAL LANGUAGES AND AUTOMATA THEORY	3/0/0/3
Nature of Course	G (Theory Analytical)	
Pre requisites	Mathematics - Set Theory	

Course Objectives:

1.	To study about Mathematical models such as Finite Automata, Pushdown Automata and Turing Machine
2.	To employ the Rule of pumping Lemma to prove that Language is not Regular
3.	To frame context free grammar to accept various programming constructs
4.	To design Turing machines to accept recursive languages
5.	To categorize types of grammar based on Pattern

Course Outcomes

Upon completion of the course, students shall have ability to

C501.1	Construct Finite Automata based on regular expressions	[AP]
C501.2	Illustrate Regular Expressions to suit pattern of language	[AP]
C501.3	Contrast Recursive and Recursive Enumerable Languages	[A]
C501.4	Apply Pumping lemma for regular and context free languages	[AP]
C501.5	Express the Properties of Regular languages and context free languages	[U]
C501.6	Construct Pushdown automata and Turing machine mathematical models.	[AP]

Course Contents:

Finite Automata and Regular Languages: **15 Hours**

Mathematical Preliminaries and Notations, Chomsky Hierarchy of languages, Concepts of Automata Theory, Finite Automata-Deterministic Finite Automata (DFA)-Non-Deterministic Finite Automata (NFA)-Finite Automata with epsilon transitions-NFA with epsilon to NFA-NFA with epsilon to DFA conversion-NFA to DFA conversion. Regular Expressions: Finite Automata and Regular Expressions-Applications of Regular Expressions-Regular Grammars. Properties of regular languages-pumping lemma for regular languages-Equivalence of Minimization of Finite Automata-Closure properties of regular languages.

Context Free Languages: **15 Hours**

Context Free Grammar (CFG)-Derivation Trees-Ambiguous Grammar-Equivalence of Parse Trees and Derivation-Applications of Context Free grammar. Definition of Pushdown Automata-Language of Pushdown Automata-Acceptance of String in Pushdown Automata-Equivalence of CFG and Pushdown Automata-Pumping Lemma for CFL-Closure Properties of CFL-Deterministic Pushdown Automata-Simplification of CFG-Chomsky Normal Form-Greibach Normal form

Turing Machines: **15 Hours**

Turing Machines-Language of Turing Machines-Instantaneous Description of Turing Machine-Turing machine as a computing device-Techniques of Turing Machine-Universal Turing Machine-Types of Turing Machine-Multiple Track Turing Machine-Two-way infinite tape Turing Machine-Multi Tape Turing Machine- Recursive and Recursive Enumerable Sets-Post Correspondence problem

Total Hours	**45**

Text Books:

1.	Hopcroft J.E, Motwani R and Ullman J.D, “Introduction to Automata Theory, Language and Computations”, 3rd Edition, Pearson Education (ISBN 1292039051), 2014.

2.	Martin J, “Introduction to Languages and the Theory of Computation”, 3rd Edition, TMH, 2007.
Reference Books:	
1.	Kamala Krithivasan and Rama R, “Introduction to Formal Languages, Automata Theory and Computation”, Pearson Education, 2009.
2.	Greenlaw, “Fundamentals of Theory of computation, Principles and Practice”, Elsevier, 2008.
3.	Peter Linz, “An Introduction to Formal Language and Automata”, Narosa Publishers, NewDelhi, 2011.
Web References:	
1.	https://lewis.seas.harvard.edu/files/harrylewis/files/introduction_0.pdf
2.	https://www.cl.cam.ac.uk/teaching/1213/RLFA/materials.html
3.	https://www.cse.iitb.ac.in/~akg/courses/2019-cs310/index.html
Online Resources:	
1.	https://www.udemy.com/course/theory-of-computation-online-course/
2.	https://nptel.ac.in/courses/106/104/106104148/
3.	https://www.youtube.com/watch?v=58N2N7zJGrQ&list=PLBlnK6fEyqRgp46KUv4ZY69yXmpwKOIev

Tentative Assessment Methods & Levels (based on Revised Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks: 20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C501.1, C501.2	Apply	Assignment	5
C501.4, C501.6	Apply	Assignment	5
C501.3	Analyze	Online Quiz	5
C501.5	Understand	Online Quiz	5

Summative assessment based on Continuous and End Semester Examination

Revised Bloom’s Level	Continuous Assessment			End Semester Examination (Theory) [50 marks]
	Theory			
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]	
Remember				
Understand	20	20	20	20
Apply	80	50	50	50
Analyse	-	30	30	30
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

Course Outcomes (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C501.1	2	3	2		2								2	2	2
C501.2	1	2	2		2								2	1	1
C501.3	2	3	2	3	3								3	3	2
C501.4	2	1	2		1								1	1	1
C501.5	2	1	2	2	2								2	1	2
C501.6	2	2	2		2								1	2	2

20IT502	DATA COMMUNICATIONS AND COMPUTER NETWORKS	3/0/0/3
Nature of Course	C (Theory Concept)	
Pre requisites	Nil	

Course Objectives:

1.	To study the concepts of data communications and functions of different layers of ISO/OSI reference architecture.
2.	To understand the error detection and correction methods and types of LAN.
3.	To study the concepts of sub netting and routing mechanisms.
4.	To understand the different types of protocols and network components.
5.	To study and configure Switches and Routers.

Course Outcomes

Upon completion of the course, students shall have ability to

C502.1	Understand the fundamentals of data communications and functions of layered architecture.	[U]
C502.2	Illustrate error detection, correction methods and interpret different network technologies.	[U]
C502.3	Analyze the requirements for a given organizational structure and select the most appropriate networking architecture and routing technologies.	[A]
C502.4	Construct Routers and Switches for efficient Data Transfer.	[AP]
C502.5	Understand the application layer protocols and also the use of network security.	[U]
C502.6	Ability to analyze the connection establishment and termination process in transport layer	[A]

Course Contents:

Data Communications and Physical layer: **15 Hours**

Introduction, networks topologies, ISO/OSI model, TCP / IP model and protocols, Performance Metrics. Different types of transmission media, errors in transmission: attenuation, noise. Repeaters. Encoding (NRZ, NRZI, Manchester, 4B/5B), Networking Devices: Hubs, Bridges, Switches, Routers and Gateways. Switching-Circuit Switched Networks-Packet Switched Networks.

Data Link and Network Layers **15 Hours**

Data Link Layer: Addressing, Error detection (Parity, CRC, Hamming code), Sliding Window, Stop and Wait protocols, LAN: Design, specifications of popular technologies, switching, Ethernet, Gigabit Ethernet, Token Ring, Token Bus, Bluetooth, Wi-Fi, Wi-Max, FDDI, PPP.**MAC Layer:** Aloha, TDMA, CDMA, CSMA/CD, CSMA/CA. **Network layer:** Internet Protocol, IPv4, IPv6, ARP, DHCP, ICMP, Distance vector routing, Link state routing, Classless Inter-domain routing, RIP, OSPF, BGP, Subnetting, Network Address Translation.

Transport layer and Application Layer: **15 Hours**

UDP, TCP, Connection establishment and termination, sliding window revisited, flow and congestion control, timers, retransmission, Socket Programming. **Application Layer:** DNS, E-Mail -SMTP, MIME, POP3, IMAP, FTP, HTTP, WWW, Design issues in protocols at different layers, CASE STUDY-Configuration of Router and Switches using Packet Tracer.

Total Hours	**45**

Text Books:

1.	Behrouz A. Forouzan, “Data communication and Networking”, 5th Edition, Tata McGraw-Hill, 2013.

2.	A S Tanenbaum, DJ Wetherall, “Computer Networks”, 6th Edition, Prentice-Hall, 2021.
Reference Books:	
1.	Peterson & Davie, "Computer Networks, A Systems Approach", 6th Edition, Elsevier, 2021.
2.	William Stallings, “Data and Computer Communications”, 10th Edition, PHI, 2013.
3.	Bertsekas and Gallagher “Data Networks, 2nd Edition, PHI, 2000.
4.	JF Kurose, KW Ross, “Computer Networking: A Top-Down Approach”, 6th Edition, Addison-Wesley, 2021.
Web References:	
1.	https://www.udacity.com/course/computer-networking--ud436
2.	http://learnerstv.in/courses/computer-sc-computer-networks-free-video-tutorials-and-notes-lectures/
3.	http://freevideolectures.com/Course/3162/Computer-Networking-Tutorial
Online Resources:	
1.	https://nptel.ac.in/courses/106/105/106105081/
2.	https://www.free-online-training-courses.com/networking/
3.	http://www.omnisecu.com/basic-networking/index.php

Tentative Assessment Methods & Levels (based on Revised Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks: 20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C502.1, C502.2, C502.5	Understand	Quiz/Assignment/Class Presentation	9
C502.3, C502.6	Analyze	Case Study	8
C502.4	Apply	Class Presentation	3

Summative assessment based on Continuous and End Semester Examination

Revised Bloom’s Level	Continuous Assessment			End Semester Examination (Theory) [50 marks]
	Theory			
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]	
Remember	40	-	-	-
Understand	30	30	20	20
Apply	30	40	40	40
Analyze	-	30	40	40
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

Course Outcomes (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C502.1	1	1	2	-	-	-	-	-	-	-	-	2	2	2	-
C502.2	3	3	3	3	2	-	-	-	-	-	-	3	3	3	3
C502.3	3	3	3	3	2	-	-	-	-	-	-	3	3	3	2
C502.4	1	2	2	1	3	-	-	-	-	-	-	2	2	1	-
C502.5	3	2	3	2	2	-	-	-	-	-	-	2	3	2	-
C502.6	1	1	-	2	2	-	-	-	-	-	-	2	3	3	-

20MA501	FOURIER SERIES AND COMPUTATIONAL METHODS	2/1/2/4
Nature of Course	J (Problem analytical)	
Pre requisites	Concepts of basic differentiation and Integration	
Course Objectives:		
1.	To study the concept of finding the solutions of polynomials using numerical interpolation and derivatives using numerical differentiation methods.	
2.	To find the numerical solution to partial differential equations.	
3.	To know the basics of Z transform and its applicability to discretely varying functions.	
4.	To acquaint the student with Fourier transform techniques which are used in variety of engineering fields.	
5.	To recall the concept of mathematical formulation of certain practical problems in terms of partial differential equations and solving them for physical interpretation.	
Course Outcomes		
Upon completion of the course, students shall have ability to		
C501.1	Recall the basic integration concepts and partial derivatives	[R]
C501.2	Understand the concepts of numerical methods for various mathematical operations and tasks, such as interpolation, differentiation and the solution of partial differential equations.	[U]
C501.3	Apply numerical methods to solve wave and heat equation with boundary conditions.	[AP]
C501.4	Formulate Fourier series solutions to engineering problems and evaluation of integrals using Fourier transform techniques.	[AP]
C501.5	Apply Z- transform for image processing and machine learning systems.	[AP]
C501.6	Apply analytical methods to solve the partial differential equations	[AP]

Course Contents:

Numerical Methods **15 Hours**

Interpolation And Approximation - Lagrangian Polynomials - Divided differences - Newton's forward and backward difference formulas - Numerical Differentiation - Differentiation using Newton forward and Backward interpolation formulae - Numerical Solution to PDE - Finite difference technique - Laplace Equation - Liebmann's Iteration Process - Parabolic Equation - Bender-Schmidt's Difference Scheme - Hyperbolic Equations.

Fourier Series and Transform **15 Hours**

Fourier Series: Introduction - Dirchlet's condition - Full range and Half range Fourier series - **Fourier Transform**: Complex form of Fourier Transform - Properties (excluding proof) - Transforms of simple functions - Parseval's Identity (Statement) - Evaluation of integrals using Parseval's Identity - **Z-transform**: Z-transform of standard functions - Properties - Inverse Z-transforms - Convolution theorem - Partial fraction method - Applications of transforms in image processing and machine learning.

Partial Differential Equations **15 Hours**

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions - Lagrange's linear equations - Linear homogeneous partial differential equations of second and higher order with constant coefficients.

Total Hours	**45**

Course Outcomes: (Laboratory)	
Upon the completion of the course, students shall have ability to	
C501.1	Understanding of basic concepts in interpolation and differentiation using numerical techniques.
C501.2	Applying the numerical techniques in the application of partial differential equations in one dimensional heat and wave equations.
C501.3	Represent discontinuous function which occurs in electrical circuits and signal processing by using Fourier series.
C501.4	Demonstrate the use of Fourier transform to connect the time domain and frequency domain.
C501.5	Understanding Z- transform and analyzing discrete signals by using Z- transform.
C501.6	To describe homogeneous and higher order partial differential equations using PDE techniques.

Laboratory Component:

S. No	List of Experiments	CO Mapping	RBT
1.	To find the solution of Lagrangian polynomial and divided difference problems using mathematical software.	C501.1	[AP]
2.	To find the derivatives of functions in numerical differentiation problems using mathematical software.	C501.1	[AP]
3.	To find the solution of Laplace equation using mathematical software.	C501.2	[AP]
4.	To find the solution of Parabolic equation using mathematical software.	C501.2	[AP]
5.	To find the solution of Hyperbolic equation using mathematical software.	C501.2	[AP]
6.	To perform symbolic Fourier series calculation of the given full range function using mathematical software.	C501.3	[AP]
7.	To perform symbolic Fourier series calculation of the given half range function using mathematical software.	C501.3	[AP]
8.	To plot the Fourier transform of time function using mathematical software.	C501.4	[AP]
9.	To find the Fourier transform of complex functions using mathematical software.	C501.4	[AP]
10.	To find the Z transform and of given expression f(n) using mathematical software.	C501.5	[AP]
11.	To find inverse Z transform of given expression f(n) using mathematical software.	C501.5	[AP]
12.	To find the solution of homogeneous and higher order partial differential equations using mathematical software.	C501.6	[AP]

Text Books:

1	Kreyszig E, "Advanced Engineering Mathematics" 10th Edition, John Wiley and Sons (Asia) Limited, Singapore 2014.
2	Grewal B S, "Higher Engineering Mathematics", 43rd Edition, Khanna Publications, Delhi, 2014.
3	Gerald C F and Wheatley P O, "Applied Numerical Analysis", Pearson Education, 7th Edition, 2004.

Reference Books:

1	Veerarajan T, "Transforms and Partial differential equations", 3rd Edition, Tata McGraw-Hill Publishing Company Ltd., reprint,2016.

2	Glyn James, “Advanced Modern Engineering Mathematics”, Pearson Education, 4th Edition, 2016.
3	Jain M K Iyengar, K & Jain R K, “Numerical Methods for Scientific and Engineering Computation”, New Age International (P) Ltd., 6th Edition, 2012.
4	Bali N P, “A Text book of Engineering Mathematics”, Sem-III/IV, 13th Edition, Laxmi publications Ltd., 2017.
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.edx.org/course/calculo-diferencial-galileox-cmath001rx
2.	https://www.edx.org/course/pre-university-calculus-delftx-calc001x-1
3.	https://www.edx.org/course/calculus-1a-differentiation-mitx-18-01-1x
Assessment Methods & Levels (based on Bloom’sTaxonomy)	
Summative assessment based on Continuous and End Semester Examination	

Bloom’s Level	**Continuous Assessment**				**End Semester Examination (Theory) [40 marks]**
	Theory			**Practical & Project**	
	CIA-I [10 Marks]	**CIA-II [10 Marks]**	**CIA-III [10 Marks]**	**Rubric based CIA [30 Marks]**	
Remember	20	20	20	20	20
Understand	30	30	30	30	30
Apply	50	50	50	50	50
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**
C501.1	3	3	2		2								2	1	1
C501.2	3	3	2		2								2	1	1
C501.3	3	3	2		2								2	1	1
C501.4	3	3	2		2								2	1	1
C501.5	3	3	2		2								2	1	1
C501.6	3	3	2		2								2	1	1

20IT503	COMPUTER NETWORKS LABORATORY	0/0/3/1.5
Nature of Course	L (Problem Experimental)	
Pre requisites:	Nil	

Course Objectives:

1	To learn socket programming.
2	To study and learn the network simulation tools.
3	Hands-on Experience on various networking protocols and tools.

Course Outcomes:

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

C503.1	Understand the foundational concepts in networking and system administration.	[U]
C503.2	Apply various networking protocols using sockets.	[A]
C503.3	Construct TCP sockets for client server communication.	[AP]
C503.4	Analyze the performance of the protocols and algorithms in different layers.	[A]
C503.5	Make use of simulation tools to implement various algorithms.	[AP]
C503.6	Analyze the network file transfer tool used for communication.	[A]

Course Contents:

1. Study of system administration and network administration.
2. Study of various networking and intermediate devices.
3. Implementation of bit stuffing and character stuffing.
4. Implementation of Sliding window protocol and stop and wait protocol.
5. Write a code simulating PING and TRACEROUTE commands
6. Applications using TCP Sockets like
    a. File transfer
    b. Remote command execution
    c. Chat
    d. Concurrent server
7. Study of socket programming and client server model using UDP and TCP.
8. Create a socket for HTTP for webpage upload and download
9. Implementation of Subnetting Applications.
10. Simulation of DNS.
11. Study of Network Simulator-3 (NS3).
12. Study of PUTTY (NETWORK FILE TRANSFER APPLICATION).

Total Hours:	**45**

Text Books:

1	Kenneth L. Calvert, Michael J. Donahoo, “TCP/IP Sockets in Java: Practical Guide for Programmers”, Imprint: Morgan Kaufmann, 2008.

2	Elliotte Rusty Harold, “Java Network Programming”, Developing Networked Applications”, O'Reilly Media, 2013.
Reference Books:	
1	Craig Hunt, “TCP/IP Network Administration”, O'Reilly Media, 3rd Edition 2002.
2	Esmond Pitt, “Fundamental Networking in Java”, 3rd Edition, Springer.
3	James F. Kurose, Keith W. Ross, “Computer Networking: A Top-down Approach”, Pearson Education, Limited, 6th Edition, 2012.
Web References:	
1	https://www.tutorialspoint.com/java/java_networking.htm
2	https://www.javatpoint.com/socket-programming
Online Resources:	
1	https://onlinecourses.nptel.ac.in/noc21_cs18/preview
2	https://www.coursera.org/lecture/distributed-programming-in-java/2-1-introduction-to-sockets-XiZXU

Assessment Methods & Levels (based on Blooms’Taxonomy)

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Rubric based Continuous Assessment (60)	End Semester Examination (40)
Remember	-	-
Understand	10	10
Apply	40	40
Analyse	50	50
Evaluate	-	-
Create	-	-

Course Outcomes (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C503.1	3	3	2	2	3	-	-	-	-	-	-	1	3	2	3
C503.2	2	3	3	2	3	-	-	-	-	-	-	1	3	3	2
C503.3	3	3	2	2	3	-	-	-	-	-	-	1	2	2	3
C503.4	2	3	3	2	3	-	-	-	-	-	-	1	3	2	3
C503.5	2	3	3	2	3	-	-	-	-	-	-	1	3	2	3
C503.6	3	3	3	2	3	-	-	-	-	-	-	1	3	2	2

20IT601	MACHINE LEARNING TECHNIQUES	3/0/0/3
Nature of Course	C (Theory Concept)	
Pre requisites	Nil	
Course Objectives:		
1.	To create a foundation for understanding and comprehending the concepts of machine learning.	
2.	To acquire theoretical knowledge on formulation of learning problems and setting hypotheses for pattern recognition.	
3.	To study the various probability-based learning techniques.	
4.	To gain the ability to evaluate and optimize the performance of various machine learning algorithms.	
5.	To appreciate supervised and unsupervised learning and their applications.	
Course Outcomes		
Upon completion of the course, students shall have ability to		
C601.1	Understand the fundamental principles, challenges and applications of machine learning.	[U]
C601.2	Classify supervised, unsupervised, semi-supervised learning and reinforcement learning.	[A]
C601.3	Apply preprocessing techniques to raw data and evaluate its performance	[AP]
C601.4	Make use of various supervised learning methods to appropriate problems.	[AP]
C601.5	Build probabilistic and unsupervised learning models for handling unknown patterns.	[AP]
C601.6	Categorize the effectiveness of different learning techniques and choose appropriate learning techniques for different kinds of data and applications.	[A]

Course Contents:

Introduction to Machine learning **15 Hours**

Introduction – Data Preprocessing – Designing a learning system – Issues. Examples of Machine Learning Applications – Overview: Supervised Learning, Unsupervised learning and Reinforcement Learning – Learning Associations – Linear Classification – Regression: Linear regression, Logistic regression, Ridge Regression, LASSO Regression, Multivariate Regression.

Supervised Learning **15 Hours**

Generative vs discriminative learning – Decision Tree learning, ID3, CART, Tree Pruning – Concept Learning - Multi Layer Perceptron, MLP for Classification, Backpropagation – Support vector machines – Instance based learning – Ensemble learning - Bagging, Boosting, Random Forests – Case Study: Spam Filtering

Probability Models and Unsupervised Learning **15 Hours**

Gaussian mixture models, Maximum Likelihood, EM for Gaussian mixtures – Introduction to Unsupervised learning – Clustering, K-means, K-medoids, Density-based Hierarchical – Curse of dimensionality, Dimensionality reduction - Principal Component Analysis – Optimization: Exhaustive Search, Least squares optimization, Gradient Descent – Case Study: Youtube video Recommendation.

Total Hours	**45**

Text Books:	
1.	Ethem Alpaydin, “Introduction to Machine Learning”, MIT Press, Prentice Hall of India, 3rd Edition 2014.
2.	Bishop, C., “Pattern Recognition and Machine Learning”, Springer, 2006.
3.	Stephen Marsland, “Machine Learning – An Algorithmic Perspectivell”, 2nd Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
Reference Books:	
1.	Andrew Ng, “Machine Learning Yearning”, deeplearning.ai, 2018
2.	Mitchell. T, “Machine Learning”, McGraw Hill, 1997
3.	P. Flach. “Machine Learning: The Art and Science of Algorithms that Make Sense of Data”, 1st Edition, Cambridge University Press, 2012.
4.	Goodfellow I,Bengio Y and Courville A.; “Deep Learning”, MIT Press, 2016
5.	Yaser S. Abu-Mostafa, Malik Magdon-Ismail, Hsuan-Tien Lin., “Learning From Data”, AMLBook, 2012.
6.	Andriy Burkov, “The Hundred - Page Machine Learning Book”, 2019.
Web References:	
1.	https://www.mlyearning.org/
2.	https://www.ibm.com/downloads/cas/GB8ZMQZ3
3.	https://www.youtube.com/playlist?list=PLOU2XLYxmsIIuiBfYad6rFYQU_jL2ryal
Online Resources:	
1.	https://www.coursera.org/learn/machine-learning
2.	https://www.deeplearning.ai/program/machine-learning-specialization/

Tentative Assessment Methods & Levels (based on Revised Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks: 20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C601.1, C601.2	Understand, Analyze	Assignment	5
C601.3, C601.4	Apply	Online Quiz	5
C601.5, C601.6	Apply, Analyze	Case Study	10

Summative assessment based on Continuous and End Semester Examination

Revised Bloom’s Level	Continuous Assessment			End Semester Examination (Theory) [50 marks]
	Theory			
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]	
Remember				
Understand	10	-	10	20
Apply	60	70	70	50
Analyse	30	30	20	30
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

Course Outcomes (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C601.1	2	3	1	1	1						1	1	1	2	2
C601.2	1	2	2	1	2						1	1	2	2	1
C601.3	3	3	3	3	3						1	1	3	3	2
C601.4	1	1	2	1	1						1	1	2	1	2
C601.5	2	1	2	2	1						1	1	2	2	2
C601.6	2	2	2	1	2						1	1	2	2	2

20CS601	PRINCIPLES OF COMPILER DESIGN *(COMMON TO CSE / IT)*	3/0/0/3
Nature of Course	D (Theory Design)	
Pre requisites	Theory of Computation	

Course Objectives:	
1	To introduce the major concept areas of language translation and compiler design
2	To understand, design and construct a lexical analyzer and parser.
3	To employ code generation schemes
4	To perform optimization of codes and gain knowledge about runtime environments
5	To provide practical programming skills necessary for constructing a compiler using LEX and YACC tools

Course Outcomes: **Upon completion of the course, students shall have ability to**		
C601.1	Construct a lexical analyzer to identify the tokens in a program	[AP]
C601.2	Construct a parser through the application of grammar.	[AP]
C601.3	Discuss the intermediate code generation and symbol table organization techniques	[U]
C601.4	Explain target machine's run time environment	[U]
C601.5	Construct a compiler for a small language with code generation and optimization strategies	[AP]

Course Contents:

Lexical Analysis and Syntax analysis: Introduction to Phases of a compiler- **Lexical Analysis:** Role of Lexical Analyzer - Input Buffering - Specification of Tokens - Recognition of Tokens. Finite Automata - From a regular expression to an NFA and DFA. **Syntax Analysis:** Role of the parser -Context-Free Grammars - **Top-Down parsing**: Recursive Descent Parsing - Predictive Parsing. **Bottom-up parsing**: Shift Reduce Parsing - LR Parsers - LEX and YACC tools.

Semantics analysis and Intermediate Code Generation: Introduction to Semantics Analysis - Type Checking. **Intermediate Code Generation**: Intermediate Languages- Declarations - Assignment Statements - Boolean Expressions - Case Statements - Back patching – Procedure Calls. **Run Time Environments**: Source Language Issues - Storage Organization – Storage Allocation strategies.

Code Generation and Code Optimization: Issues in the design of code generator – The Target Machine – Basic Blocks and Flow Graphs – A simple Code generator –— DAG representation of Basic Blocks - Peephole Optimization. **Code Optimization:** Principal Sources of Optimization – Optimization of Basic Blocks - Introduction to Global Data Flow Analysis. **Case Study**: Just-in-time Compilation with adaptive optimization - Compiler for Data science.

Total Hours:	**45**

Text Books:

1.	Alfred Aho, Ravi Sethi, Jeffrey D Ullman, Monica S. Lam, "Compilers Principles, Techniques and Tools" , 2nd Edition, Pearson Education Asia, 2013
2.	T.G Manikumar, M Ganga Durga , "Principles of Compiler Design", 1st Edition, MJP Publisher, 2021.

Reference Books:

1.	C.N.Fischer and R.J.LeBlanc, "Crafting a compiler with C", Benjamin Cummings, 2010
2.	Henk Alblas and Albert Nymeyer, "Practice and Principles of Compiler Building with C", PHI, 2001
3.	Kenneth C.Louden, "Compiler Construction: Principles and Practice", Thompson Learning, 2003
4.	Dhamdhere, D.M., "Compiler Construction Principles and Practice", 2nd edition, Macmillan India Ltd., New Delhi, 2008

Web References:

1.	gatecse.in/category/compiler-design/
2.	www.tutorialspoint.com/compiler_design

Online Resources:	
1.	http://nptel.ac.in/syllabus/syllabus.php?subjectId=106108113
2.	nptel.ac.in/courses/106104123/
3	http://openclassroom.stanford.edu/MainFolder/CoursePage.php?course=Compilers

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C601.1 &2	Apply	Assignment	10
C601.3&4	Apply	Tutorial	10

Assessment Methods & Levels (based on Blooms' Taxonomy)				
Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment Theory**			**End Semester Examination Theory [50 marks]**
	CIA1 [10 marks]	**CIA2 [10 marks]**	**CIA3 [10 marks]**	
Remember	20	20	20	20
Understand	30	40	30	30
Apply	50	40	50	50
Analyse	-	-	-	
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	**Summative Assessment Total**		**Total**
	Continuous Assessment	**End Semester Examination**	
20	30	50	100

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**
C601.1	3	3	3	3	3	2		2	1	3		3	3	3	2
C601.2	3	3	3	3	3	2			2	3		3	3	3	2
C601.3	3	3	3	3	3	2			2	3			3	3	2
C601.4	3	3	3										2	2	
C601.5	3	3	3	3	3	3		3	3	3		3	3	3	2

20IT602	CLOUD COMPUTING AND ITS APPLICATIONS	3/0/2/4
Nature of Course	F (Theory Programming)	
Pre requisites	Computer Networks, Computer Architecture	
Course Objectives:		
1.	To understand the evolution of cloud from the existing technologies.	
2.	To have knowledge on the various issues and to be familiar with the lead players in cloud.	
3.	To learn the necessary skills for designing, develop, and deploy services in creating an application in the cloud computing paradigm.	
4.	To expose the students to the frontier areas of Cloud Computing and to promote the spirit of entrepreneurship in providing Cloud Service.	
5	To identify the best suit architecture, infrastructure and delivery models of Cloud Computing for a business scenario.	
Course Outcomes:		
Upon completion of the course, students shall have ability to		
C602.1	Demonstrate the broad perspective of cloud architecture and model.	[U]
C602.2	Interpret the business scenario to provide the appropriate cloud computing solutions and recommendations	[U]
C602.3	Build a private cloud to enable and improve collaborative and small-scale business environment.	[AP]
C602.4	Analyze and use a generic cloud environment that can be used a private cloud.	[A]
C602.5	Apply large data sets in a parallel environment.	[AP]
C602.6	Inspect the cloud security architectures that assures secure isolation of compute, network and storage infrastructures, comprehensive data protection, end-to-end identity and access management	[A]

Course Contents:

Cloud Computing Fundamentals: **15 Hours**

Cloud Computing Fundamentals - Evolution of Cloud Computing- Introduction to Grid, Parallel, Utility, Cluster and Distributed Computing- System Models for Distributed and Cloud Computing, Technologies for Network based Systems- Cloud Computing: Drivers, Challenges, Benefits, Characteristics- Layered Cloud Architecture design-NIST Cloud Computing Reference architecture-Public, Private, Community and Hybrid Clouds-Iaas-Paas-Saas-Architectural Design Challenges-Cloud Ecosystem-Service Management-Case Studies-Anything as a Service(XaaS).

Cloud Enabling Technologies: **15 Hours**

Basics of Virtualization- Introduction to various Hypervisors-Types of Virtualization-Tools and mechanisms-Virtualization of CPU-Memory-I/O Devices-Application-Databases-VM Migration-Virtual Clusters and Resource Management-High Availability (HA)/Disaster Recovery (DR)-Virtualization Support and Disaster Recovery-Resource Provisioning.

Working with Cloud Enabled Platform: **15 Hours**

Public Cloud Services: AWS: Working with Amazon AWS-Amazon S3-Working with Azure-Advanced Topics in Cloud Computing: Big data on AWS, Azure, and Google Cloud Solution. **Security:** Vulnerability Issues and Security Threats, Application-level security, Data level security, and Virtual Machine level security, IDS: host and network based, Security as a service.
Case Study: Open Stack, CloudSim.

Total Hours	**45**

Laboratory Component:	
S. No	**List of Experiments**
1.	Study of Hosted Hypervisor and Bare Metal Hypervisor.
2.	Install a Virtualbox/VMware Workstation with different flavours of linux or windows OS on top of windows7 or 8.
3.	Install a C compiler in the virtual machine created using virtual box and execute simple program.
4.	Implementation of Virtual Machine(S) and create a Virtual Datacenter.
5.	Configuration of Virtual Internetworking Components.
6.	Deployment of VMs in AWS.
7.	Integration of IoT Components in AWS/Azure.
8.	Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.
9.	Find a procedure to transfer the files from one virtual machine to another virtual machine. Using VMWare.
10.	Install Google App Engine. Create hello world app and other simple web applications using python/java.
Total Hours	**30**

Text Books:	
1.	Rajkumar Buyya, Christian Vecchiola, S.Thamarai Selvi, “Mastering Cloud Computing”, Tata McGraw Hill, 2013.
2.	Toby Velte, Anthony Velte, Robert Elsenpeter, “Cloud Computing-A Practical Approach” Tata McGraw Hill, 2010.
3	Rittinghouse, John W and James F Ransome, “Cloud Computing: Implementation, Management and Security”, CRC Press, 1st Edition, 2017.
4	Tim Mather, Subra Kumaraswamy, Shahed Latif, O’Reilly “Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance”, 1st Edition Kindle Edition

Reference Books:	
1.	George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice)", O'Reilly, 1st Edition, 2009
2.	Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, "Cloud Computing Principles Books and Paradigms", Wiley, 2010.
3.	Kai Hwang, Geoffrey C Fox, Jack G Dongarra, “Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
4.	Kumar Saurabh, “Cloud Computing — insights into New-Era Infrastructure", Wiley, India, 2011.

Web References:	
1.	https://www.coursera.org/specializations/cloud-computing
2.	https://www.edx.org/course/introduction-to-cloud-computing-6
3.	https://onlinecourses.nptel.ac.in/noc22_cs20/preview

Online Resources:	
1.	https://www.youtube.com/watch?v=Wn-1OLgxHjQ
2.	https://www.youtube.com/watch?v=RWgW-CgdIk0
3.	https://intellipaat.com/course-cat/cloud-computing-courses/

Tentative Assessment Methods & Levels (based on Revised Bloom's Taxonomy					
Summative assessment based on Continuous and End Semester Examination					
Revised Bloom's Level	**Continuous Assessment**				**End Semester Examination (Theory) [40 marks]**
	Theory			**Practical**	
	CIA-1 [10 marks]	**CIA-2 [10 marks]**	**CIA-3 [10 marks]**	**Rubric based CIA [30 Marks]**	
Remember					
Understand	50	30	30	20	30
Apply	50	50	40	50	40
Analyse	-	20	30	30	30
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Course Outcomes (CO)	**Programme Outcomes (PO)**												**Programme Specific Outcomes (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C602.1	1	2	1	1								2	1	2	1
C602.2	3	3	3	3	2							2	3	3	2
C602.3	3	3	3	3								2	3	3	2
C602.4	3	3	3	3	3							2	3	3	2
C602.5	3	2	3	3	3							1	3	3	2
C602.6	1	2	1	1								2	1	2	1

20IT603	MACHINE LEARNING TECHNIQUES LAB	0/0/3/1.5
Nature of Course	M (Practical Application)	
Pre requisites:	Nil	

Course Objectives:

1	To learn the fundamentals of data preprocessing.
2	To familiarize the various libraries including Numpy, Pandas and Matplotlib for implementing machine learning algorithms and visualization.
3	To discuss implementation of various Supervised learning algorithms.
4	To discuss implementation of various Unsupervised learning algorithms.

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

C603.1	Apply data preprocessing techniques as required for specific ML algorithms.	[AP]
C603.2	Understand the implementation procedures for the machine learning algorithms.	[U]
C603.3	Build Python programs for various Learning algorithms	[AP]
C603.4	Choose appropriate datasets and incorporate required Python libraries and packages to implement the Machine Learning algorithms.	[AP]
C603.5	Identify and apply Machine Learning algorithms to solve real world problems.	[AP]
C603.6	Develop programs to implement various clustering algorithms.	[AP]

Course Contents:

1. Data Preprocessing for ML algorithms.
2. Implementation of Linear Regression.
3. Implementation of Multi variable Linear Regression.
4. Implementation of Association Rule Learning.
5. Implementation of Logistic Regression.
6. Implementation of Decision Tree learning
7. Implementation of classification using Multilayer perceptron.
8. Implementation of classification using SVM.
9. Implementation of Bagging using Random Forests.
10. Implementation of k-nearest Neighbors algorithm.
11. Implementation of K-means, K-Medoids Clustering to Find Natural Patterns in Data.
12. Implementation of Hierarchical clustering.
13. Implementation of Gaussian Mixture Model Using the Expectation Maximization.
14. Implementation of Principal Component Analysis for Dimensionality Reduction

Total Hours:	**45**

Text Books:	
1	Andreas C. Müller, Sarah Guido, “Introduction to Machine Learning with Python”, O'Reilly Media, Inc., 2016.
2	Oliver Theobald, “Machine Learning for Absolute Beginners: A Plain English Introduction”, 3rd Edition, Independently Published, 2021.
Reference Books:	
1	Raúl Garreta, Guillermo Moncecchi, “Learning Scikit-Learn: Machine Learning in Python”, Packt Publishing, 2013.
2	Peter Harrington, “Machine Learning in Action”, Manning Publications, 2012.
Web References:	
1	https://www.kaggle.com/datasets
2	https://www.ibm.com/downloads/cas/GB8ZMQZ3
3	https://scikit-learn.org/stable/
Online Resources:	
1	https://www.coursera.org/learn/machine-learning-with-python
2	https://www.mygreatlearning.com/academy/learn-for-free/courses/python-for-machine-learning.

Assessment Methods & Levels (based on Blooms’Taxonomy)

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Rubric based Continuous Assessment (60)	End Semester Examination (40)
Remember	20	20
Understand	20	20
Apply	60	60
Analyse	-	-
Evaluate	-	-
Create	-	-

Course Outcomes (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C603.1	3	3	3		3			2	3	2		3	2	3	3
C603.2	3	3	3		3			2	3	2		3	2	3	3
C603.3	3	3	3		3			2	3	2		3	2	3	3
C603.4	3	3	3		3			2	3	2		3	2	3	3
C603.5	3	3	3		3			2	3	2		3	2	3	3
C603.6	3	3	3		3			2	3	2		3	2	3	3

20IT701	BIG DATA ANALYTICS	3/0/2/4
Nature of Course	H (Theory Technology)	
Prerequisites	Nil	

Course Objectives:

1.	To introduce different kinds and sources of Big data.
2.	To provide an insight into different data analytics techniques.
3.	To explore mining hidden structures in big data.
4.	To study and evaluate dimensionality reduction for big data.

Course Outcomes

Upon completion of the course, students shall have the ability to

C701.1	Recall the key concepts and terminologies that define the veryessence of Big Data	[R]
C701.2	Understand big data management's key issues and associated applications in intelligent business and scientific computing.	[U]
C701.3	Infer the fundamental enabling techniques and scalable algorithms like Hadoop, Map Reduce and NO SQL in big data analytics.	[U]
C701.4	Apply business models, scientific computing paradigms and software tools for big data analytics.	[AP]
C701.5	Analyze adequate perspectives of big data analytics in various applications like recommender systems, social media applications.	[A]
C701.6	Examine extensive, detailed and critical knowledge of big data management principles and technology practices.	[A]

Course Contents:

Introduction to Big Data and Analytics: **15 Hours**

Introduction to Big data: characteristics of data and types of digital data. Evolution of big data-Challenges with big data- Traditional Business Intelligence vs Big data. **Big data analytics:** Classification of analytics-challenges-Terminologies used in big data environments. Plotting and visualization using NumPy and pandas data structure.

Introduction to Technology Landscape: **15 Hours**

NoSQL , Comparison of SQL and NoSQL, **Introduction to Hadoop:** RDBMS vs Hadoop, Distributed computing challenges, Hadoop overview- Hadoop Distributed File System (HDFS)-processing data with Hadoop, managing resources and applications with Hadoop YARN-interacting with Hadoop ecosystem(Storm, Flume, Amazon Kinesis). **Map Reduce Framework:** Exploring the features of Map Reduce, Working of Map Reduce, Exploring Map and Reduce Functions, Techniques to optimize Map Reduce jobs, Uses of Map Reduce. Controlling MapReduce Execution with InputFormat, Reading Data with custom RecordReader,-Reader, Writer, Combiner, Partitioners, Map Reduce Phases Developing simple MapReduce Application.

Real-Time Analytics: **15 Hours**

Spark: Introduction to Data Analysis with Spark, In-Memory Computing with Spark, Spark Basics, Interactive Spark with PySpark, Writing Spark Applications. **HBase:** Features, architecture of HBase, operations of HBase. **Sqoop:** Getting started with sqoop, Import and Export data using sqoop.

Case Study: Creating information dashboard for given scenarios using Tableau, ExploringTwitter Sentiment Analysis and the Weather

Total Hours	**45**

Laboratory Component:

S. No	List of Experiments
1.	Plotting and visualization using Numpy and Pandas data structure.
2.	Deploy the Hadoop tool and use its function for analyzing data.

3.	File Management in Hadoop.
4.	Run a basic word count Map Reduce program to understand Map Reduce Paradigm
5.	Write a Map Reduce program that mines weather data.
6.	Implement matrix multiplication with Hadoop Map Reduce.
7.	Install, Deploy & configure Apache Spark cluster and run apache spark application.
8.	Implementation of Matrix algorithms in Spark Sql programming
9.	Data analytics using Apache Spark on Amazon food dataset.
10.	Use HBase to read and write data.
	Total Hours **30**

Text Books:

1.	Seema Acharya, Subhashini Chellappan, “Big Data and Analytics”, Wiley Publication, 2016.
2.	William McKinney, “Python for Data Analysis”, O'Reilly Media, 2nd Edition, 2017.
3.	Benjamin Bengfort, Jenny Kim, “Data Analytics with Hadoop - An Introduction for Data Scientists”, O'Reilly Media, June 2016.

Reference Books:

1.	Judith Hurwitz, Alan Nugent, Dr. Fern Halper, Marcia Kaufman, “Big Data for Dummies”, John Wiley & Sons, Inc., 2013.
2.	Tom White, “Hadoop: The Definitive Guide”, O’Reilly Publications, 2011.
3.	David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", 2013.
4.	Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.

Web References:

1.	https://www.edx.org/learn/big-data
2.	https://www.coursera.org/browse/data-science/data-analysis?languages=en
3.	https://www.udemy.com/topic/big-data/

Online Resources:

1.	NoSQL vs. SQL - How NoSQL is Better for Big Data Applications? - Whizlabs Blog
2.	https://hadoop.apache.org/
3.	https://spark.apache.org/docs/latest/api/python/
4.	https://hive.apache.org/

Tentative Assessment Methods & Levels (based on Revised Bloom’s Taxonomy

Summative assessment based on Continuous and End Semester Examination

Revised Bloom’s Level	Continuous Assessment				End Semester Examination (Theory) [40 marks]
	Theory			Practical	
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]	Rubric based CIA [30 Marks]	
Remember	30	20	20	20	20
Understand	40	30	20	30	30
Apply	30	20	30	30	30
Analyse	-	30	30	20	20
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Course Outcomes (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C701.1	3	3	3	2	2				1	2		2	3	3	2
C701.2	3	3	3	3	2					1	1	3	3	2	3
C701.3	3	3	2	3	3				1	2	2	3	2	3	3
C701.4	3	2	3	2	3	1	1		2	2	2	3	3	3	3
C701.5	3	3	3	3	3				2	2	2	3	3	3	3
C701.6	3	3	3	2	3				1	2	2	3	3	3	3

20IT702	EMBEDDED SYSTEMS AND INTERNET OF THINGS	3/0/2/4
Nature of Course	D (Theory Application)	
Pre requisites	Nil	
Course Objectives:		
1.	To understand the fundamentals of IoT and Embedded systems including essence, basic design and process modeling.	
2.	To understand the market perspectives on Internet of Things.	
3.	To build simple and low cost IoT applications using Arduino / Raspberry Pi or equivalent boards in Embedded Platform.	
4.	To understand the design constraints of real world IoT applications.	
5.	To apply the concept of Internet of Things in real world scenarios such as Industrial Automation, Commercial Building Automation, Health care's etc.	
Course Outcomes		
Upon completion of the course, students shall have ability to		
C702.1	Infer the fundamental knowledge on Embedded systems and Internet of Things	[U]
C702.2	Build IoT systems using Raspberry Pi, Arduino, Node MCU on Embedded Platform.	[AP]
C702.3	Examine the application of IoT and identify the Real-World Design Constraints.	[A]
C702.4	Inspect the integration of next generation technologies with IoT	[A]
C702.5	Analyze the performance of IoT applications in different domains.	[A]
C702.6	Relate the security issues on Internet of Things.	[U]

Course Contents:

Introduction to Embedded System and Internet of Things: 15 Hours
Architecture of Embedded Systems - Embedded Systems Development process - Architecture of Internet of Things - ARM Architecture – Instruction set – Programming ports – Timer / Counter – Serial Communication. **Fundamentals and Design Methodology of IoT:** Functional Blocks of IoT –IoT Standards and Protocols – IoT Communication Models and Communication APIs – IoT Levels – IoT Design Methodology – IoE vs IoT vs M2M – Domain specific IoT.

System Hardware for IoT: 15 Hours
Sensors & Actuators – Hardware Kits: Arduino, Node MCU, Raspberry Pi. **Arduino UNO:** Physical Design – Interfaces – Arduino IDE – Arduino Programming with examples: Digital IO – Analog IO – Serial Communication – Condition and Looping statements – Programming using ESP32. **Raspberry Pi:** Physical Design – Interfaces – Pi programming using Python with examples – Python Packages for IoT.

Data Analytics and Security for IoT and IIOT: 15 Hours
Data Analytics for IoT: Overview of Hadoop ecosystem – MapReduce architecture – MapReduce Job Execution – MapReduce Schedulers. **IoT Security:** Overview of IoT Security – IoT Protocols – Network and Transport Layer Challenges – IoT Gateways and Security – IoT Routing Attacks – Bootstrapping and Authentication – Authentication Mechanisms. **Industrial IoT:** Introduction to IIoT – Key IIoT Technologies - Innovation and the IIoT - Intelligent Devices - Key Opportunities and Benefits.

Case studies: AWS / ThingSpeak / AZURE IoT Hub / Adafruit IO

Total Hours	**45**

Laboratory Component:	
S. No	**List of Experiments**
1.	Study and Configuration of Arduino kit / Node MCU / Raspberry PI.
2.	Basic Programming using Arduino / Raspberry PI: a. LED and Switch Interface b. Analog & Digital Sensor Interface c. Serial Communication d. Local display of sensor data using LCD e. Display of Sensor values in Mobile handset using Bluetooth
3.	Basic Programming using NodeMCU. a. Remote control of Electrical appliances using Mobile handset and Wi-Fi b. Local Web server using NodeMCU and displaying Sensor values.
4.	Design and development a System using LM35 temperature sensor.
5.	Design and development a System using MQ5 sensor.
6.	Design and development a System using Soil Moisture sensor.
7.	Design and Development a System using PIR sensor.
8.	Design and Development a System using Heart beat sensor.
	Total Hours **30**

Text Books:	
1.	Raj Kamal "Embedded Systems - SoC, IoT, AI and Real-Time Systems", 4th Edition, McGraw Hill Education, 2020.
2.	Arshdeep Bahga and Vijay Madisetti, "Internet of Things: A Hands-on Approach", Universities Press, 2015.
Reference Books:	
1.	Mark Torvalds, "Arduino Programming: Step-by-step guide to mastering arduino hardware and software", Createspace Publishing, 2nd Edition, 2018.
2.	Dr. Simon Monk, "Programming the Raspberry Pi: Getting Started with Python", 2nd Edition, McGraw-Hill Education, 2016.
3.	Rajkumar Buyya, Amir Vahid Dastjerdi, "Internet of Things Principles and Paradigms", Elsevier, 2016.
4.	Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", Apress, 2016.
5.	Shriram K Vasudevan, Abhishek S Nagarajan, RMD Sundaram," Internet of Things", Wiley Publication, 2019.
Web References:	
1.	https://github.com/connectIOT/iottoolkit
2.	https://www.arduino.cc/
3.	http://www.zettajs.org/
4.	http://www.buyya.com/papers/IoT-Book2016-C1.pdf
5.	https://www.ptc.com/en/technologies/iiot
Online Resources:	
1.	https://nptel.ac.in/courses/106/105/106105166/
2.	https://www.coursera.org/learn/iot
3.	http://www.iotlab.eu/
4.	http://www.libelium.com/resources/top_50_iot_sensor_applications_ranking/
5.	ps://www.edx.org/course/introduction-to-the-internet-of-things-iot
Tentative Assessment Methods & Levels (based on Revised Bloom's Taxonomy	
Summative assessment based on Continuous and End Semester Examination	

Revised Bloom's Level	Continuous Assessment				End Semester Examination (Theory) [40 marks]
	Theory			Practical	
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]	Rubric based CIA [30 Marks]	
Remember	40	20	20	20	30
Understand	40	30	30	20	30
Apply	20	30	30	30	20
Analyse	-	20	20	30	20
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

Course Outcomes (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C702.1	1	1	2		1	2	1					1	3	3	1
C702.2	3	3	3	3	3	1	2			2		2	3	3	3
C702.3	1	2	3	3	2	2	2			1		1	2	3	2
C702.4	3	3	3	3	3		2		2	2		2	2	3	2
C702.5	3	3	3	3	3		1		2	1		1	2	3	2
C702.6	1	2	1	1	2		1		1		1	2	1	1	1

20IT901	GAME THEORY AND ITS APPLICATIONS	3/0/0/3
Nature of Course	C (Theory Concept)	
Pre requisites	Data Structures, Computer Networks	

Course Objectives:

1.	To provide analytical skills into increasingly complex conflicts
2.	To introduce logic and strategic decision making involved in the theory of games
3.	To enable the students to be aware of rational behavior in strategically interdependent situations
4.	To introduce and theorize possible and probable strategies where information is incomplete

Course Outcomes

Upon completion of the course, students shall have ability to

C901.1	Demonstrate the basic knowledge of a "game" into a wide range of conflicts from the standpoint of rationality	[U]
C901.2	Define the theoretical state of Equilibrium in a single population	[R]
C901.3	Understand the strategic games between two and more agents in non-cooperative scenario	[U]
C901.4	Apply Game Theory principles in workplace settings	[AP]
C901.5	Identify externals enforcement of cooperative behavior in coalitional Games.	[AP]
C901.6	Develop the applications of Bayesian Games and extensive games	[AP]

Course Contents:

Introduction to Game Theory **15 Hours**

Theory of rational choice, Nash Equilibrium, Strategic games, the Prisoner's Dilemma, the stag Hunt, Matching Pennies, Best response functions, Dominated actions, Equilibrium in a single population: symmetric games and symmetric equilibria, Cournot's model of oligopoly, Bertrand's model of oligopoly, Electoral competition, The war of Attrition, Accident law.

Mixed Strategy Equilibrium **15 Hours**

Strategic games in which players may randomize, Mixed strategy Nash equilibrium, Dominated actions, Pure equilibria in randomization. Equilibrium in a single population, Extensive games with perfect information: strategies and outcomes, subgame perfect equilibrium, backward induction, the ultimatum game, stackelberg's model of duopoly, Coalitional Games and the Core.

Games with Variants and Extensions **15 Hours**

Bayesian Games, Extensive games with Imperfect Information, strictly competitive games and Max minimization, Bargaining, Repeated games- Finitely repeated Prisoner's Dilemma, infinitely repeated Prisoner's Dilemma and its strategies.

Total Hours	**45**

Text Books:

1.	Akio Matsumoto, Ferenc Szidarovszky, "Game Theory and Its Applications", Springer Japan, 2016.
2.	Martin Osborne, "An Introduction to Game Theory", Oxford University Press, 2003.

Reference Books:

1.	Avinash Dixit and Susan Skeath "Games of Strategy", 2nd Edition McGraw Hill Education India Private Ltd., 2013
2.	Leyton- Brown, K Shoham, "Essentials of Game Theory: A Concise, Multidisciplinary Introduction", Morgan & Claypool Publishers, 2008

Web References:	
1.	https://www.economics.utoronto.ca/osborne/igt/index.html
2.	https://cs.stanford.edu
3.	https://ocw.mit.edu/courses/economics/14-126-game-theory-spring-2016/download-course-materials/

Online Resources:	
1.	https://www.coursera.org/learn/game-theory-1
2.	https://www.coursera.org/learn/game-theory-2
3.	https://nptel.ac.in/noc/courses/noc21/SEM2/noc21-mg50/
4.	https://nptel.ac.in/noc/courses/noc21/SEM2/noc21-ge24/

Tentative Assessment Methods & Levels (based on Revised Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks: 20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C901.1	Understand	Online Quiz	3
C901.2	Remember	Online Quiz	3
C901.3	Understand	Assignment	4
C901.4	Apply	Problem Solving	4
C901.5		Assignment	3
C901.6		Case Study	3

Summative assessment based on Continuous and End Semester Examination

Revised Bloom's Level	Continuous Assessment – Theory			End Semester Examination (Theory) [50 marks]
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]	
Remember	20	40	20	20
Understand	80	40	40	40
Apply	-	20	40	40
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

Course Outcomes (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C901.1	3	3	1									1	3	-	-
C901.2	3	2	2									2	2	-	-
C901.3	3	3	2									2	3	1	2
C901.4	3	2	2									-	2	1	1
C901.5	3	2	3									2	2	2	-
C901.6	3	2	3									2	2	1	1

20IT902	DISTRIBUTED SYSTEMS	3/0/0/3
Nature of Course	D (Theory Application)	
Pre requisites	Data Communication and Computer Networks / Computer Networks	
Course Objectives:		
1.	To understand the basics of networking and the protocols used in distributed environment.	
2.	To have a basic understanding of the principles and practice in the area of Distributed Systems.	
3.	To evaluate the impact of memory on parallel/distributed algorithm formulations and validate their performance.	
4.	To gain knowledge on deadlock and how it is resolved in distributed system.	
5.	To gain knowledge of how to design and implement distributed algorithms.	
Course Outcomes		
Upon completion of the course, students shall have ability to		
C902.1	Describe the basic principles of Distribution System and classify the system models.	[U]
C902.2	Illustrate different communication methods applied in Distributed System.	[A]
C902.3	Apply clock synchronization concepts and mutual exclusion in distributed transaction.	[AP]
C902.4	Apply distributed deadlock methods to solve real-time problems.	[AP]
C902.5	Infer the architecture, design and implementation of distributed shared memory.	[A]
C902.6	Implementation of distributed algorithms in synchronous and Asynchronous network models.	[AP]

Course Contents:

Introduction **15 hours**

Definition of a distributed systems, Examples, Resource sharing and the Web, Challenges, System models, Architectural and fundamental models, Networking Interprocess communication, External data representation and marshalling, Client-server and Group communication. Communication - Introduction to Message Passing, Advantages and features of message passing, Message format, Message Buffering, Remote Procedure Call, Extended RPC Models, Remote Object Invocation, Message Oriented Communication.

Processes and Synchronization **15 hours**

Threads, code migration, clock synchronization, logical clocks, global state, Election algorithms, mutual exclusion, Distributed transaction. **Distributed Deadlock Detection** System model, Resources vs. communication deadlocks, deadlock prevention, avoidance, detection and resolution, Centralized deadlock detection, distributed deadlock detection, path pushing and edge chasing algorithm. **Case Study:** Hadoop Distributed File System (HDFS)

Distributed Shared Memory **15 hours**

Introduction, General architecture of distributed shared memory, Design and implementation, Issues of DSM, Granularity, structure of shared memory space, consistency models, thrashing, advantages of DSM **Distributed Coordination:** Importance, Ordering of Events, Logical clock, Vector clock, protocols for ordering of messages. **Distributed Algorithms** - Synchronous network model - Algorithms: leader election, - Asynchronous network model - Asynchronous network algorithms: leader election in a ring and an arbitrary network. Case Study: CORBA (CORBA RMI and Services).

Total Hours	**45**

Text Books:	
1.	Andrew Tanenbaum, Maarten Van Steen, "Distributed System- Principals Paradigm", Maarten van Steen Publication, 2nd Edition, 2016.
2.	Singhal and Shivratri, "Advanced Concept in Operating Systems", McGraw Hill, 1st Edition, 2017.
Reference Books:	
1.	Sunita Mahajan, Seema Shah, “Distributed Computing”, Oxford University Press, 2nd Edition, 2013.
2.	Pradeep K. Sinha “Distributed Operating Systems: Concepts and Design”, Prentice Hall of India Private, 2012.
Web References:	
1.	https://nptel.ac.in/courses/106/106/106106107/
2.	https://onlinecourses.nptel.ac.in/noc21_cs87/preview
3.	https://online.stanford.edu/courses/cs244b-distributed-systems
Online Resources:	
1.	https://www.wiziq.com/tutorials/distributed-computing
2.	https://www.youtube.com/watch?v=Y6Ev8GIlbxc
3.	https://www.youtube.com/watch?v=Azyizl9w2xo
4.	https://www.youtube.com/watch?v=dX2PSA0si5g
5.	https://blog.stackpath.com/distributed-system
6.	https://www.geeksforgeeks.org/introduction-to-distributed-computing-environment-dce

Tentative Assessment Methods & Levels (based on Revised Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks: 20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C902.1, C902.2, C902.3	Understand	Quiz	10
C902.4, C902.5, C902.6	Apply	Assignment	10

Summative assessment based on Continuous and End Semester Examination

Revised Bloom’s Level	Continuous Assessment Theory			End Semester Examination (Theory) [50 marks]
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]	
Remember	20	10	10	20
Understand	30	25	35	30
Apply	30	45	35	30
Analyse	20	20	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

Course Outcomes (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C902.1	2	1										2			1
C902.2	2	2		2								2	2	2	1
C902.3	3	3		3	2					1		2	2	2	1
C902.4	3	3	1	3	2							2	3	2	1
C902.5	3	3		3	1							2	3	2	1
C902.6	3	3	1	3	1					2		2	3	2	2

20IT903	NETWORK PROGRAMMING	3/0/0/3
Nature of Course	D (Theory Application)	
Pre requisites	Data Communication and Computer Networks	

Course Objectives:

1.	To recall the services of various network architectures.
2.	To identify the basic functionalities of TCP, UDP and SCTP.
3.	To understand the concept about Wireless networks, protocol stack and standards
4.	To demonstrate different tools to develop and analyze network applications.

Course Outcomes

Upon completion of the course, students shall have ability to

C903.1	Recall the features of Network Environment	[R]
C903.2	Explain the fundamental concept of network communication protocols	[U]
C903.3	Demonstrate detailed knowledge of the TCP/UDP sockets	[U]
C903.4	Understand the different wireless networks available and their applications.	[U]
C903.5	Choose various socket functionalities to develop different applications.	[AP]
C903.6	Apply different network applications using various tools	[AP]

Course Contents:

Communication Protocols and Client Server Programming: 15 Hours

Communication Protocols- IPv4, IPv6, ICMPv4, and ICMPv6 -The Transport Layer- TCP-UDP-SCTP- TCP Connection Establishment and Termination- TIME_WAIT State- SCTP Association Establishment and Termination- - Application Development: TCP Echo Server, TCP Echo Client, POSIX data type, POSIX Signal Handling, TCP Echo Server – Server with multiple clients- Boundary Conditions- Server Process Crashes- Server Crashes and Reboots- Server Shutdown- I/O Multiplexing- I/O Models- TCP echo client/server with I/O Multiplexing

Wireless Networks: 15 Hours

IEEE802.16 and WiMAX – Security – Advanced 802.16 Functionalities – Mobile WiMAX - 802.16e – Network Infrastructure – WLAN – Configuration – Management Operation – Security – IEEE 802.11e and WMM – QoS – Comparison of WLAN and UMTS – Bluetooth – Protocol Stack – Security – Profiles

Network Programming in UNIX C: 15 Hours

Socket address structures – Byte ordering and byte manipulation functions – Elementary TCP sockets – socket, connect, bind, listen, accept and close functions – TCP client and server – Elementary UDP sockets –recvfrom and sendto functions, connect function with UDP – Raw sockets – Client-server design alternatives – Iterative and Concurrent servers. Case Study- Network Analysis Tool (Wireshark, NS2, Fluentd, Network Miner, The Dude)

Total Hours	**45**

Text Books:

1.	W Richard Stevens, Bill Fenner, Andrew M Rudoff, "UNIX network programming. Vol. 1, The sockets networking API", Addison-Wesley, 3rd Edition, 11th reprint, 2015
2.	William Stallings, "Wireless Communications and Networks", 2nd Edition, Elsevier 2014.
3.	D.E.Comer, "Internetworking with TCP/IP Client-Server Programming and Applications - Vol. 3, 2nd Edition, Pearson Edition, 2015.

Reference Books:

1.	William Stallings, "SNMP, SNMPv2, SNMPv3 and RMON 1 and 2", 3rd Edition, Pearson Edition, 2009.

2.	Anurag Kumar, D.Manjunath, Joy kuri, “Wireless Networking”, 1st Edition, Elsevier 2011.

Web References:

1.	https://www.csd.uoc.gr/~hy556/material/tutorials/cs556-3rd-tutorial.pdf
2.	https://www.ibm.com/docs/en/i/7.1?topic=communications-socket-programming
3.	https://www.tutorialspoint.com/unix_sockets/what_is_socket.htm

Online Resources:

1.	https://www.coursera.org/courses?query=socket%20programming
2.	https://www.udemy.com/topic/Socket-Programming/
3.	https://www.digimat.in/nptel/courses/video/106105183/L25.html
4.	https://www.youtube.com/watch?v=LtXEMwSG5-8

Tentative Assessment Methods & Levels (based on Revised Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks: 20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C903.1	Remember	Assignment	10
C903.2, C903.3	Understand	Online Quiz	5
C903.4, C903.5, C903.6	Understand, Apply	Online Quiz	5

Summative assessment based on Continuous and End Semester Examination

Revised Bloom’s Level	Continuous Assessment			End Semester Examination (Theory) [50 marks]
	Theory			
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]	
Remember	20	25	20	30
Understand	30	25	20	20
Apply	50	50	60	50
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

Course Outcomes (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C903.1	3	3	3	2	3	1					3	3	3	2	2
C903.2	3	3	3	2	3	2					3	3	3	2	1
C903.3	3	3	3	2	3	2					3	3	3	3	1
C903.4	3	3	3	2	3	2					3	3	3	3	1
C903.5	3	3	3	2	3	1					3	3	3	3	2
C903.6	3	3	3	2	3	2					3	3	3	3	2

20IT904	MOBILE ADHOC NETWORKS	3/0/0/3
Nature of Course	C (Theory Concept)	
Pre requisites	Data Communications and Computer Networks	

Course Objectives:

1.	Analyse the features and challenges in ad-hoc networks.
2.	Understand the protocols and scheduling mechanisms used at the MAC layer.
3.	Summarize the types of routing protocols used in network and transport layer.
4.	Evaluate the energy management and QoS schemes used in ad hoc networks.
5.	Identify the security issues and cross layer integration used in ad-hoc networks.

Course Outcomes

Upon completion of the course, students shall have ability to

C904.1	Outline the challenges in ad-hoc networks.	[U]
C904.2	Analyze the protocols and scheduling mechanisms used at the MAC layer.	[A]
C904.3	Summarize the different routing protocols used in network and transport layers.	[U]
C904.4	Apply the energy management and QoS techniques in various real time environments.	[AP]
C904.5	Identify the issues related to security and cross layer integration.	[AP]
C904.6	Analyze the current technology trends for the implementation and deployment of ad-hoc networks.	[A]

Course Contents:

Introduction to Ad Hoc networks and MAC Protocols **15 Hours**

Definition, characteristics- features, applications. Characteristics of Wireless channel, Adhoc Mobility Models: - entity and group models.MAC Protocols: design issues, goals and classification. Contention based protocols; Reservation based protocols, Scheduling algorithms-MAC protocols using directional antennas; IEEE standards: 802.11g, 802.15, HIPERLAN.

Network and Transport Layer Protocols **15 Hours**

Addressing issues in ad hoc network, Routing Protocols: Design issues, goals and classification. Proactive Vs reactive routing, Unicast routing algorithms, Multicast routing algorithms, Broadcast routing, Geocast routing in MANET, hybrid routing algorithm, Power/ Energy aware routing algorithm, Hierarchical Routing, QoS aware routing, AODV routing protocol, Routing path discovery. Transport layer: Issues in designing- Transport layer classification, ADHOC transport protocols.

Security Issues and Cross layer Integration **15 Hours**

Security issues in Ad hoc networks: issues and challenges, network security attacks- Black hole, warm hole, grey hole, secure routing protocols. Need for cross layer design, cross layer optimization, parameter optimization techniques, Co-operative networks: - Architecture, methods of cooperation, co-operative antennas, Integration of Ad hoc network with other wired and wireless networks. Case study on Intrusion Detection Techniques in MANET, Case study on Hostile Environment, Case Study on Disaster Scenarios.

Total Hours	**45**

Text Books:

1.	C.Siva Ram Murthy, B.S.Manoj, “Adhoc Wireless Networks Architectures and protocols”, 2nd Edition, Pearson Education. Fourteenth Impression, 2012.
2.	Carlos De Morais Cordeiro, Dharma Prakash Agrawal “Ad Hoc & Sensor Networks: Theory and Applications”, World Scientific Publishing Company, 2011.
3.	Mohammad Ilyas, “The Handbook of Ad Hoc Wireless Networks”, CRC Press,2017.

4.	Stefano Basagni, Marco Conti, Silvia Giordano and Ivan stojmenovic, “Mobile adhoc networking”, Wiley-IEEE press, 2004.
5.	Xiuzhen Cheng, Xiao Huang, Ding Zhu DU,” Ad hoc Wireless Networking”, Kluwer Academic Publishers, 2004.
Reference Books:	
1.	Ozan K. Tonguz and Gianguigi Ferrari, John Wiley, “Ad hoc Wireless Networks”, Wiley Publications, 2006.
2.	Jaime Lloret Mauri, Jesús Hamilton Ortiz, Jonathan Loo, “Mobile Ad Hoc Networks Current Status and Future Trends” CRC Press, 2016.
3.	T. Camp, J. Boleng, and V. Davies “A Survey of Mobility Models for Ad Hoc Network Research,” Wireless Communication and Mobile Comp., Special Issue on Mobile Ad Hoc Networking Research, Trends and Applications, vol. 2, no. 5, 2002, pp. 483–502.
4.	Prasant Mohapatra, Srikanth Krishnamurthy, “AD HOC NETWORKS Technologies and Protocols”, Springer US, 2005.
5.	V.Kawadia and P.P.Kumar, “A cautionary perspective on Cross-Layer design”, IEEE Wireless commn.,vol 12, no 1, 2005.
Web References:	
1.	https://www.it.iitb.ac.in/~sri/talks/manet.pdf
2.	https://www.geeksforgeeks.org/introduction-of-mobile-ad-hoc-network-manet/
3.	https://www.javatpoint.com/mobile-adhoc-network
4.	https://www.sciencedirect.com/topics/computer-science/mobile-ad-hoc-network
Online Resources:	
1.	https://www.coursera.org/lecture/iot/lecture-3-2-manets-ED6nz
2.	https://nptel.ac.in/courses/106105160/
3.	https://www.classcentral.com/course/swayam-wireless-ad-hoc-and-sensor-networks-7888

Tentative Assessment Methods & Levels (based on Revised Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks: 20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C904.1	Understand	Quiz	10
C904.2, C904.6	Analyze	Assignment	5
C904.5, C904.4, C904.3	Apply	Assignment	5

Summative Assessment based on Continuous and End Semester Examination

Revised Bloom’s Level	Continuous Assessment Theory			End Semester Examination (Theory) [50 marks]
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]	
Remember	-	-	-	-
Understand	40	30	-	20
Apply	-	70	80	60
Analyse	60	-	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

Course Outcomes (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C904.1	3	3	2	2	2						3	2	3	3	2
C904.2	3	3	3	3	2						2	2	2	3	1
C904.3	3	3	3	3	2						2	2	2	3	2
C904.4	3	3	3	2	2						2	1	1	2	2
C904.5	3	3	3	2	2						2	2	2	2	2
C904.6	3	3	3	3	2						2	2	2	3	1

20IT905	ADVANCED MOBILE COMMUNICATION	3/0/0/3
Nature of Course	C (Theory Concept)	
Pre requisites	Fundamentals of Data and Mobile Communication	

Course Objectives:

1.	To understand the basics of wireless communication and cellular networks
2.	To study the popular cellular networking technologies.
3.	To learn the architecture of Mobile OS
4.	To explore various protocols that support mobility at different layers.
5.	To be familiar with mobile security and its applications.

Course Outcomes

Upon completion of the course, students shall have ability to

C905.1	Recall the basics of mobile telecommunication systems	[R]
C905.2	Interpret the architecture and protocols of 3G and 4G cellular system.	[U]
C905.3	Illustrate the characterization and architecture of Mobile OS	[U]
C905.4	Identify a routing protocol for a given network through the functionality of Network layer	[AP]
C905.5	Apply the functionality of Transport and Application layers	[AP]
C905.6	Outline the Security aspects and business trends impacting mobile applications	[U]

Course Contents:

Mobile Communication Technologies: **15 Hours**

Introduction: Basics of Communication technologies - Generations of Cellular Communication technologies. **3G Cellular Networks**: 3GPP – UMTS and IMT-2000: Architecture, User Equipment. **4G Cellular Networks**: 3G Vs 4G – LTE – Control Plane – NAS and RRC – User Plane – PDCP, RLC And NAC – IMT– Advanced Standard – Features Of LTE Advanced.**5G Cellular Networks** : 4G Vs 5G – Benefits – 5G Use cases. **6G Cellular Networks :** Overview.

OS Architecture and Layers of Mobile Network: **15 Hours**

OS Architecture : Android, iOS and Harmony OS **Mobile Network layer** : Mobile IP – DHCP – AdHoc– Proactive protocol-DSDV, Reactive Routing Protocols – DSR, AODV , MANET Vs VANET .**Mobile Transport layer** : Mobile TCP– WAP – Architecture – WDP – WTLS – WTP –WSP – WAE – WTA Architecture – WML

Mobile Databases and Applications: **15 Hours**

Mobile databases: Issues in transaction processing, Transaction processing in Mobile environment, Mobile transaction models, Two-phase commit protocol, Query processing, Recovery. **Mobile Applications**: M-Commerce – Structure – Pros & Cons – Mobile Payment System Architecture, Security in Android, iOS and Harmony OS.

Total Hours	**45**

Text Books:

1.	Prasant Kumar Pattnaik, Rajib Mall, “Fundamentals of Mobile Computing”, 2nd Edition, PHI Learning Pvt. Ltd, New Delhi, 2016.
2.	Jochen Schiller, “Mobile Communications”, 2nd Edition, Pearson, 2009.

Reference Books:

1.	Paul Bedell, “Cellular Networks: Design and Operation – A real world Perspective”, Outskirts Press, 2014.
2.	Valentino Lee, Heather Schneider, and Robbie Schell “Mobile Applications: Architecture, Design, and Development “, Prentice Hall, 2004.

3.	Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, “Principles of Mobile Computing“, Springer, 2003.
4.	Reza B’Far, “Mobile Computing principles”, Cambridge University Press, 2005.

Web References:

1.	https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-452-principles-of-wireless-communications-spring-2006/
2.	https://www.intel.com/content/www/us/en/wireless-network/what-is-5g.html
3.	http://developer.android.com/index.html
4.	http://developer.apple.com
5.	https://consumer.huawei.com/en/harmonyos/

Online Resources:

1.	http://nptel.ac.in/courses/117104099/
2.	https://www.udemy.com/course/telecommunications-mobile-networks/
3.	https://www.edx.org/course/4g-network-essentials
4.	https://www.edx.org/course/understanding-wireless-technology-economics-and-po

Tentative Assessment Methods & Levels (based on Revised Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks: 20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C905.1	Remember	Assignment	3
C905.2, C905.3	Understand	Online Quiz	7
C905.4, C905.5	Apply	Online Quiz	6
C905.6	Understand	Case Study	4

Summative assessment based on Continuous and End Semester Examination

Revised Bloom’s Level	Continuous Assessment Theory			End Semester Examination (Theory) [50 marks]
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]	
Remember	40	20	20	20
Understand	60	40	30	40
Apply	-	40	50	40
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

Course Outcomes (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C905.1	3	1	3	2								1	1	1	
C905.2	3	1	3	3								2	2	2	
C905.3	3	2	1	2								2	3	2	
C905.4	2	2	3	3			2					2	3	2	2
C905.5	2	1	2	2			2					1	2	1	
C905.6	3	1	3	2								1	2	2	

20CS602	CRYPTOGRAPHY AND NETWORK SECURITY	3/0/0/3
Nature of Course:	G (Theory Analytical)	
Pre requisites:	Data Communications and Computer Networks	

Course Objectives:

1.	To interpret the security goals of cryptography.
2.	To identify the different types of modern cryptographic techniques.
3.	To illustrate public key encryption and hash functions.
4.	To analyze email security, IP security and web security.

Course Outcomes:

Upon completion of the course, students shall have ability to

C602.1	Discuss OSI security architecture and classical encryption techniques.	[U]
C602.2	Apply the Symmetric and Asymmetric Cryptographic algorithms in real-time examples	[AP]
C602.3	Examine the applications of Cryptographic Hash Functions and Message Authentication Codes	[AP]
C602.4	Develop a model for Digital signature system and authentication system	[AP]
C602.5	Apply techniques to enhance the security in different applications and networks	[AP]

Course Contents:

MODULE I Introduction **15 Hours**

Concepts of Cyber security– CIA Triad – OSI Security Architecture (attacks, services, mechanisms)- Cryptography - Network Security - Trust and Trustworthiness – Classical Encryption techniques - Symmetric ciphers - Substitution Techniques - Transposition Techniques- Data Encryption Standard – DES example - The Strength of DES - Block Cipher Design Principles -Advanced Encryption Standard, AES Structure-AES Transformation Functions- AES Key Expansion – AES Example- Multiple Encryption and Triple DES

MODULE II Public-Key Encryption and Hash Functions **15 Hours**

Fermat's and Euler's theorem - Testing of primality -The Chinese remainder theorem - Public Key Cryptography: RSA- The RSA Algorithm - Diffie-Hellman (ElGamal) - Elliptic curve arithmetic - Elliptic curve cryptography - Cryptographic Hash Functions - Applications of Cryptographic Hash Functions - Two Simple Hash Functions - Secure Hash Algorithm (SHA) - SHA 3 - Message Authentication Codes – Requirements – Functions - MACs Based on Hash Functions: HMAC.

MODULE III Network Security Applications **15 Hours**

Digital Signatures: Introduction **-**ElGamal / Schnorr Digital Signature Scheme
Authentication Applications: Remote User-Authentication Principles - Kerberos - **Transport-Level Security:** Web Security Considerations **-** Transport Layer Security – HTTPS - Secure Shell (SSH)- **Wireless Network Security**: Wireless Security - Mobile Device Security- **IP Security**: Policy - Architecture - Authentication header - Encapsulating security payloads - **Network Endpoint Security**: Firewalls - Intrusion Detection Systems - Malicious Software - Distributed Denial of Service Attacks
Case Study: Hardening CISCO Devices based on Cryptography and Security Protocols.

Total Hours:	**45**

Text Books:

1.	William Stallings, "Cryptography and Network Security - Principles and Practice", 8th Edition, Pearson, 2020.

Reference Books:	
1.	Behrouz A. Forouzon, “Cryptography and Network Security”, 3rd Edition, Tata McGraw Hill, 2015.
2.	Atul Kahate, “Cryptography and Network Security”, 3rd edition, Tata McGraw-Hill, 2013.

Web References:	
1.	https://crypto.stanford.edu/~dabo/cs255/syllabus.html
2.	http://www.iitg.ac.in/icdcn2006/isg.pdf
3.	http://www.tutorialspoint.com/cryptography/
4.	https://blockgeeks.com/guides/what-is-blockchain-technology/
5.	https://www.kaspersky.com/resource-center/definitions/what-is-cryptocurrency
6.	https://ieeexplore.ieee.org/document/6527783 - Lightweight cipher implementations on embedded processors.
7.	https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3523710
Online Resources:	
1.	https://onlinecourses.nptel.ac.in/noc18_cs07/preview
2.	http://www.nptelvideos.in/2012/11/cryptography-and-network-security.html
3.	http://freevideolectures.com/Course/3027/Cryptography-and-Network-Security
4.	https://www.coursera.org/learn/crypto
5.	https://www.youtube.com/playlist?list=PL96A74njP_C8arW6NeU1o0e1NKjAWj0HA

Assessment Methods & Levels (based on Blooms’ Taxonomy)

Formative assessment based on Capstone Model (Max.Marks:20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C602.1 & C602.2	Understand	Quiz	5
C602.3 & C602.4	Apply	Assignment	5
C602.5	Apply	Case Study	10

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment			End Semester Examination (50)
	CIA1 (10)	CIA2 (10)	CIA3 (10)	
Remember	20	-	10	20
Understand	40	40	30	30
Apply	40	60	60	50
Analyze	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

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**
C602.1	3	1										2			1
C602.2	3	2	1	2								2	2	2	1
C602.3	3	3	1	3	2							2	2	2	1
C602.4	3	3	1	3	2							2	3	2	1
C602.5	3	3	1	3	1							2	3	2	1
C602	**3**	**3**	**1**	**3**	**2**							**2**	**3**	**3**	**1**

20CS902	FAULT TOLERANT COMPUTING	3/0/0/3
Nature of Course	C (Theory Concept)	
Pre requisites	Computer Architecture	

Course Objectives:

1.	To provide fundamental concepts of fault tolerance systems.
2.	To describe basic techniques for achieving fault tolerance in hardware.
3.	To discuss fault tolerance in networks.
4.	To illustrate software fault tolerance systems.
5.	To develop skills in modeling and evaluating fault tolerant architectures in Real time systems.

Course Outcomes:

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

C902.1	Express the need for fault tolerance systems and Information redundancy.	[U]
C902.2	Identify the internal technologies of fault tolerance in hardware.	[U]
C902.3	Examine the fault tolerant methodologies in networks.	[AP]
C902.4	Administer the behavior of various software faults.	[AP]
C902.5	Illustrate fault tolerant architectures in Real time systems.	[A]

Course Contents:

MODULE I Information Redundancy **15 Hours**

Introduction: Definition of Fault Tolerance - Fault Tolerance and Redundancy - Applications of Fault Tolerance - Dependability Attributes - Dependability Impairments - Measures of Dependability - Dependability Modeling and evaluation. **Information Redundancy:** Error Detection/Correction Codes Encoding/Decoding circuits - Resilient Disk Systems.

MODULE II Fault-Tolerance in Hardware and Networks **15 Hours**

Hardware Fault-Tolerance: Canonical and Resilient Structures - Reliability Evaluation Techniques and Models - Processor-level Fault Tolerance - Byzantine Failures. **Fault-Tolerant Networks:** Network Topologies and their Resilience - Fault-tolerant Routing.

MODULE III Fault-Tolerance in Software and Real Time Systems **15 Hours**

Software Fault-Tolerance: Single-Version Fault Tolerance - N-Version Programming - Recovery Approach - Exception Handling - Reliability Models. Optimal Checkpointing - Checkpointing in Distributed and Shared-memory Systems. **Fault Tolerance in Real Time Systems:** Non-stop systems - Stratus systems - Cassini command and data sub system - IBM G5 – Itanium – Monitoring – Disaster Recovery.**Case Study:** Fault tolerance in Cloud – Hot and Cold Storage.

Total Hours	**45**

Text Books:

1.	Israel Koren and C. Mani Krishna, Fault-Tolerant Systems, Morgan-Kaufman Publishers, 2020.
2.	Elena Dubrova, Fault-Tolerant Design, Springer, 2013.

Reference Books:

1.	Kishor S. Trivedi; Probability and Statistics with Reliability, Queuing and Computer Science Applications; John Wiley & Sons Inc., 2016.
2.	Shooman, Martin, Reliability of Computer Systems and Networks: Fault Tolerance, Analysis, and Design, Wiley Interscience, 2008.

Web References:

1.	http://ieeexplore.ieee.org/document/56849/

2.	https://cs.stanford.edu/people/eroberts/courses/soco/projects/2003-04/fault-tolerant-computing/why.html
Online Resources:	
1.	https://www.coursera.org/lecture/blockchain-business-models/byzantine-fault-tolerance-5mOug
2.	https://www.coursera.org/lecture/big-data-essentials/fault-tolerance-live-demo-A8VUM

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C902.1 & 2	Understand	Quiz	5
C902.3 & 4	Apply	Assignment	5
C902.5	Analyse	Case study	10

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment(30)			End Semester Examination [50 marks]
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]	
Remember	20	20	10	10
Understand	30	40	40	40
Apply	50	40	30	30
Analyse	-	-	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

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
C902.1	3	3	3		3	2	2	2				2	2	2	2
C902.2	3	3	2		2	2	2	2				2	2	2	2
C902.3	3	3	3	2	2	2	2	2	2	2		2	2	2	2
C902.4	3	3	3	2	2	2	2	2	2	2		2	2	2	2
C902.5	3	3	3	2	2	2	2	2	2	2		2	3	2	2

20CS907	CYBER FORENSICS	3/0/0/3
Nature of Course	D (Theory Application)	
Pre-requisites	Cryptography and Network Security	

Course Objectives:

1.	To recognize the security issues in computer networks.
2.	To analyze the role of technology in validating forensics data with analytical tools.
3.	To discuss Email Investigations and Mobile device forensics.
4.	To illustrate the need for ethical hacking.

Course Outcomes:

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

C907.1	Illustrate the basics of computer forensics.	[U]
C907.2	Use computer forensic tools to solve real world problems.	[AP]
C907.3	Examine Email and Mobile devices in forensic perspective.	[AP]
C907.4	Explain Graphics file formats, data compression and copyright issues.	[A]
C907.5	Explore real-world hacking attacks.	[AP]

Course Contents:

MODULE I Introduction to Computer Forensics **15 Hours**

Introduction to Traditional Computer Crime, Traditional problems associated with Computer Crime - Forensics Technology and Systems Understanding Computer Investigation Data Acquisition - Investigation e-mail crimes and Violations - Using specialized E-mail forensics tools - Understanding mobile device forensics and Acquisition procedures - **Ethical Hacking:** Introduction to Ethical Hacking - Foot printing and Reconnaissance - Scanning Networks Enumeration - System Hacking – Malware Analysis - Threats Sniffing.

MODULE II Forensic Tools, Analysis and Validation **15 Hours**

Processing Crime and Incident Scenes Working with Windows and DOS Systems - Current Computer Forensics Tools - Software and Hardware Tools – Wireshark - TCPdump - Validating Forensics Data - Data Hiding Techniques - Performing Remote Acquisition - Network Forensics - Email Investigations- Cell Phone and Mobile Devices Forensics - Cyber Crimes and Offenses - Cyber Security and Policies.

MODULE III Image and Video Forensics **15 Hours**

Recognizing a Graphics File – Data Compression – Locating and Recovering Graphics Files– Identifying Unknown File Formats – Copyright Issues with Graphics – Fraud using image and video – Detection of Fraud in images and video - Installing Kali Linux using Virtual Box – Tor - Proxy chains – VPN - DoS attacks - SLL strip – SIEM.

Total Hours	**45**

Text Books:

1.	Bill Nelson, Amelia Philips, Frank EnFinger, Christopher Steuart, Computer Forensics and Investigations, Cengage Learning, India Edition, 2016.
2.	CEH official Certfied Ethical Hacking Review Guide, Wiley India Edition, 2015.

Reference Books:

1.	Marjie T Britz, “Computer Forensics and Cyber Crime: An Introduction”, 3rd Edition, Prentice Hall, 2013.
2.	John R vacca, “Computer Forensics”, Cengage learning, 2005.
3.	AnkitFadia, “Ethical Hacking”, 2nd Edition, Macmillan India Ltd,2006
4.	MajidYar, “Cybercrime and Society”, SAGE Publications Ltd, Hardcover, 2nd Edition, 2013.

Web References:	
1.	https://resources.infosecinstitute.com/topics/digital-forensics/
2.	http://www.forensiceducation.co.in/courses.html
Online Resources:	
1.	https://onlinecourses.swayam2.ac.in/cec21_ge10/preview
2.	https://www.coursera.org/specializations/computerforensics
3.	https://www.edx.org/course/computer-forensics

Assessment Methods & Levels (based on Blooms'Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C907.1	Understand	Quiz	5
C907.2 & 4	Analyse	Case Study	10
C907.3 & 5	Apply	Assignment	5

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment (30)			End Semester Examination [50 marks]
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]	
Remember	20	20	20	20
Understand	40	30	30	30
Apply	40	50	50	50
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

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
C907.1	3	3	3	2	1							1	3	2	1
C907.2	3	3	3	2	1							1	3	2	1
C907.3	3	3	3	2	1							1	3	2	1
C907.4	3	3	3	2	1							1	3	2	1
C907.5	3	3	3	2	1							1	3	2	1

20EC921	WIRELESS SENSOR NETWORKS	3/0/0/3
Nature of Course	: C (Theory Concept)	
Course Objectives:		
1	To obtain a broad understanding of wireless sensor networks	
2	To study the challenges and design issues in wireless sensor networks	
3	To focus on network architectures and energy efficiency	
4	To study the concept of Time Synchronization and Localization	
5	To focus on Routing Protocols and Operating Systems	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C921.1	Learn the basics of wireless sensor networks and its applications.	[R]
C921.2	Understand the architecture and elements of wireless sensor networks	[U]
C921.3	Analyze the MAC protocols for wireless sensor networks.	[A]
C921.4	Apply the concept of Synchronization and Localization for sensor networks	[AP]
C921.5	Understand the various routing protocols of wireless sensor networks	[U]
C921.6	Understand the basics of operating systems needed to establish sensor networks	[U]

Course Contents:

Overview of Wireless Sensor Networks: **15 Hours**

Characteristics-Types of Wireless Sensor Networks-Applications. Challenges for Wireless Sensor Networks - Enabling Technologies for Wireless Sensor Networks - Single-Node Architecture**:** Hardware Components - Energy Consumption of Sensor Nodes - Network Architecture: Sensor Network Scenarios - Optimization Goals and Figures of Merit -Design principles for WSNs - GatewayConcepts - Physical Layer and Transceiver design Considerations

Time Synchronization and Localization: **15 Hours**

MAC Protocols for Wireless Sensor Networks - S-MAC - Wakeup radio concepts – Introduction to the time synchronization problem - Protocols based on sender/receiver synchronization - Single-hop localization - Positioning in multi-hop environments - Topology-control: Aspects of topology-control algorithms

Routing Protocols and Operating Systems: **15 Hours**

Energy-Efficient unicast - Broadcast and multicast - Geographic Routing-Operating Systems for Wireless Sensor Networks: Operating System Design Issue - Examples of Operating Systems: TinyOS, Mate, MagnetOS and OSPM - Application specific support: Target detection and tracking.

Total Hours:	**45**

Text Books:

1	Holger Karl and Andreas Willig, “Protocols And Architectures for Wireless Sensor Networks”, John Wiley, 1st Edition, 2015.
2	KazemSohraby, Daniel Minoli and TaiebZnati, “Wireless Sensor Network-Technology, Protocolsand Applications”, John Wiley, 2nd Edition, 2012.

Reference Books:

1	Feng Zhao and Leonidas J. Guibas, “Wireless Sensor Networks - An Information Processing Approach", Elsevier, 1st Edition, 2016.
2	Waltenegus Dargie, Christian Poellabauer, “Fundamentals of Wireless Sensor Networks – Theory and Practice”, John Wiley, 1st Edition, 2017.

3	C.S. Raghavendra, Krishna M. Sivalingam, TaiebZnati, “Wireless Sensor Networks”, Springer,1st Edition, 2010.
Web References:	
1	http://profsite.um.ac.ir/~hyaghmae/ACN/WSNbook.pdf
2	http://ijcttjournal.org/Volume4/issue-8/IJCTT-V4I8P194.pdf
3	profsite.um.ac.ir/~hyaghmae/ACN/WSNbook.pdf
4	https://pdfs.semanticscholar.org/e552/059d73eef06be26fd0e1a1e4118d4f4e4b20.pdf
Online Resources:	
1	https://www.coursera.org/lecture/internet-of-things-history/sensor-networks
2	https://nptel.ac.in/courses/106105160/21
3	https://nptel.ac.in/courses/114106035/37
4	https://www.edx.org/course/computer-networks-internet-kironx-fhlcnx

Assessment Methods & Levels (based on Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C921.1	Remember	Quiz	**3**
C921.2	Understand	Quiz	**3**
C921.3	Analyse	Assignment	**5**
C921.4	Apply	Assignment	**5**
C921.5	Understand	Class Presentation	**2**
C921.6	Remember	Class Presentation	**2**

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment			End Semester Examination [50 Marks]
	CIA1 [10 Marks]	CIA2 [10 Marks]	CIA3 [10 Marks]	
Remember	50	20	30	30
Understand	50	20	30	30
Apply	-	30	20	20
Analyse	-	30	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

Course Articulation Matrix

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
1	2	2	2	2	1	2	2	-	-	-	-	1		3	1
2	3	3	2	3	1	1	3	-	-	-	-	1	2	3	
3	3	3	2	2	1	1	2	-	-	-	-	1		3	1
4	3	3	2	3	1	2	2	-	-	-	-	1	2	3	
5	3	2	2	2	1	2	3	-	-	-	-	1		3	2
6	3	3	2	2	1	1	2	-	-	-	-	1		3	

20IT911	DEEP LEARNING TECHNIQUES	3/0/0/3
Nature of Course	C (Theory Concept)	
Pre requisites	Machine Learning Techniques	

Course Objectives:

1.	To explain the basic concepts of neural networks and deep networks.
2.	To discuss the major architectures of deep networks.
3.	To examine the core concepts in deep architecture tuning.
4.	To demonstrate the applications of deep learning.
5.	To understand the underlying implementations of deep learning models, and techniques for optimization

Course Outcomes

Upon completion of the course, students shall have ability to

C911.1	Classify Neural and Deep Networks.	[U]
C911.2	Discover the appropriate Deep Network Architecture that helps resolve complex problems.	[A]
C911.3	Analyze the performance of a Deep Learning Network.	[A]
C911.4	Apply Deep Learning for solving Real world problems.	[AP]
C911.5	Develop mathematical concepts, numerical algorithms, principles, GPU frameworks, and applications of deep learning.	[AP]
C911.6	Build deep learning neural network models to solve complex and advanced problems.	[AP]

Course Contents:

Foundations of Neural Networks **15 Hours**

Neural Networks – Training Neural Networks – Activation Functions – Loss Functions – Hyper parameters. Fundamentals of Deep Networks – Defining Deep Learning – Common Architectural Principles of Deep Networks – Building Blocks of Deep Networks.

Major Architectures of Deep Networks **15 Hours**

Unsupervised Pre-trained Networks – Convolutional Neural Networks – Recurrent Neural Networks – Stochastic Gradient Descent – Recursive Neural Networks. Tuning Deep Networks – Basic Concepts in Tuning Deep Networks – Matching Input Data and Network Architectures – Relating Model Goal and Output Layers – Working with Layer Count, Parameter Count, and Memory – Weight Initialization Strategies – Using Activation Functions. Case Study: Opinion Mining using Recurrent Neural Networks

Applications **15 Hours**

Large-Scale deep learning – Computer Vision – Speech Recognition – Natural Language Processing – Recommender systems in social networks. Case Study – Applications of Deep Learning in Health care for diagnosis of diseases, Image Classification using Transfer Learning.

Total Hours	**45**

Text Books:

1.	Ian J. Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2017.
2.	Adam Gibson, Josh Patterson, “Deep Learning, A practitioner’s approach”, O’Reilly, 1st Edition, 2017.
3.	Navin Kumar Manaswi, “Deep Learning with Applications Using Python”, Apress, 2018.

Reference Books:	
1.	Aurelien Geron, “Hands-On Learning with Scikit-Learn and Tensorflow”, O’Reilly, 1st Edition, 2017.
2.	Ragav Venkatesan, Baoxin Li, “Convolutional Neural Networks in Visual Computing”, CRC Press, 2018.
3.	Francois Chollet, “Deep Learning with Python”, Manning Publications, 2018
Web References:	
1.	https://home.cs.colorado.edu/~mozer/Teaching/syllabi/DeepLearningFall2017/
2.	http://www.cs.iit.edu/~agam/cs577/index.html
3.	https://online.stanford.edu/courses/cs230-deep-learning
Online Resources:	
1.	https://www.edx.org/course/deep-learning-with-tensorflow
2.	https://datascience.uci.edu/education/data-science-short-courses/
3.	https://onlinecourses.nptel.ac.in/noc19_cs81/preview

Tentative Assessment Methods & Levels (based on Revised Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks: 20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C911.1	Understand	Assignment	5
C911.2, C911.3	Analyze	Online Quiz	5
C911.4, C911.5	Apply	Assignment	5
C911.6	Apply	Case Study	5

Summative assessment based on Continuous and End Semester Examination

Revised Bloom’s Level	Continuous Assessment			End Semester Examination (Theory) [50 marks]
	Theory			
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]	
Remember	-	-	-	-
Understand	20	10	-	10
Apply	40	40	60	50
Analyze	40	50	40	40
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

Course Outcomes (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C911.1	2	3	3	2	2						1	1	1	2	2
C911.2	2	2	2	3	2						1	1	2	3	3
C911.3	3	3	3	3	3						1	1	3	3	3
C911.4	2	2	2	3	2						1	1	1	2	3
C911.5	2	2	2	3	3						1	1	2	1	2
C911.6	2	3	2	3	3						1	1	2	3	3

20IT912	DATA VISUALIZATION TECHNIQUES	3/0/0/3
Nature of Course	G (Theory Analytical)	
Prerequisites	Nil	
Course Objectives:		
1.	To perceive in-depth knowledge on how to represent data with visual analytics as suits the target audience, task and data.	
2.	To equip the students with knowledge of visual encoding design choices for arranging and representing data in an interactive and spatial form.	
3.	To gain an insight into Data Visualization techniques and tools.	
4.	To explore business insights and achieve business goals in the right direction.	
5.	To provide insight and training on designing visualization dashboard that would support decision making on large scale data.	
Course Outcomes		
Upon completion of the course, students shall have ability to		
C912.1	Understand the need for data abstraction and task abstraction and would be able to relate with the various data, datasets associated with different applications.	[U]
C912.2	Apply the various visual analytics techniques available for arranging the different types of data.	[AP]
C912.3	Identify and apply appropriate data visualization techniques given particular requirements imposed by the data.	[A]
C912.4	Employ best practices in data visualization to develop charts, maps, tables and other visual representations of data and would be able to identify the need for reducing and aggregating item-sets.	[U]
C912.5	Apply the different exploratory data analysis techniques on the datasets using Tableau.	[AP]
C912.6	Develop Visualizations and dashboards on Tableau.	[AP]

Course Contents:

Introduction: **15 Hours**

Purpose of visualization, Data Abstraction: Data Types, Dataset types, Attribute types, Semantics, preparing your Data, Survey Data, compute descriptive Statistics, Explore the data visually, Design Standards: Chart Format, Color, Text and Labels Readability, Scales, data Integrity, chart Junk, data density, data richness, Attribution and Design Standard Checklist.

Data Manipulation Techniques: **15 Hours**

Introduction - Pandas, Data Indexing and selection, operating on data, handling missing data, Hierarchical Indexing, combining dataset, Aggregation and Grouping, Pivot tables, String operation Graph Representation: Matplotlib-Line plots, Scatter Plots, Visualizing Errors, Density and Contour plots, Histogram, Customizing Plot legends, Colorbars, Text and Annotation, Three-dimensional Plotting, Geographic data with base map, visualization with seaborn.

Data Visualization using Tableau: **15 Hours**

Exploratory Data Analysis using Tableau Visualizations, Creating basic visualizations- Bar Chart, Geographic map, Crosstab Report, Scatter plot, Line Chart, Connecting to Data, Live Connection, Extract Data, Combine data sources, Join tables, Blend data sources, cross-database join, filtering and sorting data, creating groups and hierarchies, Mapping – Geographic Maps, Filled Maps, Mapping options Heat Map and highlight table, Histograms, Dashboard Development, Design Principles and Interactivity.

Total Hours	**45**

Text Books:	
1.	Sosulski K, “Data Visualization made simple: Insights into Becoming Visual, New York: Routledge, 2019.
2.	Jake VanderPlas “Python Data Science Handbook”, O'Reilly Media, November 2017.
Reference Books:	
1.	Andrea De Mauro, “Data Analytics Made Easy: Analyze and present data to make informed decisions without writing any code”, Packt Publishing Limited, 2021.
2.	Tamara Munzner, “Visualization Analysis and Design”, A K Peters/CRC Press, 1st Edition, December 2014.
3.	Few, Stephen, “Show me the numbers: Designing Tables and Graphs to Enlighten” 2nd Edition. Analytics Press Publishers, 2012.
4.	Mathew Ward, Georges Grinstein and Daniel Keim, “Interactive Data Visualization Foundations, Techniques, Applications”, 2nd Edition, CRC Press, May 2015.
Web References:	
1.	https://datavizproject.com/
2.	https://app.rawgraphs.io/
3.	https://www.datawrapper.de/
4.	https://www.tableau.com/
5.	https://marketing platform.google.com/about/data-studio/
Online Resources:	
1.	Tableau Desktop 10: Students should download and install the free version of tableau for class use here http://www.tableau.com/academics/students
2.	https://learning.oreilly.com/library/view/visualization-analysis-and/9781466508910/
3.	https://www.udacity.com/course/data-visualization-nanodegree--nd197
4.	https://www.udemy.com/course/mastering-the-art-of-data-visualization-2020/
5.	https://www.datacamp.com/courses/data-visualization-for-everyone

Tentative Assessment Methods & Levels (based on Revised Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks: 20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C912.1 & C912.4	Understand	Online Quiz	10
C912.2,C912.5 & C912.6	Analyze	Group Assignment	5
C912.3	Apply	Assignment	5

Summative assessment based on Continuous and End Semester Examination

Revised Bloom’s Level	Continuous Assessment			End Semester Examination (Theory) [50 marks]
	Theory			
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]	
Remember	-	-	-	-
Understand	50	20	30	40
Apply	50	40	40	30
Analyse	-	40	30	30
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

Course Outcomes (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C912.1	2	3	1		1								1	2	2
C912.2	1	2	2		2								2	1	1
C912.3	3	3	3	3	3								3	3	1
C912.4	1	1	2		1								1	1	1
C912.5	2	1	2	2	1								2	1	2
C912.6		2	2		2								1	1	1

20IT913	ARTIFICIAL INTELLIGENCE AND ITS APPLICATIONS	3/0/0/3
Nature of Course	D (Theory Application)	
Prerequisites	Nil	
Course Objectives:		
1.	To understand the concepts of AI and Intelligent Agents.	
2.	To explore Problem-solving using search techniques in AI.	
3.	To Understand Logical Agents and First-Order logic.	
4.	To Explore knowledge Representation issues.	
5.	To Understand concepts of learning from examples.	
Course Outcomes		
Upon completion of the course, students shall have the ability to		
C913.1	Demonstrate a fundamental understanding of the evaluation of Artificial Intelligence (AI) and its foundation.	[U]
C913.2	Summarize the Searching techniques for problem-solving in AI.	[U]
C913.3	Define First-order Logic and chaining techniques for problem-solving.	[R]
C913.4	Build the importance of artificial intelligence and planning in solving real-world problems.	[AP]
C913.5	Examine supervised learning and Neural Networks for solving problems in AI.	[A]
C913.6	Discover an interactive and rational system using appropriate learning techniques also, to measure the level of user satisfaction and efficiency of the expert system and ANN.	[A]

Course Contents:

Introduction: **15 Hours**

What Is AI, the Foundations of Artificial Intelligence, The History of Artificial Intelligence, The State of the Art-Intelligent Agents: Agents and Environments, Good Behaviour: The Concept of Rationality, The Nature of Environments, and The Structure of Agents. Solving Problems by Searching: Problem-Solving Agents, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, A* Algorithm, and Heuristic Functions. Beyond Classical Search: Local Search Algorithms and Optimization Problems, Searching with Nondeterministic Actions and Partial Observations, Online Search Agents, and Unknown Environments. Constraint Satisfaction Problems: Constraint Propagation, Backtracking Search, Local Search, The Structure of Problems.

Logical Agents: **15 Hours**

Knowledge-Based Agents, Propositional Logic, Propositional Theorem Proving, Effective Propositional Model Checking, Agents Based on Propositional Logic. First-Order Logic: Syntax and Semantics, Knowledge Engineering in FOL, Inference in First-Order Logic, Unification and Lifting, Forward Chaining, Backward Chaining, Resolution - Planning: Algorithms, Planning Graphs, Hierarchical Planning, Multi-agent Planning - Knowledge Representation: ontological Engineering, Categories and Objects, Events, Mental Events and Mental Objects, Reasoning Systems for Categories, Reasoning with Default Information, The Internet Shopping World.

Types of Learning: **15 Hours**

Forms of Learning, Supervised Learning, Unsupervised Learning, Learning Decision Trees, Evaluating and Choosing the Best Hypothesis, The Theory of Learning, Regression and Classification with Linear Models, Artificial Neural Networks. Principles of Natural Language Processing Rule Based Systems Architecture - Expert systems-Knowledge acquisition concepts - AI application to robotics – Robotic process automation and its Benefits-Current trends in Intelligent Systems.

Total Hours	**45**

Text Books:	
1.	Russel S, Norvig P, Artificial Intelligence: "A Modern Approach", 4th Edition, Pearson Education, 2020.
2.	Margaret H. Dunham, "Data Mining: Introductory and Advanced Topics", Prentice Hall, 2006.
Reference Books:	
1.	Rich E, Knight K, Nair S B, "Artificial Intelligence", 3rd Edition, Tata McGraw HiII, 2009.
2.	Luger George F, "Artificial Intelligence: Structures and Strategies for Complexproblem solving", 6th Edition, Pearson Education, 2009.
3.	S.BaIakrishnan, J.Janet, "Artificial Intelligence and Expert Systems", LAP Lambert Academic Publishing, 2017.
Web References:	
1.	https://zoo.cs.yale.edu/classes/cs470/materials/aima2010.pdf
2.	https://www.cet.edu.in/noticefiles/271_AI%20Lect%20Notes.pdf
3.	https://www.tutorialspoint.com/artificial_intelligence/
Online Resources:	
1.	https://in.coursera.org/professional-certificates/applied-artifical-intelligence-ibm-watson-ai
2.	https://in.coursera.org/learn/building-autonomous-ai
3.	https://www.udemy.com/course/artificial-intelligence-in-unity/

Tentative Assessment Methods & Levels (based on Revised Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks: 20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C913.1	Understand, Remember	Assignment	10
C913.2, C913.3	Understand	Online Quiz	3
C913.4, C913.5	Apply, Analyse	Online Quiz	3
C913.6	Analyse	Case Study	4

Summative assessment based on Continuous and End Semester Examination

Revised Bloom's Level	Continuous Assessment Theory			End Semester Examination (Theory) [50 marks]
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]	
Remember	20	20	10	10
Understand	80	40	40	40
Apply	-	30	40	40
Analyse	-	10	10	10
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

Course Outcomes (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C913.1	2	3	1	1	1	1							3	2	2
C913.2	1	2	2	2	2	1							2	3	3
C913.3	3	3	3	3	3	2							3	3	3
C913.4	1	1	2	2	1	1							3	3	3
C913.5	2	1	2	2	1	1							2	3	3
C913.6	1	2	2	1	2	1							3	2	3

20IT914	BLOCKCHAIN TECHNOLOGY	3/0/0/3
Nature of Course	C (Theory Concept)	
Prerequisites	Data Communications and Computer Networks	

Course Objectives:

1.	To provide an understanding skill of blockchain technologies
2.	To introduce the technical aspects of cryptocurrencies, blockchain technologies, and distributed consensus.
3.	To enable the students to be aware of Bitcoin and its security features
4.	To make students understand the innovative application models using Blockchain technology. How these systems work and how to engineer secure software that interacts with the Bitcoin network and other cryptocurrencies.

Course Outcomes

Upon completion of the course, students shall have the ability to

C914.1	Extend the emerging abstract models for Blockchain Technology	[U]
C914.2	Build new applications with different tiers of blockchain technology	[AP]
C914.3	Understand the concept of bitcoin and the technological background behind it	[U]
C914.4	Utilize the Bitcoin Security features and its implementation	[AP]
C914.5	Categorize Ethereum and Hyperledger technology	[A]
C914.6	Apply Blockchain concepts in the latest advances and their applications	[AP]

Course Contents:

Introduction to Blockchain **15 Hours**

Introduction to Blockchain- Features of Block Chain-Applications of Blockchain Technology-Types of Block Chain - Benefits and Limitations of Block Chain - Decentralization in Block Chain -Tiers of Blockchain Technology - Blockchain 1.0: Currency - Blockchain 2.0: Contracts - Blockchain 3.0: Justice Applications Beyond Currency, Economics, and Markets.

Bitcoin Security **15 Hours**

Introduction to Bitcoin, History, Transactions, Bitcoin Address-Bit coin Wallet- Bitcoin Network-How to store and use Bitcoin- Structure of a Block, Linking Blocks in the Blockchain, Merkle Trees, Bitcoin's Test Blockchains - Bitcoin Mining- Mining the Block - Mining and the Hashing Race - Bitcoin Security- Security Principles, User Security Best Practices.

Ethereum - Hyperledger and Blockchain Applications **15 Hours**

Introduction to Ethereum Blockchain - Ethereum Virtual Machine (EVM), Transaction-Mining-Ethereum Network -Ethereum Wallets for Ethereum Smart Contracts, Ricardian Contracts-Introduction to Hyperledger- Hyperledger as a Protocol-Fabric- Blockchain Applications - Blockchain in Government -Applications from Building Blocks - Colored Coins - Payment Channels and State Channels. Case Study: Wazirx trading tool.

Total Hours	**45**

Text Books:

1.	Melanie Swan, "Block Chain: Blueprint for a New Economy", O"Reilly, 1st Edition, 2015.
2.	Andreas M. Antonopoulos, "Mastering Bitcoin: Programming the Open Blockchain", O'Reilly, 2016
3.	Imran Bashir, "Mastering Blockchain: Deeper insights into decentralization, Cryptography, Bitcoin", Packt Publishing, 2017.

Reference Books:	
1.	Daniel Drescher, “Block Chain Basics”, Apress; 1st Edition, 2017
2.	Anshul Kaushik, “Block Chain and Crypto Currencies”, Khanna Publishing House, Delhi, 2018
3.	S. Shukla, M. Dhawan, S. Sharma, S. Venkatesan, “Blockchain Technology: Cryptocurrency and Applications”, Oxford University Press,2019
4.	Bikramaditya Singhal, Gautam Dhameja, Priyansu Sekhar Panda “Beginning Blockchain, A Beginner’s Guide to Building Blockchain Solutions”, Apress, 2018.
Web References:	
1.	https://en.wikipedia.org/wiki/Blockchain
2.	http://bitcoinbook.cs.princeton.edu/
3.	https://builtin.com/blockchain
4.	https://j2-capital.com/wp-content/uploads/2017/11/AIR-2016-Blockchain.pdf
Online Resources:	
1.	https://www.tutorialandexample.com/blockchain/
2.	https://faculty.fuqua.duke.edu/~charvey/Teaching/898_2017/syl898.htm
3.	https://www.coursera.org/learn/cryptocurrency
4.	https://onlinecourses.nptel.ac.in/noc22_cs44/preview
5.	https://builtin.com/blockchain/blockchain-applications
6.	https://dl.acm.org/doi/fullHtml/10.1145/3427097
7.	https://j2-capital.com/wp-content/uploads/2017/11/AIR-2016-Blockchain.pdf
8.	https://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/crse0401.html
9.	https://ethereum.org/en/
10	https://www.hyperledger.org/use/tutorials

Tentative Assessment Methods & Levels (based on Revised Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks: 20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C914.1, C914.2	Understand, Apply	Online Quiz	10
C914.3, C914.4	Understand, Apply	Assignment	4
C914.5	Analyse	Assignment	3
C914.6	Apply	Case Study	3

Summative assessment based on Continuous and End Semester Examination

Revised Bloom’s Level	Continuous Assessment – Theory			End Semester Examination (Theory) [50 marks]
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]	
Remember	20	20	25	20
Understand	40	40	25	30
Apply	40	40	30	30
Analyse	-	-	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

Course Outcomes (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C914.1	3	3	1									1	2	2	2
C914.2	3	2	2									2	-	2	2
C914.3	3	3	2									2	2	1	2
C914.4	3	2	2									-	-	1	1
C914.5	3	2	3									2	-	2	2
C914.6	3	2	3									2	2	1	1

20IT915	EVOLUTIONARY COMPUTING	3/0/0/3
Nature of Course	G (Theory Analytical)	
Pre requisites	Nil	

Course Objectives:

1.	To explore a variety of evolutionary approaches for problem solving.
2.	To demonstrate how to apply neural models for problem solving.
3.	To discuss complexity issues for solution methods.
4.	To learn to develop appropriate models for problem solving.
5.	To explore solution approaches and algorithms for determining feasible and optimal solutions.

Course Outcomes

Upon completion of the course, students shall have ability to

C915.1	Recall evolutionary approaches for problem solving.	[R]
C915.2	Apply various evolutionary computation methods and algorithms for particular classes of problems.	[AP]
C915.3	Describe the principles underlying in genetic algorithms.	[U]
C915.4	Illustrate genetic programming and evolutionary programming.	[U]
C915.5	Explain swarm intelligence and multi objective optimization	[U]
C915.6	Examine evolutionary algorithms for real-world applications.	[A]

Course Contents:

Computational Intelligence: **15 Hours**

Foundation of Computational Intelligence, Biological Basis, Classic optimization, Linear Programming- optimality and feasibility. Artificial Neuron, Supervised Learning Neural Networks, Unsupervised Learning Neural Networks, Radial Basis Function Networks, Reinforcement Learning, Performance Issues .

Evolutionary Computation: **15 Hours**

Introduction to Evolutionary Computation.:Generic Evolutionary Algorithm., Representation – The Chromosome , Initial Population, Fitness Function , Selection , Reproduction Operators , Evolutionary Computation versus Classical Optimization. Genetic Algorithms, Genetic Programming, Evolutionary Programming, Evolution Strategies.

Optimization Techniques: **15 Hours**

Swarm Intelligence- Particle Swarm Optimization, Ant Colony Optimization, Fuzzy Systems. Optimizing Evolutionary Algorithms,Pareto optimality. Case study: Combination of GA and NN (COGANN). Application: From Airline Crew Scheduling to Car Crash Optimization.

Total Hours	**45**

Text Books:

1.	A.E. Eiben, J.E. Smith “Introduction to Evolutionary Computing”, Springer, Berlin, 2015.
2.	Andries P. Engelbrecht, “Computational Intelligence”, John Wiley &Sons, 2nd Edition, 2008.

Reference Books:

1.	T. Baeck, D. B. Fogel, and Z. Michalewicz (eds.), “Evolutionary Computation: A Unified Approach", Bradford Books Reprint Edition, 2016.
2.	A.E. Eiben, J.E. Smith, “Introduction to Evolutionary Computing “ (Natural Computing Series), Springer Nature; 2nd Edition, 2015.

3.	X. Yao (ed), “Evolutionary Computation: Theory and Applications”, World Scientific Publ. Co., Singapore, 1999.
4.	Z Michalewicz, “Genetic Algorithms + Data Structures = Evolution Programs”, Springer-Verlag, Berlin, 3rd Edition, 1996.

Web References:

1.	http://www.cs.drexel.edu/~jpopyack/Courses/AI/Wi16
2.	https://courses.cs.washington.edu/courses/cse466/05sp/pdfs/lectures/10-EvolutionaryComputation.pdf

Online Resources:

1.	https://www.udemy.com/course/geneticalgorithm/
2.	https://nptel.ac.in/courses/112103301

Tentative Assessment Methods & Levels (based on Revised Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks: 20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C915.1	Remember	Assignment	5
C915.2	Understand	Presentation	5
C915.3, C915.4	Apply	Online Quiz	5
C915.5, C915.6	Analyze	Case Study	5

Summative assessment based on Continuous and End Semester Examination

Revised Bloom’s Level	Continuous Assessment – Theory			End Semester Examination (Theory) [50 marks]
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]	
Remember	20	20	10	10
Understand	80	30	30	30
Apply	-	30	30	40
Analyse	-	20	20	20
Evaluate	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

Course Outcomes (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C915.1	2	3	1		1								1	2	2
C915.2	1	2	2		2								2	1	1
C915.3	2	2	2	2	2								3	3	1
C915.4	1	1	2		1								1	1	1
C915.5	2	1	2	2	1								2	1	2
C915.6		2	2		2								1	1	1

20IT916	COGNITIVE SCIENCE AND ANALYTICS	3/0/0/3
Nature of Course	H (Theory Technology)	
Pre requisites	Nil	

Course Objectives:

1.	To learn the history and fundamentals of cognitive science.
2.	To demonstrate learning, reasoning and design principles in cognitive systems.
3.	To illustrate the various analytics techniques in cognitive computing.
4.	To develop skills in analyzing, interpreting and assessing the empirical data and research techniques that contributes to cognitive science.

Course Outcomes:

Upon completion of the course, students shall have ability to

C916.1	Recall the basic concepts of cognitive science and its algorithms	[R]
C916.2	Understand the complexities of cognition using neural, social and technological approaches	[U]
C916.3	Practice the Learning, reasoning and designing methodologies in cognitive systems	[AP]
C916.4	Use various Analytics techniques in cognitive systems	[AP]
C916.5	Apply cognitive science theories, concepts to individual, social and cultural issues	[AP]
C916.6	Examine various cognitive applications for social issues	[A]

Course Contents:

Introduction to Cognitive Science **15 Hours**

Introduction: Foundation of Cognitive Science and design principles - Natural language processing in support of a cognitive system - Role of cloud and distributed computing in cognitive computing - Relationship between big data and Cognitive computing - The Business Implications of Cognitive Computing – Case based Reasoning.

Cognitive Systems and Learning **15 Hours**

Concept Learning-Classification Logic-Planning-Understanding Common Sense Reasoning-Scripts. Cognitive Systems and Reasoning- Explanation Based Learning -Analogical Reasoning-Version Spaces-Constraint Propagation Diagnosis-Meta Reasoning

Cognitive System Design Principles & Applications **15 Hours**

Machine Learning Hypothesis -Generation and Scoring-Representing Knowledge taxonomies and Ontologies -Advanced Analytics- Predictive Analytics-Text Analytics - Image Analytics-Speech Analytics Case study- Sensitivity Analysis using AWS services. Applications of cognitive computing - Building a Cognitive Healthcare Application, Smarter cities in Government & Emerging cognitive computing areas.

Total Hours	**45**

Text Books:

1.	S.Hurwitz, M.Kaufman and A.Bowles, "Cognitive Computing and Big Data Analytics", Wiley Publishers, 2015.
2.	Herre van Oostendorp, "Cognition in a Digital World", Publishers: Lawrence Erlbaum Associates, 2003

Reference Books:

1.	Felix Goodson “The Evolution and Function of Cognition” Publishers: Lawrence Erlbaum Associates, 2003

2.	Paul Thaugard, BradFord Book " Mind- Introduction to Cognitive Science", 2nd Edition, MIT Press, 2005.
Web References:	
1.	www.cognitivesciencesociety.org
2.	https://www.shortcoursesportal.conn/search/#q=di-2751lv-short
3.	https://cognitiveclass.ai/learn/cognitive-analytics-ibm
Online Resources:	
1.	https://www.edx.org/learn/cognitive-science
2.	https://ocw.mit.edu/courses/brain-and-cognitive-sciences/
3.	https://swayam.gov.in/course/267-cognitive-science
4.	https://www.coursera.org/courses?query=cognitive%20science
5.	https://www.coursera.org/learn/philosophy-cognitive-sciences

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Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C916.1	Understand	Online Quiz	5
C916.2	Understand	Assignment	5
C916.3, C916.4 & C916.5	Apply	Assignment	5
C916.6	Analyze	Case study	5

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [50 marks]**
	CIA-1 [10 Marks]	**CIA-2 [10 Marks]**	**CIA-3 [10 Marks]**	
Remember	50	-	-	20
Understand	50	50	30	30
Apply	-	50	50	30
Analyze	-	-	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	**Summative Assessment**		**Total**
	Continuous Assessment	**End Semester Examination**	
20	30	50	100

Course Outcomes (CO)	**Programme Outcomes (PO)**												**Programme Specific Outcomes (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C916.1	3		3		3		2					2	3		
C916.2	2			2			3				2	2		2	
C916.3		3			2				2			2	3		
C916.4	3		2			2	3			2		3			3
C916.5	3		2			2	3			2		3			3
C916.6	3		2			2	3			2		3			3

20IT917	DATA WAREHOUSING AND DATA MINING	3/0/0/3
Nature of Course	D (Theory Application)	
Pre requisites	Nil	
Course Objectives:		
1.	To learn the fundamentals of data warehousing and mining.	
2.	To acquire knowledge in data pre-processing and association rule mining.	
3.	To perform data classification and clustering.	
4.	To gain knowledge about the emerging trends in data mining.	
5.	To perform classification and prediction of data.	
Course Outcomes		
Upon completion of the course, students shall have ability to		
C917.1	Understand basics of data warehousing and mining.	[U]
C917.2	Perform data pre-processing.	[AP]
C917.3	Apply association, classification and clustering methods.	[AP]
C917.4	Compare between classification and clustering solutions.	[AP]
C917.5	Analyze data mining techniques for real world problems.	[A]
C917.6	Apply association rule mining techniques for data analysis.	[AP]

Course Contents:

Data Warehousing and Online Analytical Processing: **15 Hours**

Basic Concepts, Warehouse Modeling, Schemas, Data cube, Multidimensional data model, Concept hierarchy, Dimension, Measures, OLAP operations, Starnet query model, Data warehouse design process, Data cube computation, OLAP Indexing, OLAP server architectures, OLAP and OLTP.

Introduction to Data Mining: **15 Hours**

Describe data mining, Related technologies - Machine Learning, Statistics, Stages of the Data Mining Process, Data Mining Techniques, Knowledge Representation Methods, and Applications. **Data preprocessing**: Experiments with H2O and Orange tools. **Data mining knowledge representation**: Task relevant data, Background knowledge, Representing input data and output knowledge, Visualization techniques. **Attribute-oriented analysis**: Attribute generalization, Attribute relevance, Class comparison, Statistical measures.

Data Mining Algorithms: **15 Hours**

Association rule mining: Apriori, FP Growth algorithms. Classification: Inferring rudimentary rules: 1R algorithm, Decision trees, covering rules. Prediction: The prediction task, Bayesian classification, Bayesian networks, Instance-based methods (nearest neighbor), Linear models. Descriptive analytics: Data Modeling, Trend Analysis, Simple Linear Regression Analysis. Clustering: Partitioning methods and Hierarchical methods.

Total Hours	**45**

Text Books:

1.	Jiawei Han, Jian Pei and Hanghang Tong, “Data Mining Concepts and Techniques”, 4th Edition, Elsevier, 2022
2.	Pang-Ning Tan, Michael Steinbach, Anuj Karpatne, Vipin Kumar, “Introduction to Data Mining”, 2nd Edition, Pearson Education, 2021.

Reference Books:	
1.	M. Kantardzic, “Data Mining: Concepts, Models, Methods, and Algorithms”, 3rd Edition, Wiley-IEEE Press, 2019.
2.	Alex Berson, Stephen J Smith, “Data Warehousing, Data Mining, & OLAP”, Tata McGraw-Hill Education, 2017.
3.	K.P. Soman, Shyam Diwakar and V. Ajay, “Insight into Data mining Theory and Practice”, Eastern Economy Edition, Prentice Hall of India, 2014.
4.	Colleen McCue, “Data Mining and Predictive Analysis: Intelligence Gathering and Crime Analysis”, Butterworth-Heinemann, 2007.
Web References:	
1.	https://www.kdnuggets.com/
2.	https://www.datasciencecentral.com/
3.	https://ocw.mit.edu/courses/sloan-school-of-management/15-062-data-mining-spring-2003/lecture-notes/
Online Resources:	
1.	https://onlinecourses.nptel.ac.in/noc21_cs06/preview
2.	https://www.edx.org/course/data-science-wrangling-2
3.	https://www.coursera.org/specializations/data-mining

Tentative Assessment Methods & Levels (based on Revised Bloom’s Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks: 20)			
Course Outcome	**Bloom’s Level**	**Assessment Component**	**Marks**
C917.1	Understand	Online Quiz	2
C917.2, C917.3	Apply	Presentation	4
C917.4, C917.6	Apply	Assignment	7
C917.5	Analyze	Case Study	7

Summative assessment based on Continuous and End Semester Examination

Revised Bloom’s Level	**Continuous Assessment**			**End Semester Examination (Theory) [50 marks]**
	Theory			
	CIA-1 [10 marks]	**CIA-2 [10 marks]**	**CIA-3 [10 marks]**	
Remember	20	20	20	20
Understand	30	20	20	20
Apply	50	30	30	30
Analyse	-	30	30	30
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	**Summative Assessment**		**Total**
	Continuous Assessment	**End Semester Examination**	
20	30	50	100

Course Outcomes (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C917.1	2	3	1		1								1	2	2
C917.2	1	2	2		2	2							2	1	1
C917.3	3	3	3	3	3	1							3	3	1
C917.4	1	1	2		1								1	1	1
C917.5	2	1	2	2	1	3							2	1	2
C917.6	1	2	2	3	3	3							2	2	3

20CS921	SPEECH AND NATURAL LANGUAGE PROCESSING	3/0/0/3

Nature of Course	G (Theory Analytical)
Prerequisites	Theory of Computation / Formal Languages and Automata Theory

Course Objectives:

1	To provide a foundational knowledge in natural language processing methods and strategies.
2	To apply computational semantics in real time applications.
3	To apply the NLP techniques to information retrieval applications
4	To introduce the relevant theory and algorithms for processing human speech.

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

C921.1	Discuss the basics of Natural Language Processing and techniques for grammar-driven natural language parsing.	[U]
C921.2	Apply Computational Semantics, Lexical Semantics and Computational Lexical Semantics for a real world applications.	[AP]
C921.3	Develop useful systems for language processing and related tasks involving text processing.	[AP]
C921.4	Analyse the various steps involved in human speech production and it's processing by a machine.	[A]
C921.5	Demonstrate the ideas behind different speech algorithms and their use.	[AP]

Course Contents:

Module I: INTRODUCTION- Text and Syntactic Analysis **15 Hours**

Basic Text Processing: Regular Expressions, Words, Corpora, Text Normalization - Tokenization, Stemming - N-grams - The role of language models - Simple N-gram models. Estimating parameters and smoothing - Evaluating language models - Part-of- Speech - Tagging - Hidden Markov and Maximum Entropy Models. Formal Grammars of English - Syntactic Parsing – CKY – PCFGs – Inside – Outside Probabilities.

Module II: Semantic Analysis and Applications **15 Hours**

The Representation of Meaning - Computational Semantics - Lexical Semantics - Information Extraction: Named Entity Recognition - Relation Extraction and Timings – Template Filling - Word Senses and WordNet: Relations Between Senses - Word Sense Disambiguation - Alternate WSD algorithms and Tasks - Using Thesauruses to Improve Embeddings - Word Sense Induction . Selection Restrictions - Primitive Decomposition of Predicates. Discourse Coherence - Coherence Relations - Discourse Structure Parsing - Centring and Entity-Based Coherence - Representation learning models for local coherence - Global Coherence. Case study on Chatbots and Dialogue Systems.

Module III: Speech Processing and Applications **15 Hours**

Speech Fundamentals: Articulatory Phonetics – Production and Classification of Speech Sounds; Acoustic Phonetics – acoustics of speech production - The Automatic Speech Recognition Task - Architecture of a large vocabulary continuous speech recognition system – acoustics and language models – ngrams, context dependent sub-word units; Applications and present status. Text-to-Speech Synthesis: Concatenative and waveform synthesis methods, subword units for TTS, intelligibility and naturalness – role of prosody, Applications and present status.

Total Hours	**45**

Text Books:

1.	Daniel Jurafsky, James H. Martin - Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition-Prentice Hall, 3rd Edition, 2021.
2.	Ankur A Patel, Ajay Uppili Arasanipalai, "Applied Natural Language Processing in the Enterprise", O'Reilly , 2021.

3.	J. Eisenstein, “Introduction to Natural Language Processing”, MIT Press, 2019.
Reference Books:	
1.	Hobson Lane, Cole Howard, Hannes Hapke, “Natural Language Processing in Action”, 2019
2.	Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta, Harshit Surana, “Practical Natural Language Processing”, O'Reilly, 2020
Web References:	
1	https://indiaai.gov.in/article/natural-language-processing-nlp-simplified-a-step-by-step-guide
2	https://web.stanford.edu/~jurafsky/slp3/
3	https://www.ed.ac.uk/studying/postgraduate/degrees/index.php?r=site/view&id=290
Online Resources:	
1	https://medium.com/@raftaarrashedin100/introduction-to-natural-language-processing-nlp-72a9fc00af89
2	https://medium.com/@alishashaikh2408/speech-recognition-in-nlp-f5b0700c4570
3	https://nptel.ac.in/courses/106101007

Assessment Methods & Levels (based on Blooms’ Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C921.1	Understand	Quiz	5
C921.2, 3 & 5	Apply	Assignment	5
C921.4	Analyze	Assignment	10

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment (30)			End Semester Examination [50 marks]
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]	
Remember	20	20		20
Understand	40	30	30	30
Apply	40	50	40	30
Analyze			30	20
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
C921.1	3	3	3										3		
C921.2	3	3	3										3		
C921.3	3	3	3	2	1							2	3	2	2
C921.4	3	3	3	2	1							2	3	2	2
C921.5	3	3	3	2	1	2						2	3	2	2

20CS922	DIGITAL IMAGE PROCESSING	3/0/0/3
Nature of Course:	D (Theory Application)	
Prerequisites:	Engineering Mathematics II	

Course Objectives:

1.	To become familiar with digital image fundamentals
2.	To get exposed to simple image enhancement techniques in Spatial and Frequency domain.
3.	To learn concepts of degradation function and restoration techniques.
4.	To study the image segmentation and representation techniques.
5.	To become familiar with image compression and recognition methods

Course Outcomes:

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

C922.1	Acquire the knowledge of basics and fundamentals of digital image processing such as digitization, sampling, quantization, and 2D-transforms.	[U]
C922.2	Operate on images using the techniques of smoothing, sharpening and enhancement.	[U]
C922.3	Apply the restoration concepts and filtering techniques to various applications.	[AP]
C922.4	Apply the basics of segmentation, features extraction, compression and recognition methods for color models for real time applications.	[AP]
C922.5	Analyse the various tools for image enhancement.	[A]

Course Contents:

MODULE I - Introduction to Image Fundamentals and Image Enhancement 15 Hours

Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels – Color image fundamentals – RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms – DFT, DCT. Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering–Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters –Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement.

MODULE II – Image Restoration and Segmentation 15 Hours

Image Restoration – degradation model, Properties, Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering. Segmentation: Edge detection, Edge linking via Hough transform – Thresholding – Region based segmentation – Region growing – Region splitting and merging – Morphological processing- erosion and dilation, Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm.

MODULE III – Image Compression, Recognition and Tools 15 Hours

Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture – Patterns and Pattern classes – Recognition based on matching. Statistical tools - Kalman Filter, Hidden Markov Models High Dynamic Range (HDR) Imaging - Multi-exposure fusion for static and dynamic scenes, low light image enhancement.

Total Hours:	**45**

Text Books:

1.	Rafael C. Gonzalez, Richard E. Woods, “Digital Image Processing”. Pearson, 4th Edition, 2017.

2.	Anil K. Jain, “Fundamentals of Digital Image Processing”, Pearson, 2005.
Reference Books:	
1.	Kenneth R. Castleman, “Digital Image Processing”, Pearson, 2007.
2.	William K. Pratt, “Introduction to Digital Image Processing”, John Wiley, New York, 2013.
Web References:	
1.	https://www.tutorialspoint.com/dip/index.htm
2.	https://www.geeksforgeeks.org/digital-image-processing-basics/
3.	https://www.mygreatlearning.com/blog/digital-image-processing-explained/
4.	https://www.edx.org/learn/image-processing
5.	https://www.udemy.com/topic/image-processing/
6.	https://www.udemy.com/topic/image-processing/
Online Resources:	
1.	https://in.coursera.org/learn/digital
2.	https://nptel.ac.in/courses/117105135

Assessment Methods & Levels (based on Blooms’ Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C922.1 & 2	Understand	Quiz	5
C922.3 & 4	Apply	Assignment	5
C922.5	Analyze	Assignment	10

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment (30)			End Semester Examination [50 marks]
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]	
Remember	30	30	20	20
Understand	40	30	40	40
Apply	10	20	20	20
Analyse	20	20	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

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
C922.1	3	2	3	3	2	3				1	2	1	2	3	2
C922.2	3	3	2		3					3	2	3	2	3	3
C922.3	3	3	3	2	2	1				3	3	3	3	2	2
C922.4	3	3	3	2	2	2				2	2	1	1	1	3
C922.5	3	3	3	3	2	2				1	2	3	1	2	3

20IT921	DATA ANALYSIS USING R	3/0/0/3
Nature of Course	F (Theory Programming)	
Pre requisites	Database Management Systems	
Course Objectives:		
1.	To understand the basics in R programming.	
2.	To understand different data types and data structures in R programming.	
3.	To identify and deal with missing data	
4.	To understand and learn different packages in R programming	
5.	To interface R with other languages like C/C++/Python	
Course Outcomes		
Upon completion of the course, students shall have ability to		
C921.1	Relate the different data structures in R to define the input and output.	[R]
C921.2	Recall the different operations on list and vectors.	[U]
C921.3	Interpret the R programming constructs, control statements and functions.	[U]
C921.4	Demonstrate Linear, nonlinear and Time series models.	[U]
C921.5	Apply graphs to visualize the data.	[AP]
C921.6	Analyze and Interface R with Other programming languages like C/C++/Python.	[A]

Course Contents:

Introduction to R and Data Structures **15 hours**

R Introduction - R Data Structures: Vectors, Scalar, Declarations, recycling, Common Vector operations, Using all and any, Vectorized operations, NA and NULL values, Filtering, Vectorized if-then else, Vector Equality, Vector Element names. Matrix and Arrays: Creating matrices, Matrix operations, Applying Functions to Matrix Rows and Columns - Adding and deleting rows and columns. Lists: Creating lists, General list operations, Accessing List components and values, applying functions to lists, recursive lists. Case Study: Missing values and handling missing values in real dataset using R with imputation techniques.

Data Frames, Factors and Tables **15 Hours**

Data Frames: Creating Data Frames, Matrix-like operations in frames, Merging Data Frames - Applying functions to Data frames. Factors: factors and levels, Common functions used with factors, Working with tables, Other factors and table related functions. R programming Structures: Control statements, Arithmetic and Boolean operators and values, Default values for arguments, Returning values, functions are objects, Environment and Scope Issues, Recursion, Replacement functions — Tools for composing function code. Case study: Exploratory data analysis in R - Voting system using dplyr package.

Simulations in R **15 Hours**

Graphs: Creating Graphs, Customizing Graphs, Saving graphs to files, Creating 3D plots. Interfacing: Interfacing R to other languages - Parallel R - Basic Statistics: Text - Image - Linear Model -Non- linear models - Time Series and Auto-correlation - Clustering - PCA - RDA. Case study to visualize the data using ggplot2.

Total Hours	**45**

Text Books:	
1.	Norman Madoff, “The Art of R Programming: A Tour of Statistical Software Design”, No Starch Press, 2011.
2.	Jared P. Lander, “R for Everyone: Advanced Analytics and Graphics”, Addison-Wesley Data Analytics Series, 2nd Edition,2017.
Reference Books:	
1.	Mark Gardener, " Beginning R - The Statistical Programming Language", Wiley, 2013.
2.	Robert J Knell, “Introductory R: A Beginner's Guide to Data Visualisation, Statistical Analysis and Programming in R”, Amazon Digital South Asia Services Inc, 2014.
Web References:	
1.	https://www.stats.ox.ac.uk/~evans/Rprog/LectureNotes.pdf
2.	https://learn.datacamp.com/courses/free-introduction-to-r
3.	https://www.listendata.com/2016/08/dplyr-tutorial.html
Online Resources:	
1.	https://www.vskills.in/practice/r-programming-practice-questions
2.	https://www.dezyre.com/projects/data-science-projects/data-science-projects-in-r
3.	https://nptel.ac.in/courses/111/104/111104120/

Tentative Assessment Methods & Levels (based on Revised Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks: 20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C921.1	Remember	Assignment	5
		Seminar	
C921.2, C921.3	Understand	Online Quiz	5
C921.4, C921.5	Understand, Apply	Case Study	10
C921.6	Analyze		

Summative assessment based on Continuous and End Semester Examination

Revised Bloom’s Level	Continuous Assessment			End Semester Examination (Theory) [50 marks]
	Theory			
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]	
Remember	20	10	10	10
Understand	40	30	30	20
Apply	20	40	40	40
Analyze	20	20	20	30
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

Course Outcomes (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C921.1	3	3	3	2	2						3	2	3	3	2
C921.2	3	2	2	1	2							3	2	2	1
C921.3	2	3	3	2	3						2	2	3	3	2
C921.4	2	1	3	2	1						2	2	2	2	1
C921.5	2	1	3	2	1						2	2	2	3	2
C921.6	3	3	3	2	2							3	3	2	2

20IT922	WEB APPLICATIONS USING JAVA	3/0/0/3
Nature of Course	K (Problem Programming)	
Prerequisite	Fundamental OOPs Concepts and Java Programming	

Course Objectives:

1	To acquire knowledge on Java Standard Edition beyond the fundamental language concepts.
2	To introduce new classes of Java library and put together in developing complex applications.
3	To learn basic principles of HTML, Java Script and XML.
4	To gain knowledge to develop dynamic Web applications like Servlet, JSP.
5	To introduce tools, technologies and framework including Hibernate, Spring and Struts to enhance web development skills.

Course Outcomes:

Upon completion of the course, students shall have ability to

C922.1	Recall the knowledge on wider range of classes and develop complex application.	[R]
C922.2	Illustrate the application based on the java concepts, HTML5, XML and JavaScript.	[U]
C922.3	Apply Servlets and JSP to design web-based information systems to meet business needs.	[AP]
C922.4	Make use of Object-Relation mapping and interpret the objects using XML and Hibernate framework.	[AP]
C922.5	Develop interactive, client-side, server-side executable web applications using Eclipse or Net Beans.	[AP]
C922.6	Relate the features of various platforms and frameworks like Spring and Struts used in web applications development.	[U]

Course Contents:

Java and Web Design **15 Hours**

Java Script**-** HTML5 common tags – List – Tables – Images – Forms – Frames - CSS- Introduction to Java Scripts- data types - Objects- Properties - Events - Decision making – Looping - Functions - Array-Conversions-Processing HTML forms and validation using JavaScript-Creating XML using XSD.

Servlets and JSP **15 Hours**

Overview of Servlet -Servlet Architecture- Servlet life cycle-Servlet Request and Response-web.xml and its need -Servlet configuration- Session Tracking - Simple examples -Introduction to JSP – Problem with servlet -Life cycle of JSP- scripting Elements (Expression tag, scriptlets tag and declarations tag)-JSP Directive Elements-page directive - JSP objects- Action Elements **–** Sharing data Between JSP pages

Hibernate, Spring and Struts **15 Hours**

Hibernate Introduction-features-Architecture-Mapping and Configuration Files in Hibernate - Hibernate O/R Mappings –Hibernate query language-Simple examples using hibernate - Spring Introduction- Architecture-IOC container- Dependency Injection Bean – Getting started with Spring MVC framework- Simple examples using Spring – STRUTS – Introduction, Struts framework core components- Installing and setting up struts – Getting started with struts.

Total Hours:	**45**

Text Books:	
1	Thomas. A. Powell, “HTML and CSS: The Complete Reference”, Tata McGraw Hill, 5th Edition, 2010.
2	Kathy Sierra, “SCJP/ OCJP Sun Certified Programmer for Java 6 Study Guide”, Dream tech press, Kogent Learning Solutions Inc. 2011.
3	Atul Kahate, “XML and Realted Technologies”, Pearson India, 1st Edition, 2009.
4	Bryan Basham, Kathy Sierra, Bert Bates, “Head First Servlets and JSP”, O' Reilly Media, 2011.
5	Craig Walls, "Spring in Action", Manning, Dream Tech Press, 2014.
6	James Holmes, “Struts: The Complete Reference”, 2nd Edition, 2007
Reference Books:	
1	Cay S. Horstmann and Gary Cornell, “Core Java, Vol. 2: Advanced Features”, 9th Edition, Prentice Hall, 2013.
2	Robert W. Sebesta, “Programming the World Wide Web”, Addison - Wesley, 7th Edition, 2012.
3	Wesley Hales,” HTML5 and Javascript Web Apps”, Shroff Publishers, 2012.
4	Herbert Schildt, “Java The Complete Reference”, 8th Edition, McGraw-Hill Osborne Media, 2015.
5	Gavin King, Christian Bauer, “Java Persistence with Hibernate”, Dreamtech press, Kogent Learning Solutions Inc. 2008.
6	Seth Ladd, Darren Davison, Steven Devijver,” Expert Spring MVC and Web Flow “, APress, 2006.
Web References:	
1	https://www.udemy.com/java-tutorial/
2	http://www.studytonight.com/servlet/introduction-to-web.php
3	https://www.w3schools.com/css/default.asp
4	http://www.java4s.com/hibernate/
5	http://www.oracle.com/technetwork/java/javaee/jsp/index.html
6	http://www.javatpoint.com

Assessment Methods & Levels (based on Blooms’ Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C922.1,2	Remember	Assignment	5
C922.3,4,5	Apply	Coding	10
C922.6	Understand	Quiz	5

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA 1 [10 marks]	CIA 2 [10 marks]	CIA 3 [10 marks]	
Remember	40	10	-	25
Understand	60	40	50	25
Apply	-	50	50	50
Analyze	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

Course Outcomes (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C922.1	3	3		2	2						3	2	3	3	3
C922.2	3	3		3	3						3	3	2	3	3
C922.3	3	3		3	3						3	2	3	3	3
C922.4	3	3		3	2						3	3	3	2	1
C922.5	3	3	1	2	2						3	2	2	2	2
C922.6	3	3	2	2	2						3	2	2	2	1

20IT923	OPEN SOURCE SYSTEMS	3/0/0/3
Nature of Course	F (Theory programming)	
Pre requisites	Nil	
Course Objectives:		
1.	To study the evolution of the Open Source movement, and its technical and societal impact and to understand the differences between Proprietary Software and Open Source Software.	
2.	To understand the essential Linux Command line operations and to manage user services with file access.	
3.	To learn PHP language fundamentals and to apply common web application techniques, such as form processing and data validation.	
4.	To obtain a strong understanding of Ruby Language's fundamentals and functionality.	
5.	To gain an understanding of programming using Perl.	
Course Outcomes		
Upon completion of the course, students shall have ability to		
C923.1	Summarize the theoretical foundation and practices associated with modern Free and Open Source Software (FOSS) projects.	[U]
C923.2	Demonstrate the knowledge of the fundamental concepts of open source Linux Operating system.	[U]
C923.3	Apply the various options in PHP to develop solutions and will be able to integrate HTML controls, text fields, forms, radio buttons, and checkboxes.	[AP]
C923.4	Build efficient and simplified code by incorporating the object oriented tools in PHP, Perl, Ruby.	[AP]
C923.5	Code solutions using various concepts of Perl including data and variable types, Subroutines, File operations, String manipulation, Lists, etc.	[AP]
C923.6	Apply the techniques available in Ruby for text processing, numeric manipulations, and other input/output operations.	[AP]

Course Contents:

INTRODUCTION to FOSS and Linux **15 Hours**

Introduction to Open sources - Need of Open Sources -Advantages of Open Sources FOSS- FOSS usage Free Software Movement, Commercial aspects of Open Source movement Certification courses issues global and Indian. Application of Open Sources. LINUX- Introduction - General Overview- Kernel mode and User mode process Scheduling - Time Accounting- Personalities - Cloning and Backup your Linux System.

OSS for Web Development - PHP, Perl **15 Hours**

Essential PHP, Operators and flow control, strings and arrays, Creating Functions, Working with Objects, Processing Web forms, Using PHP to access a database. PERL - Overview, Parsing Rules, Variables and Data, Statements and Control Structures, Subroutines, Object Oriented Programming, Working with Files, Data Manipulation.
Case Study: Eclipse and Netbeans.

Web Application Framework - Ruby **15 Hours**

Ruby Fundamentals - Datatypes, Variables, Functions and Control flow, Data Structures, Classes, Models and Forms. Introduction to Ruby on rails. **Case Study:** Git and Github.

Total Hours	**45**

Text Books:	
1.	Ellen Siever, Stephen Figgins, Robert Love, Arnold Robbins, “Linux in a Nutshell”, 6th Edition, OReilly Media, 2009.
2.	Rasmus Lerdorf, Kevin Tatroe, Peter MacIntyre, “Programming PHP”, O'Reilly Media, Inc., 3rd Edition, February 2013.
3.	Martin C. Brown, “Perl: The Complete Reference”, McGraw Hill, 2nd Edition, 2001
4.	David Flanagan, Yukihiro Matsumoto, “The Ruby Programming Language”, O'Reilly Media, Inc., 2008
Reference Books:	
1.	Remy Card, Eric Dumas and Frank Mevel, “The Linux Kernel Book”, Wiley Publications, 2003.
2.	David Sklar “Learning PHP”, O'Reilly Media, Inc., 2016.
3.	Andy Harris, “PHP 5 / MySQL Programming for the Absolute Beginner”, Cengage Learning PTR, 2004.
Web References:	
1.	http://ruby-for-beginners.rubymonstas.org/variables.html
2.	https://www.perl.org/books/beginning-perl/
3.	https://www.railstutorial.org/book
Online Resources:	
1.	https://www.coursera.org/learn/web-applications-php
2.	https://www.coursera.org/learn/introduction-git-github
3.	https://onlinecourses.swayam2.ac.in/aic20_sp31/preview

Tentative Assessment Methods & Levels (based on Revised Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks: 20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C923.1, C923.2	Understand	Assignment	5
C923.3, C923.4, C923.5	Apply	Online Quiz	5
C923.6	Apply	Case Study	10

Summative assessment based on Continuous and End Semester Examination

Revised Bloom’s Level	Continuous Assessment			End Semester Examination (Theory) [50 marks]
	Theory			
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]	
Remember	20	-	-	10
Understand	80	40	40	40
Apply	-	60	60	50
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

Course Outcomes (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C923.1	2	3	2	-	-	3	-	3	2	1	-	2	1	1	2
C923.2	1	2	1	-	1	-	-	-	-	-	-	2	1	1	2
C923.3	2	3	2	-	3	-	-	-	-	-	-	-	2	3	3
C923.4	1	3	3	2	3	-	-	-	2	-	2	-	3	3	3
C923.5	2	3	3	2	3	-	-	-	2	-	2	2	3	3	3
C923.6	2	3	3	2	3	-	-	-	2	-	2	2	3	3	3

20IT924	INDUSTRIAL ETHICS	3/0/0/3
Nature of Course	C (Theory Concept)	
Pre requisites	Nil	

Course Objectives:

1.	To understand the need for ethics in a work place.
2.	To Understand the basic principles, theories, concepts and dynamics of Industry.
3.	To gain knowledge on different codes of ethics and Correlate the concepts in addressing the ethical dilemmas.
4.	Apply these principles and tools in case analysis and to practical business decision making.
5.	Resolve the moral issues in the profession.

Course Outcomes:

Upon completion of the course, students shall have ability to

C924.1	Understand the importance of values and Ethics in Personal and Professional lives.	[U]
C924.2	Explain the various industrial management principles.	[R]
C924.3	Identify the impact of social environment on individuals and groups.	[U]
C924.4	Apply risk and safety measures in various engineering fields.	[AP]
C924.5	Illustrate plans to resolve the issues in the working environment.	[A]
C924.6	Understand the rights and responsibilities of an employee.	[U]

Course Contents:

Introduction to Ethics: **15 Hours**

Basic Concepts - scope of engineering ethics - Personal & Professional ethics - Ethical dilemmas - Life Skills - Emotional Intelligence - Thoughts of Ethics - Value Education - Dimensions of Ethics - Engineering as experimentation - Engineers as responsible experimenters - Codes of ethics - Corporate climates and ethics – Women's rights- role of Women – SWOT Analysis.

Ethical Theories and Responsibility for Safety: **15 Hours**

Basic Ethical Principles - Moral Developments Theories - Basic Theories - Deontology - Utilitarianism - Virtue Theory - Rights Theory - Casuist Theory - Moral Absolution - Moral Rationalism - Moral Pluralism - Ethical Egoism - Feminist Consequentialism - Moral Issues - Moral Dilemmas - Moral Autonomy - Religion and Ethics - Safety and Risk - Assessment of Risk - Safety in Engineering Products - Risk and Cost - Engineers' Responsibility for Safety - Designing for Safety - Risk Benefit Analysis - Risk Costs and Management - Principles of Risk Management - Severity and Probability of Risk.

Workplace Responsibilities and Rights **15 Hours**

Employee relationships - Employee responsibilities -Ethical responsibilities - Impediments to responsibilities - Professional rights - Employee rights - Industry loyalty vs. whistle blowing - International values and practices - International rights - Environmental Ethics - Status of the environment - Stewardship vs. corporations and industry vs. economics and costs – Participative style of Management – Concepts of Quality Circles - Japanese 5S principles and 8D methodology.

Case Study - Space Shuttle Challenge.

Total Hours	**45**

Text Books:	
1.	R. Subramanian, “Professional Ethics includes Human Values”, 2nd Edition, Oxford University Press, 2017.
2.	Mike W. Martin, Roland Schinzinger, “Ethics in Engineering”, 3rd Edition, Tata McGraw Hill, New Delhi, 2017.
Reference Books:	
1.	Govindarajan M, Natarajan S, Senthil Kumar V. S, “Engineering Ethics”, Prentice Hall of India, New Delhi, 2011.
2.	Naagarazan R.S, “Professional Ethics and Human Values”, New Age International Publishers, 2007.
3.	Richard A. Spinello, “Case Studies in Information Technology Ethics”, 2nd Edition, Prentice Hall, 2002.
4.	Dakle H. Besterfield, Carol Besterfield, Glen H. Besterfield, Mary Besterfield, Hemant Urdhwareshe, Rashmi Urdhwareshe, “Total Quality Management”, 5th Edition, Pearson, 2019.
Web References:	
1.	https://www.tutorialspoint.com/professional_ethics/professional_ethics_tutorial.pdf
2.	https://www.theiet.org/media/1649/risk-manage.pdf
3.	https://www.papertyari.com/general-awareness/management/theories-corporate-governance-agency-stewardship-etc/
Online Resources:	
1.	https://www.coursera.org/learn/ethics-technology-engineering#about
2.	https://www.udemy.com/course/business-ethics-how-to-create-an-ethical-organization/
3.	https://onlinecourses.nptel.ac.in/noc21_mg60/preview

Tentative Assessment Methods & Levels (based on Revised Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks: 20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C924.1, C924.3, C924.6	Understand	Assignment	10
C924.4	Apply	Online Quiz	5
C924.5	Analyze	Case Study	5

Summative assessment based on Continuous and End Semester Examination

Revised Bloom’s Level	Continuous Assessment Theory			End Semester Examination (Theory) [50 marks]
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]	
Remember	20	20	10	10
Understand	80	40	40	40
Apply	-	40	30	40
Analyse	-		20	10
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

Course Outcomes (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C924.1	3		2	1		3	3	3	3	2	2	2	1	1	
C924.2			2			2	1	3	1	1	3	1	2	1	
C924.3	2		3	2		3		3	2	3	3	2	2	2	
C924.4	3		3	1		3	1	3		1	1	1	1	1	
C924.5	1		1	2		3		3		1	2	1	3	1	
C924.6			1	1		1		3	3	2	1	2	2	1	

20IT925	COMPUTER GRAPHICS AND MULTIMEDIA	3/0/0/3
Nature of Course	D (Theory Application)	
Pre requisites	Nil	

Course Objectives:

1.	To study the Graphics Display Systems and Algorithms
2.	To understand Computational Development of Graphics and Animations
3.	To provide in depth knowledge of 2D and 3D Applications
4.	To study and understand Data Standard, Compression Algorithms and latest technologies in multimedia

Course Outcomes

Upon completion of the course, students shall have ability to

C925.1	Apply conventional algorithms to understand the importance of computer display technologies used.	[AP]
C925.2	Make use of 2D and 3D transformations, object representations and viewing in real life	[AP]
C925.3	Relate the knowledge of interactive animation using multimedia tools.	[U]
C925.4	Explain the different Input and output technologies and storage Mechanism in multimedia.	[U]
C925.5	Classify the various compression techniques in multimedia.	[U]
C925.6	Infer the databases, authoring tools and user interfaces used in multimedia	[U]

Course Contents

Introduction to Computer Graphics and Object Transformations: 15 Hours

Overview of computer graphics- Computer Display Technologies, Graphics Software, Output Primitives: - Points & lines, Line drawing algorithms, Circle generation algorithm, Ellipse generating algorithm. Basic transformations, 3D Transformation, Clipping operations

Object Representations, Animations and Multimedia System Design 15 Hours

3D Object Representations, 3D viewing, Projections, Visible Surface Identification Methods- Introduction to OpenGL programming and Animations- Introduction to Multimedia-Multimedia Applications-Multimedia Architecture-Technologies for Multimedia Data- File Format Standards-Multimedia Input Output Technologies-Multimedia Storage and Retrieval Technologies.

Compression Techniques and Authoring Systems: 15 Hours

Lossless and Lossy Compression- Inter-Frame and Intra-Frame Compression Text Compression, Image Compression, Video Compression. Multimedia databases- Hypermedia- Multimedia Authoring Systems and User Interfaces. Case Study: Color Models- RGB, YIQ, CMY, HSV, HSL, XYZ, Drawing Basic Shapes

Total Hours	**45**

Text Books:

1.	Donald Hearn and M.Pauline Baker, "Computer graphics with OpenGL", 4th Edition, Pearson Education, 2013.
2.	Prabhat K. Andleigh, Kiran Thakrar, Dorling Kindesley, "Multimedia Systems Design", Pearson Education, 2015.

Reference Books:

1.	Foley, Vandam, Feiner, Hughes – "Computer Graphics Principles", 2nd Edition, Pearson Education, 2014
2.	Elsom Cook, "Principles of Interactive Multimedia", McGraw Hill, 2012.

Web References:	
1.	http://en.wikipedia.org/wiki/Computer_graphics
2.	https://www.youtube.com/watch?v=A0qWBDm6Nok

Online Resources:	
1.	https://www.coursera.org/learn/interactive-computer-graphics
2.	https://onlinecourses.nptel.ac.in/noc20_cs90/preview
3.	https://nptel.ac.in/content/storage2/courses/117105083/pdf/ssg_m1l1.pdf

Tentative Assessment Methods & Levels (based on Revised Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks: 20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C925.1	Apply	Assignment	5
C925.2	Apply	Tutorial	5
C925.3, C925.4, C925.5, C925.6	Understand	Assignment, Online Quiz	10
Total			20

Summative assessment based on Continuous and End Semester Examination

Revised Bloom's Level	Continuous Assessment Theory			End Semester Examination (Theory) [50 marks]
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]	
Remember	10	10	20	20
Understand	40	30	40	40
Apply	50	60	40	40
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

Course Outcomes (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C925.1	3	3	3		2								3	3	2
C925.2	3	3	2		2								3	2	2
C925.3	2	2	3		1								1	2	1
C925.4	1	2	1		1								1		1
C925.5	1	1	1		1									1	1
C925.6	1	2	2		1								1		1

20IT926	SOFTWARE TESTING	3/0/0/3
Nature of Course	C (Theory Concept)	
Pre requisites	Software Engineering and Management	
Course Objectives:		
1.	To provide students with an understanding of Core Testing Concept.	
2.	To learn the Functional and Non-Functional Testing	
3.	To understand the different types of User Acceptance Testing and End-to-End Testing	
4.	To understand the impact of Continuous Delivery Model.	
5.	To understand the Best Practices of Testing	
Course Outcomes		
Upon completion of the course, students shall have ability to		
C926.1	Plan and apply the appropriate level of testing within the context of a software development application to the satisfaction of its beneficiaries.	[AP]
C926.2	Model specific and measurable test cases to ensure coverage and traceability to requirements	[A]
C926.3	Understand the problem of reporting techniques, metrics, and testing status reports and communicate testing results to colleagues, managers, and end users.	[U]
C926.4	Apply testing models, processes and practices appropriate for the software development lifecycle model of a project	[AP]
C926.5	Apply principles and practices of test-driven development to improve testing quality and reduce delivery times	[AP]
C926.6	Integrate testing processes within a continuous delivery model of software development	[A]

Course Contents:

Testing Techniques **15 Hours**

Need for Testing **-** Functional and Non-Functional Testing. Software Engineer in Test. Test Management and Planning. Testing Phases. Testing Roles. Unit Testing – Approach and Testing Techniques, Data Requirements. Roles & Responsibilities, testing techniques for Unit testing. Integration Testing – Approach and Testing Techniques, Data Requirements. Testing Leadership, Maintenance Mode Testing, Test Analytics.

System Testing **15 Hours**

Approach and Techniques, Data Requirements. Test Engineering Manager Role. System Integration Testing – Approach and Techniques, Data Requirements. Test Process Evaluation. User Acceptance Testing – Approach and Techniques, Data Requirements. Test Plan Example. Operations Acceptance Testing – Approach and Techniques, Data Requirements. Example: Test Tours. Stress and Performance tests.

Regression Testing **15 Hours**

Approach and Techniques, Data Requirements. Software Delivery Concepts and Configuration Management. Test Process Improvements, Metrics. Continuous Integration Process - Agile Testing. Test Strategy Implementation Deployment Pipeline. Automated Acceptance Test Suite. Commit Stage. Commit Stage Test Suite. Automated Acceptance Testing. Testing Nonfunctional Requirements. Test Data Management. Continuous Delivery Management. Software Testing Considerations and Challenges in varied platforms and devices- Testing in simulated Environments, Tools and Scripts for testing.

Case Study: Testing process in real world, The British Library & Crown quality assurance group.	
Total Hours	**45**

Text Books:	
1.	Watkins, Mills, “Testing IT”, Cambridge University Press, 2nd Edition, 2011
2.	Jez Humble, David Farley, Continuous Delivery: Addison-Wesley Signature Series, 2010
Reference Books:	
1.	Glanford J. Myers, Corey Sandler, Tom Budget, “The Art of Software Testing, 3rd Edition”, Wiley, 2011.
2.	Ron Patton, “Software Testing”, 2nd Edition, SAMS, 2005.
3.	Deskin, Gopalaswamy, “Software Testing: Principles and Practices”, 1st Edition, Pearson 2014.
Web References:	
1.	https://www.tutorialspoint.com/software_testing/software_testing_quick_guide.htm
2.	https://www.softwaretestinghelp.com/types-of-software-testing/
3.	https://www.perfecto.io/resources/types-of-testing
Online Resources:	
1.	https://www.coursera.org/specializations/software-testing-automation
2.	https://nptel.ac.in/courses/106/105/106105150/
3.	https://www.udacity.com/course/software-testing--cs258

Tentative Assessment Methods & Levels (based on Revised Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks: 20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C926.1	Apply	Assignment	10
C926.4, C926.5	Apply, Apply	Online Quiz	5
C926.6	Analyze	Case Study	5

Summative assessment based on Continuous and End Semester Examination

Revised Bloom’s Level	Continuous Assessment			End Semester Examination (Theory) [50 marks]
	Theory			
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]	
Remember	20	20	10	10
Understand	80	40	40	40
Apply	-	30	30	30
Analyse	-	10	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

Course Outcomes (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C926.1	-	-	2	-	-	-	-	-	-	-	-	-	1	-	-
C926.2	2	2	-	-	-	-	-	-	-	-	-	-	1	2	-
C926.3	2	-	1	-	3	-	-	-	-	-	-	-	2	-	1
C926.4	2	2	-	2	-	1	-	-	-	-	3	3	-	-	2
C926.5	1	2	-	-	-	-	-	-	-	-	3	-	1	-	-
C926.6	1	3	-	-	1	-	-	-	-	-	-	-	2	1	-

20CS911	MOBILE APPLICATION DEVELOPMENT	3/0/0/3
Nature of Course	H (Theory Technology)	
Pre requisites	Core Java Programming	

Course Objectives:

1.	To illustrate the components and structure of mobile application development.
2.	To generalize mobile application frameworks.
3.	To evaluate the mobile application security and its performance.
4.	To develop cloud storage based mobile applications

Course Outcomes:

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

C911.1	Examine the Mobile application development architecture.	[U]
C911.2	Recognize the mobile application framework.	[AP]
C911.3	Estimate long running tasks and background work in Android Applications.	[AP]
C911.4	Design and Develop mobile application using android network programming and multimedia components.	[AP]
C911.5	Illustrate Firebase application for uplifting cloud data storages.	[AP]
C911.6	Generalize the steps involved in publishing an Android application to share with the world.	[AP]

Course Contents:

Introduction to Mobile Application and Android Programming **15 Hours**

Introduction to mobile application- Market values for mobile applications-System Requirements for mobile application - Material Design- Mobile application development architecture. **Android Programming:** Android toolkit - Java for android - components of an Android Application - Android Studio - Eclipse Concepts and Terminology - Eclipse Views and Perspectives - Eclipse and Android – Android versions.

GUI for Mobile Applications **15 Hours**

Developing GUI for Android -Layout –Input Controls and Events - Menus - Dialogs - intent object -intent filters Notification and Toasts – Flutter – React Native Framework. **Current Material design:** Themes - Widgets - Card layouts - Recycler View – Introduction to iOS. **Multimedia & Services:** Lifecycle of a Service - GPS - Android location API - Google maps V2 services using Google API - WIFI- Playing audio – video - Messaging and Telephony services.

Handling Data and Android Network Programming **15 Hours**

Introduction to SQLite -SQLite Programming -Android Database APIConnection and Operations - APK Conversion Process-App Publishing Guidance -Performance and Security. **Android network programming:** HttpUrlConnection - Connecting to REST-based and SOAP based Web services -Kotlin language for Android. **Case study:** Application Development for Uplifting the Farmer through a Connected Ecosystem.

Total Hours	**45**

Text Books:

1.	Jeff McWherter and Scott Gowell, Professional Mobile Application Development, Wrox, 2012.
2.	ZigurdMednieks, Laird Dornin, G. Blake Meike, and Masumi Nakamura, Programming Android, O'Reilly Media, 2012.
3.	Simone Alessandria, Brian Kayfitz, Flutter Cookbook, Packt Publisher, 2021.

Reference Books:

1.	James Dovey and Ash Furrow, Beginning Objective C, Apress, 2012.

2.	Abbey Deitel, Paul Deitel,Harvey Deitel, Android for programmers: An App-driven approach, Michael Morgano, Pearson Education, Inc., 2012.
Web References:	
1.	https://www.tutorialspoint.com/android
2.	https://www.journaldev.com/8988/android-studio-tutorial-hello-world-app
3.	https://www.raywenderlich.com/5114-firebase-tutorial-for-android-getting-starte
Online Resources:	
1.	https://www.edx.org/learn/android-development
2.	https://www.udemy.com/course/learn-android-application-development-y
3.	https://www.coursera.org/specializations/android-app-development

Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C911.1 & C911. 2	Understand	Assignment	5
C911.3 & C911.4	Apply	Online Quiz	5
C911.5 & C911.6	Apply	Mini project	10

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment (30)			End Semester Examination [50 marks]
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]	
Remember	20	20	20	20
Understand	40	30	30	30
Apply	40	50	50	50
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

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
C911.1	3	3	3	3	3	2		2	2		2	3	3	3	2
C911.2	3	3	3	3	3	2		2	2		2	3	3	3	2
C911.3	3	3	3	3	3	2		2	2		2	3	3	3	2
C911.4	3	3	3	3	3	2		2	2		2	3	3	3	2
C911.5	3	3	3	3	3	2		2	2		2	3	3	3	2
C911.6	3	3	3	3	3	2		2	2		2	3	3	3	2

20CS925	DESIGN PATTERNS AND DESIGN THINKING	3/0/0/3
Nature of Course	C (Theory Concept)	
Pre requisites	Object Oriented Analysis and Design	

Course Objectives:

1.	To identify the importance of design patterns.
2.	To categorize different aspects of objects interacting with each other.
3.	To demonstrate the process to solve a problem by building a prototype.
4.	To interpret the insight into design thinking with graphical interfaces to provide dynamism.

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

C925.1	Summarize the various design patterns and its purpose.	[U]
C925.2	Analyze the various behavioral aspects of design patterns.	[A]
C925.3	Discriminate the importance of dynamic responsibility.	[AP]
C925.4	Practice empathy in human-centered design techniques.	[AP]
C925.5	Apply design thinking approach to solve real world problems.	[AP]

Course Contents:

Introduction **15 Hours**

Introduction to Design patterns: Describing design pattern- Design problems- Selection of a design pattern-Usage of design patterns. **The catalog of design pattern:** Creational pattern- Structural pattern-Behavioral pattern- Class & object communication. **Designing a document editor:** Design Problems-Document Structure – Formatting-Embellishing the User Interface -Multiple Look-and-Feel Standards-Multiple Window Systems-User Operations Spelling Checking - Hyphenation.

Design Thinking **15 Hours**

Design Thinking: Definition - Requirements - Stages. **Preliminary Immersion**: Reframing- Exploratory Research-Desk Research **In-Depth Immersion:** Interviews**-**Cultural Probes- Generative Sessions- A Day in the Life-Shadowing. **Analysis and Synthesis:** Insight Cards- Affinity diagram- Conceptual Map-Guiding criteria – Personas-Empathy Map-User's journey- Blueprint.

Empathization, Ideation and Prototyping **15 Hours**

Empathizing Techniques: Purpose-Empathy Methods-Empathic Listening-Empathy Mapping – Curiosity**-** Engagement. **Ideation:** Brainstorming-Mind Mapping-Questioning assumptions - Co-creation workshop- Idea menu – Scamper-Decision matrix. **Prototyping:** Paper prototyping-Volumetric model – Staging – Storyboard- Service prototyping. **Case Study:** Andorinha project.

Total Hours	**45**

Text Books:

1.	Enrich Gamma, Richard Helm, Ralp Johnson and John Vissides, Design Patterns: Elements of reusable object oriented software, Pearson, 1st Edition, 2015.
2.	Maurício Vianna, Ysmar Vianna, Brenda Lucena and Beatriz Russo, Design thinking: Business innovation, MJV Technologies and innovation press, 2011.

Reference Books:

1.	Alan Shalloway and James R. Trott, Design Pattern Explained: A new perspective on object oriented design, Addison Wesley publication, 2011.
2.	Tim Brown, "Change by Design: Design Thinking Transforms organizations and inspires innovations", Harper Collins publication, 2009.

3.	Roger Martin, “The Design of Business: Why Design Thinking is the Next Competitive Advantage”, Harvard Business Press, 2009.
Web References:	
1.	https://sourcemaking.com/design_patterns
2.	https://www.tutorialspoint.com/design_pattern/design_pattern_overview.htm
Online Resources:	
1.	https://www.roitraining.com/course-315-introduction-to-design-thinking/
2.	http://www.creativityatwork.com/design-thinking-strategy-for-innovation/
3.	https://www.coursera.org/learn/uva-darden-design-thinking-innovation.

Assessment Methods & Levels (based on Blooms’ Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C925.1	Understand	Quiz	5
C925.2 & 3	Apply	Assignment	5
C925.4 & 5	Analyse	Case Study	10

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment (30)			End Semester Examination [50 marks]
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]	
Remember	20	30	20	20
Understand	40	40	40	40
Apply	40	30	40	40
Analyze	-	-		-
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

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
C925.1	3	3	3	2	2	2		2		2		3	2	2	3
C925.2	3	3	3	2	2	2		2		2		3	2	2	3
C925.3	3	3	3	2	2	2		2		2		3	2	2	3
C925.4	3	3	3	2	2	2		2		2		3	2	2	3
C925.5	3	3	3	2	2	2		2		2		3	2	2	3

20IT927 PROFESSIONAL READINESS FOR INNOVATION, EMPLOYABILITY AND ENTREPRENEURSHIP

L	T	P	C
0	0	6	3

OBJECTIVES:

- To empower students with overall Professional and Technical skills required to solve a real world problem.
- To mentor the students to approach a solution through various stages of Ideation, Research, Design Thinking, workflows, architecture and building a prototype in keeping with the end-user and client needs.
- To provide experiential learning to enhance the Entrepreneurship and employability skills of the students.

This course is a four months immersive program to keep up with the industry demand and to have critical thinking, team based project experience and timely delivery of modules in a project that solves world problems using emerging technologies.

To prepare the students with digital skills for the future, the Experiential Project Based Learning is introduced to give them hands-on experience using digital technologies on open-source platforms with an end-to-end journey to solve a problem. By the end of this course, the student understands the approach to solve a problem with team collaboration with mentoring from Industry and faculties. **This is an EEC category course offered as an elective, under the type, "Experiential Project Based Learning".**

Highlights of this course:

- Students undergo training on emerging technologies
- Students develop solutions for real-world use cases
- Students work with mentors to learn and use industry best practices
- Students access and use Self-Learning courses on various technologies, approaches and methodologies.
- Collaborate in teams with other students working on the same topic
- Have a dedicated mentor to guide

OUTCOMES:

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

- Upskill in emerging technologies and apply to real industry-level use cases
- Understand agile development process
- Develop career readiness competencies, Team Skills / Leadership qualities
- Develop Time management, Project management skills and Communication Skills
- Use Critical Thinking for Innovative Problem Solving
- Develop entrepreneurship skills to independently work on products

The course will involve 40-50 hours of technical training, and 40-50 hours of project development. The activities involved in the project along with duration are given in Table 1.

TABLE 1: ACTIVITIES

Activity Name	Activity Description	Time (weeks)
Choosing a Project	Selecting a project from the list of projects categorized various technologies & business domains	2
Team Formation	Students shall form a team of 4 Members before enrolling to a project. Team members shall distribute the project activities among themselves.	1
Hands on Training	Students will be provided with hands-on training on selected technology in which they are going to develop the project.	2
Project Development	Project shall be developed in agile mode. The status of the project shall be updated to the mentors via appropriate platform	6
Code submission, Project Doc and Demo	Project deliverables must include the working code, project document and demonstration video. All the project deliverables are to be uploaded to cloud based repository such as GitHub.	3
Mentor Review and Approval	Mentor will be reviewing the project deliverables as per the milestone schedule and the feedback will be provided to the team.	1
Evaluation and scoring	Evaluators will be assigned to the team to evaluate the project deliverables, and the scoring will be provided based on the evaluation metrics	1
TOTAL		**16 WEEKS**

Essentially, it involves 15 weeks of learning and doing, and one week for evaluation. The evaluation will be carried out to assess technical and soft skills as given in Table 2.

TABLE 2: EVALUATION SCHEMA

PROFESSIONAL READINESS FOR INNOVATION, EMPLOYABILITY AND ENTREPRENEURSHIP			
Technical Skills		Soft Skills	
Criteria	Weightage	Criteria	Weightage
Project Design using Design Thinking	10	Teamwork	5
Innovation & Problem Solving	10	Time Management	10
Requirements Analysis using Critical Thinking	10	Attendance and Punctuality	5
Project Planning using Agile Methodologies	5	Project Documentation	5
Technology Stack (APIs, tools, Platforms)	5	Project Demonstration	5
Coding & Solutioning	15		
User Acceptance Testing	5		
Performance of Product / Application	5		
Technical Training & Assignments	5		
Total	70	Total	30
Total Weightage			100
Passing Requirement			50
Continuous Assessment Only			

AMENDMENT IN RESPECTIVE REGULATIONS:

1. Course is offered in the
    - $6^{th}/7^{th}$ semesters of UG programmes
2. This is an EEC category course offered as an elective under the type, “Experiential ProjectBased Learning”.
3. **Evaluation of Experiential Project Based Learning:**
    - **Project Review & Scoring**: Evaluator accesses the project deliverables, reviews the work done by the team and assigns the score for defined metrics.
    - **Project Status Review**: Mentor reviews the deliverables submitted by studentteams and shares his/her comments. Mentor ensures the timely completion ofproject.
    - The evaluation shall be carried out as per the metrics given in Table 2.
4. If a student takes a break and rejoins the programme at a later point in time in a semesterother than the prescribed semesters identified for the course, he/she is permitted to opt for a professional elective in lieu of this course.

Course Assessment scheme: Assessed through **Continuous assessment mode**

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Passing Criteria:

The passing requirement for the courses of the type ‘Experiential Project Based Learning’ falling under the category of EEC is 50% of the continuous assessment marks only.

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20IT001	MOBILE APPLICATIONS DEVELOPMENT USING ANDROID	3/0/0/3
Nature of Course	D (Theory Application)	
Pre requisites	Nil	

Course Objectives:

1.	To understand the Java concepts required for mobile application development.
2.	To understand the system requirements for mobile applications
3.	To generate suitable design using Android studio.
4.	To create and deploy an application in marketplace for distribution.

Course Outcomes

Upon completion of the course, students shall have ability to

C001.1	Recall the knowledge on basic java programming for mobile application development.	[R]
C001.2	Summarize the framework of android application and interpret simple user interfaces.	[U]
C001.3	Build an android application using multimedia components.	[AP]
C001.4	Develop application with server side connectivity.	[AP]
C001.5	Construct the mobile application to work with the database to store data locally.	[AP]
C001.6	Develop and deploy mobile applications to the Android marketplace for distribution	[AP]

Course Contents:

Introduction: **15 Hours**

Introduction to mobile application-System requirements for mobile application Mobile - application development architecture-Anatomy of Android Project. **Java for Android** Classes and Objects- Loops, Lists, Variables and Control structures. - Access specifiers and modifiers- Interfaces and Abstract classes - Inheritance -Exception Handling.

Activities, Intent and User Interface: **15 Hours**

Activity- Life Cycle of an Activity - Creating an Activity - Developing user interfaces Notifications and Toasts. **Multimedia & Services**: Lifecycle of a Service - GPS Android location API-WIFI- Playing audio, video- Messaging and Telephony services.

Persistent Data Storage and APK Publishing: **15 Hours**

Introduction to SQLite -Android Database API- Connection and Operations -APK Conversion Process-App Publishing Guidance.

Total Hours	**45**

Text Books:

1.	K. Saravanan, L. Srinivasan, R. J. Anandhi “Mobile Application Development using Android “, Walnut Publication, 2021.
2.	John Horton, “Android Programming for Beginners”, Packt Publishing, 2015.
3.	Jeff McWherter, Scott Gowell, “Professional Mobile Application Development", Wrox, 2012.
4.	Reto Meier, “Professional Android 4 Application Development”, Wrox Professional Guides, 2012.

Reference Books:

1.	Paul Deitel, Harvey Deitel, "Java How to Program”, 10th Edition, Prentice Hall Publications, 2014.
2.	Charlie Collins, Michael Galpin and Matthias Kappler, "Android in Practice", DreamTech, 2012.
3.	Mark L Murphy, “Beginning Android”, Wiley India Pvt Ltd, 2009
4	Barry Burd, John Paul Mueller, “Android Application Development All in one for Dummies”, 2020.

Web References:	
1.	https://developer.android.com/docs
2.	https://www.tutorialspoint.com/android/
3.	https://developer.android.com/ndk/reference
Online Resources:	
1.	https://www.androidhive.info/
2.	https://developer.android.com/courses
3.	https://www.coursera.org/specializations/android-app-development

Tentative Assessment Methods & Levels (based on Revised Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks: 20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C001.1, C001.2, C001.3	Understand	Assignment	10
C001.4, C001.5 C001.6	Apply	Project Presentation	10

Summative assessment based on Continuous and End Semester Examination

Revised Bloom's Level	Continuous Assessment			End Semester Examination (Theory) [50 marks]
	Theory			
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]	
Remember	25	20	30	30
Understand	45	30	30	30
Apply	30	50	40	40
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

Course Outcomes (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C001.1	3	1	3	2	2	1					2	1	3	3	2
C001.2	3	3	2	2	3	2	1				2	2	2	3	2
C001.3	3	3	3	2	3	2	2	1		1	2	3	3	3	2
C001.4	3	2	3	2	3	2	2		1	1	2	2	3	3	2
C001.5	3	2	3	2	3	2	2		1	1	2	3	3	2	3
C001.6	3	3	3	2	3	2	2		1	1	2	3	3	2	3

20IT002	PHP AND MYSQL	3/0/0/3
Nature of Course	F (Theory Programming)	
Pre requisites	C Programming	

Course Objectives:

1.	To Understand Scripting Language Power in Portal Development.
2.	To analyze the usage of Object Oriented Techniques in Web Server interaction.
3.	To Apply Session and transaction management in MYSQL.
4.	To learn the intricacies in Client Server Management and Data Storage.

Course Outcomes

Upon completion of the course, students shall have ability to

C002.1	Interpret the object-oriented parameters required for web development	[U]
C002.2	Demonstrate the Session Management between various Clients effectively	[AP]
C002.3	Integrating the Security mechanisms in Database Transaction Management	[A]
C002.4	Illustrate the Concept of Code Reusability B2B and B2C Application Development.	[AP]
C002.5	Investigate the Database Security rules and ensure Backup and Restoration of MYSQL Data	[A]
C002.6	Apply Software Architecture and Design Specifications in PHP for portal development	[AP]

Course Contents:

Introduction to PHP **15 Hours**

Installing PHP (WAMP SERVER/XAMPP SERVER), Lexical Structure, Data Types, Variables, Expressions and Operators, Flow Control Statements, Including Code, Embedding PHP in Web Pages, Functions-Calling a Function, Defining Function, Function Parameters, Return Values, Variable Scope, Variable Functions, Built-in Functions, Anonymous Functions.

Strings, Arrays and Classes: **15 Hours**

Strings-Accessing Individual Characters, Cleaning Strings, Encoding and Escaping, Searching Strings, Regular Expressions, Arrays-Identifying elements in Array, Single and Multi-Dimensional Arrays, converting between Arrays and Variables, Sorting Arrays, Class-Declaring Class, Accessing Methods and Properties, Inheritance in class, Introspection and Serialization, Optimization Techniques in PHP.

Accessing MYSQL Databases using PHP: **15 Hours**

Global variables and Form Data, concealing PHP libraries, File Permissions and File Uploads, Using PHP to Access Databases-connection establishment, Basic SQL Commands, Creating Database, Accessing Record Set, Updating records, MYSQL functions. CASE STUDY-Design an Online Examination System, Design an interactive Marketing Portal for Customer Business Interaction

Total Hours	**45**

Text Books:

1.	Rasmus Lerdorf, Kevin Tatroe, “Programming PHP”, O’REILLY Publications, 2020.
2.	Steven Holzner, “PHP: The Complete Reference”, McGraw Hill Education, 2017.

Reference Books:

1.	Mario Lurig, “PHP Reference: Beginner to Intermediate PHP5”, 2008.
2.	Larry Ullman, “PHP and MYSQL for Dynamic web sites”, Pearson Education India, 2017.
3.	Kevin Tatroe, Peter MacIntyre, “Programming PHP : Creating Dynamic web pages”, O'Reilly Media, Inc, 2020.

Web References:

1.	http://www.nptelvideos.com/php/php_video_tutorials.php
2.	https://www.w3schools.com/php

3.	https://www.javatpoint.com/php-tutorial
4.	https://www.studytonight.com/php/

Online Resources:

1.	https://onlinecourses.swayam2.ac.in/aic20_sp32/preview
2.	https://www.coursera.org/projects/dynamic-web-app-php-mysql

Tentative Assessment Methods & Levels (based on Revised Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks: 20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C002.2	Apply	Assignment	5
C002.4	Apply	Assignment	5
C002.6	Apply	Assignment	10

Summative assessment based on Continuous and End Semester Examination

Revised Bloom's Level	Continuous Assessment – Theory			End Semester Examination (Theory) [50 marks]
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]	
Remember	-	-	-	-
Understand	-	20	20	20
Apply	60	50	40	40
Analyse	40	30	40	40
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

Course Outcomes (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C002.1	3	3	2	2	3	2	2	-	-	-	2	2	2	3	3
C002.2	3	3	2	3	1	2	2	-	-	-	2	3	3	3	2
C002.3	3	3	2	2	3	1	1	-	-	-	2	2	3	2	2
C002.4	3	3	3	3	2	2	2	-	-	-	2	3	2	2	3
C002.5	3	3	1	2	3	2	1	-	2	-	2	2	3	3	2
C002.6	3	3	2	3	2	1	1	-	2	-	3	2	3	2	2

20IT003	BLOCKCHAIN ESSENTIALS	3/0/0/3
Nature of Course	C (Theory Concept)	
Pre requisites	-	

Course Objectives:

1.	To Provide an understanding skill of blockchain technologies
2.	To introduce the technical aspects of crypto currencies, block chain technologies, and distributed consensus.
3.	To enable the students to be aware of Bit coin and its security features
4.	To make students understand the innovative application models using Block chain technology., how these systems work and how to engineer secure software that interacts with the Bit coin network and other crypto currencies.

Course Outcomes

Upon completion of the course, students shall have ability to

C003.1	Relate cryptography concepts in emerging abstract models for Block chain Technology	[R]
C003.2	Demonstrate the working principles of block chain, bit coin and crypto currency in real time environment	[U]
C003.3	Classify the concept of bitcoin and technological background behind it	[U]
C003.4	Make use of the Bitcoin transaction and its implementation	[AP]
C003.5	Relate the concept of Hyperledger in block chain	[U]
C003.6	Apply Block chain concepts in the latest advances and their applications	[AP]

Course Contents:

Introduction **15 Hours**

Introduction to Cryptography and Network Security- Classical Encryption Techniques-Block Cipher and Data Encryption Standards- Authentications and Hash Functions- SHA3- Introduction to Block Chain- Features of Block chain- -Types of Block Chain-Decentralization in Block Chain-Tiers of Block chain Technology- Blockchain 1.0: Currency- Blockchain 2.0: Contracts.

Block Chain and Cryptocurrency **15 Hours**

Blockchain 3.0: Justice Applications Beyond Currency, Economics, and Markets- Name coin: Decentralized Domain Name System- Digital Identity Verification- Introduction to Bitcoin, History of Bitcoin, Bitcoin Transactions, Bitcoin Address-Bit coin Wallet- Bit Coin Network- How to store and use Bit Coin- Legal aspects of Bitcoin.

Hyperledger and Blockchain Applications **15 Hours**

Structure of a Block, Linking Blocks in the Blockchain, Merkle Trees, Bitcoin's Test Block chains - Bitcoin Mining- Mining the Block - Mining and the Hashing Race-Altcoin and crypto currency eco system- Introduction to Hyperledger- Hyperledger as a Protocol-Fabric- Applications of Block chain Technology - Blockchain in Government - Colored Coins- Payment Channels and State Channels. Case study- Wazirx trading tool etc.

Total Hours	**45**

Text Books:

1	William Stallings," Cryptography and Network Security- Principles and Practices", 7th Edition, Prentice Hall of India, 2017
2.	Melanie Swan, "Block Chain: Blueprint for a New Economy", O"Reilly, 1st Edition, 2015.
3.	Andreas M. Antonopoulos, "Mastering Bitcoin: Programming the Open Blockchain", O'Reilly, 2016
4.	Imran Bashir, Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, 2017.

Reference Books:

1.	Daniel Drescher, “Block Chain Basics”, Apress; 1st Edition, 2017
2.	Anshul Kaushik, “Block Chain and Crypto Currencies”, Khanna Publishing House, Delhi, 2018
3.	S. Shukla, M. Dhawan, S. Sharma, S. Venkatesan, Blockchain Technology: Cryptocurrency and Applications, Oxford University Press, 2019
4.	Bikramaditya Singhal, Gautam Dhameja, Priyansu Sekhar Panda Beginning Blockchain, A Beginner’s Guide to Building Blockchain Solutions, Apress, 2018.

Web References:

1.	https://en.wikipedia.org/wiki/Blockchain
2.	https://developer.ibm.com/patterns/create-and-deploy-block chain-network usingfabric-sdk-java/
3.	http://bitcoinbook.cs.princeton.edu/
4.	https://builtin.com/blockchain
5.	https://j2-capital.com/wp-content/uploads/2017/11/AIR-2016-Blockchain.pdf

Online Resources:

1.	https://www.tutorialandexample.com/blockchain/
2.	https://faculty.fuqua.duke.edu/~charvey/Teaching/898_2017/syl898.htm
3.	https://www.coursera.org/learn/cryptocurrency
4.	https://onlinecourses.nptel.ac.in/noc22_cs44/preview
5.	https://builtin.com/blockchain/blockchain-applications
6.	https://dl.acm.org/doi/fullHtml/10.1145/3427097
7.	https://j2-capital.com/wp-content/uploads/2017/11/AIR-2016-Blockchain.pdf
8.	https://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/crse0401.html
9.	https://ethereum.org/en/
10	https://www.hyperledger.org/use/tutorials

Tentative Assessment Methods & Levels (based on Revised Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks: 20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C003.1, C003.2	Remember, Understand	Assignment	5
C003.3, C003.4	Understand, Apply	Online Quiz	5
C003.5, C003.6	Understand, Apply	Assignment	10

Summative Assessment based on Continuous and End Semester Examination

Revised Bloom’s Level	Continuous Assessment			End Semester Examination (Theory) [50 marks]
	Theory			
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]	
Remember	20	20	30	30
Understand	40	40	30	30
Apply	40	40	40	40
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

Course Outcomes (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C003.1	3	3	1			1						1	2	2	2
C003.2	3	2	2			2						2	1	2	2
C003.3	3	3	2			2						2	2	1	2
C003.4	3	2	2			2		1				1	1	1	1
C003.5	3	2	3			3		1				2	1	2	2
C003.6	3	2	3	2	3	3	2	2				2	2	1	1

20IT004	CLOUD AND VIRTUALIZATION	3/0/0/3
Nature of Course	C (Theory Concept)	
Pre requisites	Nil	

Course Objectives:

1.	To understand the fundamentals of Networking Concepts.
2.	To understand the evolution of cloud from the existing technologies and knowledge on the various issues with the lead players in cloud
3.	To learn the necessary tools, technologies, and skills for design, develop and deploy services in a virtualized cloud computing paradigm.
4.	To identify the best suit IT architecture, infrastructure and delivery models of Cloud Computing for a small to medium scale business scenarios.
5.	To expose the students to the frontier areas of Cloud Service Platforms with next generation computing technologies

Course Outcomes

Upon completion of the course, students shall have ability to

C004.1	Understand and explain the basic concepts of networking.	[U]
C004.2	Demonstrate the broad perspective of cloud architecture and model, computing solutions and recommendations.	[U]
C004.3	Interpret the best virtualization tools and mechanisms to design, develop and deploy services.	[U]
C004.4	Illustrate virtual management of IT resources and its provisioning	[U]
C004.5	Select, Configure and enable a private cloud using virtualization for a small scale business environment.	[AP]
C004.6	Identify the best real time storage environments suitable for the next generation integrated technologies.	[AP]

Course Contents:

Introduction to Networking Concepts and Cloud: 15 Hours

Introduction to Networks and Internet: Protocol and Standards – Communication Models - Network Models – OSI Reference Model – Transmission Media - Network Devices – Network Types and topologies – Ethernet standards - IPV4 and IPV6 addressing. Introduction to Cloud Computing and its Evolution - Introduction to Grid, Utility, Cluster, Parallel and Distributed Computing - System Models for Distributed and Cloud Computing - NIST Layered Cloud Computing Reference Model - Architectural Design Challenges – Cloud Computing : Characteristics, Drivers, Challenges, Benefits - Deployment Models: Public, Private, Community and Hybrid Clouds – Service models: laaS- PaaS-SaaS

Case study: Anything as a service (XaaS)

Fundamentals of Virtualization: 15 Hours

Introduction to Virtualization – Virtual Machines and its resources – Hypervisors and its types - Types of Virtualization - Tools and Mechanisms - **CPU Virtualization** (process & benefits) - **Storage Virtualization** (Process, benefits, Storage for VMs, Block level and file level storage, NAS, FC SAN, iSCSI,FCIP, & FCoE, Resource management and Virtual Provisioning) - **Network Virtualization** (Process, benefits, infrastructure components, VLANs, traffic Management Techniques) - **Application Virtualization** - **Desktop Virtualization**.

Real Time Public Cloud Platform: 15 Hours

Public Cloud Services: Working with Amazon AWS – AWS Compute and its types- AWS Storages: S3, Glacier, EBS, and EFS - Big data on AWS. Working on Azure – Azure compute - Azure storages: File, Blob, Queue and Table

Case Study: Google Cloud Solutions, Open Stack, Alibaba Cloud and IBM cloud.

Total Hours	**45**

Text Books:

1.	Behrouz A. Forouzan, “Data communication and Networking”, 5th Edition, Tata McGraw-Hill, 2013.
2.	Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, "Mastering Cloud Computing", Tata McGraw Hill, 2013.

3.	Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
4.	Tim Mather, Subra Kumaraswamy, and Shahed Latif, “Cloud Security and Privacy an Enterprise Perspective on Risks and Compliance”, O'Reilly, 2009

Reference Books:

1.	A S Tanenbaum, DJ Wetherall, “Computer Networks”, 6th Edition, Prentice-Hall, 2021.
2.	William Stallings, “Data and Computer Communications”, 10th Edition, PHI, 2013.
3.	Rittinghouse, John W., and James F. Ransome, " Cloud Computing: Implementation, Management and Security", CRC Press,1st Edition, 2017.
4.	Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing - A Practical Approach ll”, Tata McGraw Hill, 2009.
5.	Barrie Sosinsky, “Cloud Computing Bible” John Wiley & Sons, 2010

Web References:

1.	https://aws.amazon.com/
2.	https://azure.microsoft.com/en-in/
3.	https://nptel.ac.in/courses/106/105/106105167/
4.	https://explore.skillbuilder.aws/learn/public/learning_plan/view/82/cloud-foundations-learning-plan?cta=lacp_topbanner
5.	https://cloud.google.com/training/cloud-infrastructure

Online Resources:

1.	https://www.edx.org/course/introduction-cloud-infrastructure-linuxfoundationx-lfsl51-x
2.	https://www.aws.training/training.com
3.	https://www.qwiklabs.com/
4.	https://www.gslab.com/cloud
5.	https://www.cloudshare.com/

Tentative Assessment Methods & Levels (based on Revised Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks: 20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C004.1	Remember	Assignment	10
C004.2 – C004.5	Apply	Online Quiz	5
C004.6	Apply	Case Study	5

Summative assessment based on Continuous and End Semester Examination

Revised Bloom’s Level	Continuous Assessment Theory			End Semester Examination (Theory) [50 marks]
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]	
Remember	20	30	10	15
Understand	80	70	60	65
Apply	-		30	20
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

Course Outcomes (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C004.1	3	2	1	2	1	1	2				2	2	3	2	2
C004.2	3	3	1	1	2	1	1				2	2	3	2	2
C004.3	3	3	3	3	3	1	1				2	2	3	2	1
C004.4	3	3	3	2	3	1	1				2	3	3	2	1
C004.5	3	3	3	3	3	1	1				3	3	3	2	1
C004.6	3	3	2	3	3	1	1				3	3	3	2	1

20IT005	INTERNET PROGRAMMING	3/0/0/3
Nature of Course	F (Theory Programming)	
Pre requisites	Nil	

Course Objectives:

1.	To provide an overview of working principles of Internet and its functionalities.
2.	To impart the knowledge of web application development platforms.
3.	To develop the front-end user interface using HTML, CSS.
4.	Develop web sites which are secure and dynamic in nature using JavaScript.
5.	Learn the importance of server-side scripts like JSP and servlets for web interactivity and web Hosting.

Course Outcomes:

Upon completion of the course, students shall have ability to

C005.1	Outline Internet standards and recent web technologies like Conferencing, newsgroup etc.	[U]
C005.2	Identify working model and learn basic web concepts to develop Static and Dynamic web pages.	[AP]
C005.3	Apply the knowledge of HTML and CSS code to create personal and/or business websites following current professional and/or industry standards.	[AP]
C005.4	Develop a web-based information systems using HTML, XML.	[AP]
C005.5	Apply static and dynamic web page design techniques to construct an interactive web page using Client-side technologies.	[AP]
C005.6	Construct server-side scripts using JSP and Servlets for web applications.	[AP]

Course Contents:

Essentials of Web Programming **15 Hours**

Evolution of Web – Web architecture – Web Concepts – Web Technology Protocols – Web Servers: Internet Web Server, Personal Web Server, Apache Web Server, JBOSS, XAMP – Basics of HTML – Elements and Attributes of HTML – HTML Layouts – HTML Forms – HTML Lists and Tables – HTML Media – Getting started with HTML5 – HTML Graphics.

Introduction tO CSS and XML **15 Hours**

Basics of CSS – HTML Style attributes – CSS Syntax – CSS Selectors – Three ways to insert CSS – Element based CSS – CSS Layouts – CSS Image Gallery – Gradients and Shadows – 2D and 3D transforms with CSS – XML – DTD – XSD – XSLT– XQuery – Xpath.

Scripting Languages **15 Hours**

JAVASCRIPT - Variables - Statements - Popup Boxes - Functions - Loops - Arrays- Form Validation -Error Handling – objects in Javascripts - AJAX Basics - Fundamentals of Jquery & JSON- SERVLET: Introduction- Servlet features - Servlet Architecture - Three Tier Applications - Servlet package and API - Configuring Servlet - JAVA SERVER PAGES(JSP) - Introduction - JSP architecture - Life cycle - JSP Tags and Implicit objects - Basic concepts of SQL and database connectivity.

Total Hours	**45**

Text Books:

1.	Harvey M Deitel and Paul J Deitel, Internet and World Wide Web - How to Program, 5th Edition, Pearson Education, 2012.
2.	Thomas a Powell, “HTML & CSS: The Complete Reference”, 5th Edition, Tata McGraw Hill Education Private Limited, 2010.
3.	Russ Ferguson, “Beginning JavaScript: The Ultimate Guide to Modern JavaScript Development”, Apress Publishers, 3rd Edition, 2019.

Reference Books:

1.	Jeffrey C. Jackson, Web Technologies: A Computer Science Perspective, Prentice Hall, 2007.

2.	Jon Duckett, “HTML and CSS: Design and build websites”, John Wiley & Sons, 2011.
3.	David Flanagan, “JavaScript: The Definitive Guide”, 5th Edition, O’Reilly, 2011

Web References:

1.	https://developer.mozilla.org/en-US/docs/Web/HTML
2.	https://developer.mozilla.org/en-US/docs/Web/CSS
3.	https://developer.mozilla.org/en-US/docs/Web/JavaScript
4.	https://www.geeksforgeeks.org/gate-cs-notes-gq/
5.	https://www.w3schools.com/html/

Online Resources:

1.	https://www.coursera.org/learn/html-css-javascript-for-web-developers
2.	https://nptel.ac.in/courses/106/105/106105084/
3.	https://online-learning.harvard.edu/subject/javascript
4.	https://ocw.mit.edu/courses/sloan-school-of-management/15-561-information-technology-essentials-spring-2005/lecture-notes/lecture8.pdf

Tentative Assessment Methods & Levels (based on Revised Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks: 20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C005.1, C005.2	Remember	Assignment	10
C005.3, C005.4, C005.5, C005.6	Apply	Online Quiz	10

Summative assessment based on Continuous and End Semester Examination

Revised Bloom’s Level	Continuous Assessment Theory			End Semester Examination (Theory) [50 marks]
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]	
Remember	-	20	10	10
Understand	20	40	40	40
Apply	80	40	50	50
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

Course Outcomes (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C005.1	3	2	3	2	3	2	-	-	-	-	1	2	3	3	2
C005.2	3	3	3	3	3	2	1	-	-	-	2	2	3	3	3
C005.3	3	3	3	3	3	2	1	-	-	-	2	2	3	3	3
C005.4	3	3	3	3	3	2	-	-	-	-	2	2	3	2	3
C005.5	3	3	3	3	3	2	-	-	-	-	1	3	3	2	2
C005.6	3	2	3	3	3	2	-	-	-	-	1	3	3	2	3

20IT006	INTRODUCTION TO CYBER SECURITY	3/0/0/3
Nature of Course	C (Theory Concept)	
Pre requisites	Computer Networks	

Course Objectives:

1.	To understand the fundamental concepts of cyber security.
2.	To learn various hacking techniques and attacks.
3.	To assess and measure threats to information assets.
4.	To learn intrusion detection mechanism.
5.	To design various security policies.

Course Outcomes

Upon completion of the course, students shall have ability to

C006.1	Understand hacking attacks and protect data assets.	[U]
C006.2	Implement various techniques to protect system from security attacks.	[AP]
C006.3	Relate the hacking and security concepts in cyber security.	[U]
C006.4	Apply various cyber security techniques in real time applications.	[AP]
C006.5	Apply various detection mechanism for intrusion detection.	[AP]
C006.6	Make use of suitable security policies for the given requirements.	[AP]

Course Contents:

Introduction **15 Hours**

Network and security concepts: Information assurance – Cryptography – DNS - Firewalls – Virtualization, Microsoft windows security principles – Define boundary of trust – Tunneling and fraud techniques-Threat infrastructure- Exploitation: Techniques to gain a foothold Misdirection, Reconnaissance and disruption methods, Malicious code: Self-replicating codes – Evading detection and elevating privileges - Stealing information and exploitation.

Hacking and Security **15 Hours**

System Hacking: Hacking windows – Hacking Unix – Remote Connectivity and VoIP Hacking – Network Hacking: Network Devices – Wireless Hacking – Firewalls – Denial of Service Attacks – Software Hacking: Hacking Code – Web Hacking – Hacking the Internet User – Design for physical protection- Physical access control – Measures to control access – Process Evaluation – Case Study on Colonial Pipeline Ransomware attack and Ukraine Power Grid Hack

Intrusion Detection and Policies **15 Hours**

Detection mechanism, Signatures, Traffic analysis, Intrusion detection project life cycle: Project phases - Resource estimates - Project planning - Acquisition - Deployment phase - Tuning - Deployment issues - Maintenance. Cyber security policies - Policy needs- Writing security policies – Internet and email security policies – Compliance and Enforcement Policies – Case study on GDPR and Information security management system

Total Hours	**45**

Text Books:

1.	James Graham, Richard Howard and Ryan Olson, "Cyber Security Essentials", Auerbach Publications, USA, 2016.
2.	Stuart McClure, Joel Scambray and George Kurtz, “Hacking Exposed Network Security Secrets and Solutions”, Tata McGraw hill Publishers 2012.
3.	Scott Barman, “Writing Information Security Policies”, New Riders Publications, 2002.

Reference Books:

1.	Ben Smith and Brain Komer, “Microsoft Windows Security Resource Kit” Prentice Hall of India, 2010.
2.	Ankit Fadia and Manu Zacharia, "Network Intrusion Alert: An Ethical Hacking Guide to Intrusion Detection", Thomson Course Technology, USA, 2010.

3.	George K. Kostopoulous, “Cyber Space and Cyber Security”, CRC Press, 2017.
4.	Martti Lehto, Pekka Neittaanmaki, “Cyber Security: Analytics, Technology and Automation”, Springer International Publishing Switzerland, 2015.
Web References:	
1.	https://en.wikipedia.org/wiki/Colonial_Pipeline_ransomware_attack
2.	https://en.wikipedia.org/wiki/Ukraine_power_grid_hack
3.	https://gdpr-info.eu/
4.	https://www.isms.online/information-security-management-system-isms/
Online Resources:	
1.	https://onlinecourses.swayam2.ac.in/nou19_cs08/preview
2.	https://www.edx.org/course/cybersecurity-fundamentals
3.	https://www.coursera.org/specializations/intro-cyber-security
4.	https://www.coursera.org/learn/introduction-cybersecurity-cyber-attacks

Tentative Assessment Methods & Levels (based on Revised Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks: 20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C006.1	Understand	Quiz	5
C006.4	Apply	Assignment	5
C006.5, C006.6	Apply	Group presentation	10

Summative assessment based on Continuous and End Semester Examination

Revised Bloom’s Level	Continuous Assessment – Theory			End Semester Examination (Theory) [50 marks]
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]	
Remember	10	-	-	10
Understand	60	40	40	30
Apply	30	60	60	60
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

Course Outcomes (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C006.1	2	3	3	3	2	-	1	-	2	2	3	3	2	2	2
C006.2	2	3	3	3	3	2	2	-	1	-	2	3	2	1	2
C006.3	3	2	2	2	2	-	-	-	2	2	-	-	2	2	2
C006.4	3	2	2	3	3	1	-	-	-	-	2	2	2	2	2
C006.5	3	3	3	3	3	2	-	2	2	1	-	2	2	2	1
C006.6	2	3	3	3	1	3	-	3	3	2	-	2	1	2	1

20IT007	OPEN-SOURCE DEEP LEARNING FRAMEWORKS	3/0/0/3
Nature of Course	D (Theory Application)	
Pre requisites	Python Programming, Machine Learning Techniques	

Course Objectives:	
1.	To become familiar with the language and fundamental concepts of artificial neural networks.
2.	To understand and implement Deep Learning Architectures.
3.	To familiarize the student with the Image Processing facilities like TensorFlow and Keras.
4.	To get familiar with the use of TensorFlow/Keras in Deep Learning Applications.
5.	To make the students build deep learning models, interpret results, and build own deep learning projects.

Course Outcomes		
Upon completion of the course, students shall have ability to		
C007.1	Understand and review tools available to build Deep Learning including Tensor Flow, Keras.	[U]
C007.2	Build Deep Learning Machine Learning models using Tensor Flow and various interfaces	[AP]
C007.3	Apply deep neural network models to generate realistic images in Tensorflow	[AP]
C007.4	Develop probabilistic models with TensorFlow, making particular use of the TensorFlow Probability library	[AP]
C007.5	Classify regression and classification models using the Keras library together with convolutional networks and to build them using the Keras library	[A]
C007.6	Develop deep learning algorithms for computer vision problems using Keras	[AP]

Course Contents:

Introduction to Artificial Neural Networks with Keras: 15 Hours
From Biological to Artificial Neurons - **Implementing MLPs with Keras:** Building an Image Classifier Using the Sequential API - Building an Image Classifier and regression MLP using the Sequential API - Building Complex Models using the Functional API - Building Dynamic Models Using the Subclassing API – Fine-Tuning Neural Network Hyperparameters. **Training Deep Neural Networks:** Vanishing/Exploding Gradients Problems - Reusing Pretrained Layers - Faster Optimizers - Avoiding Overfitting through Regularization.

Models and Training with Tensorflow: 15 Hours
Tour of TensorFlow - Using TensorFlow like NumPy -Customizing Models and Training Algorithms - TensorFlow Functions and Graphs - **Loading and Preprocessing Data with TensorFlow**: The Data API - The TFRecord Format - The Features API - TF Transform. **Case Study**: The TensorFlow Datasets (TFDS) Project

Deep Computer Vision using Convolutional Neural Networks: 15 Hours
The Architecture of the Visual Cortex - Convolutional Layer - Pooling Layer - CNN Architectures: LeNet-5 – AlexNet – GoogLeNet – VGGNet – ResNet – Xception – SENet. Implementing a ResNet-34 CNN using Keras - Using Pretrained Models from Keras - Pretrained Models for Transfer Learning - Classification and Localization - Object Detection - Semantic Segmentation

Total Hours	**45**

Text Books:	
1.	Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems", 2nd Edition, O'Reilly Media, 2019.

2.	Antonio Gulli, Amita Kapoor, Sujit Pal “Deep Learning with TensorFlow 2 and Keras”, 2nd Edition, Packt Publishing, 2019
3.	Ian Goodfellow, Yoshua Bengio, Aaron Cour, “Deep Learning (Adaptive Computation and Machine Learning series)”, The MIT Press, 2016.
Reference Books:	
1.	Liangqu Long, Xiangming Zeng, “Beginning Deep Learning with TensorFlow: Work with Keras, MNIST Data Sets, and Advanced Neural Networks”, APress; 1st Edition, 2022.
2.	Joseph, Ferdin Joe John, Sarayut Nonsiri, and Annop Monsakul. "Correction to Keras and TensorFlow: A Hands-On Experience." Advanced Deep Learning for Engineers and Scientists. Springer, 2021.
3.	Davies, E. R., and Matthew Turk. “Advanced methods and deep learning in computer vision”, Elsevier Science & Technology, 2021.
Web References:	
1.	https://www.kaggle.com/jameskhoo/deep-learning-with-keras-and-tensorflow
2.	https://codebasics.io/courses/deep-learning-with-tensorflow-keras-and-python
3.	https://github.com/codebasics/deep-learning-keras-tf-tutorial
Online Resources:	
1.	https://www.edx.org/course/deep-learning-with-tensorflow
2.	https://datascience.uci.edu/education/data-science-short-courses/
3.	https://onlinecourses.nptel.ac.in/noc19_cs81/preview

Summative assessment based on Continuous and End Semester Examination

Revised Bloom’s Level	Continuous Assessment – Theory			End Semester Examination (Theory) [50 marks]
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]	
Remember	-	-	-	
Understand	30	30	30	30
Apply	40	60	70	60
Analyse	30	10	-	10
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

Course Outcomes (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C007.1	2	3	3	3	3								3	2	2
C007.2	1	2	2	2	2								3	2	1
C007.3	3	3	2	2	3								3	3	3
C007.4	1	2	3	3	1								2	2	2
C007.5	2	3	2	2	2								2	3	2
C007.6	2	2	3	2	2								3	2	3

20IT008	KOTLIN FOR CROSS - PLATFORM APPLICATION DEVELOPMENT	3/0/0/3
Nature of Course	H (Theory Technology)	
Pre requisites	Web and Java Programming	

Course Objectives:

1.	To study the key characteristics of Kotlin
2.	To understand the types of tasks where Kotlin can be used
3.	To understand the basic syntaxes of variables, conditions, loops and array
4.	To learn the working of different types of functions, OOP in Kotlin
5.	To understand the creation and running of an Android Activity

Course Outcomes

Upon completion of the course, students shall have ability to

C008.1	Outline the Kotlin programming concepts.	[U]
C008.2	Classify the standard functions included with Kotlin's standard library	[U]
C008.3	Experiment with the basics of Android for creating text, images, and interactive buttons	[AP]
C008.4	Illustrate the interoperability with Java classes and ensure Java compatibility	[U]
C008.5	Make use of object-oriented concepts in implementing simple Android Application.	[AP]
C008.6	Examine Kotlin language and debug common issues	[A]

Course Contents:

Introduction: **15 Hours**

Overview of Kotlin – Advantages and Disadvantages- Kotlin for Android - Getting started with Hello World app - Data Types – Operators - Kotlin mutable and immutable variables Type Conversion - Expression & Statement – Comments - Input/Output- Java Interoperability – Calling Kotlin from Java – Calling Java from Kotlin – Case study: Design a simple arithmetic calculator App

Flow Control: **15 Hours**

if expression - when Expression - while Loop - for Loop – break and continue- Kotlin function- Infix Function Call - Default and Named Arguments - Recursion - Tail Recursion - Kotlin Collections- Kotlin list : Arraylist- list : listOf() - Set : setoff - mutableSetOf() - hashSetOf() - Map : mapOf() – Hashmap- Case study: Develop a technical quiz app and store marks using Array.

Object Oriented Concepts: **15 Hours**

Kotlin Class and Objects – Constructors- Kotlin Getters and Setters - Inheritance - Visibility Modifiers - Abstract Class - Interfaces - Nested and Inner Classes - Data Class - Sealed Class - Kotlin Object- Companion Objects - Extension Function - Operator Overloading – Accessing database from Kotlin - Android event handling, multi-touch event handling. Exception Handling - try, catch, throw and finally - Nested try block and multiple catch block. Case study: Build a simple database application that can sort and store the user's data

Total Hours	**45**

Text Books:

1.	Pierre-Yves Saumont, "The Joy of Kotlin", Manning Publications, 2019.

2.	Ken Kousen, “Kotlin Cookbook, A Problem Focused Approach”, O'Reilly Media, Inc. 2019.
3.	Antonio Leiva, “Kotlin for Android Developers: Learn Kotlin while developing an Android App”, CreateSpace Independent Publishing, 2016
Reference Books:	
1.	John Horton, “Android Programming with Kotlin for Beginners”, Packt Publishing Limited, 2019.
2.	Dmitry Jemerov, Svetlana Isakova, “Kotlin in Action”, Manning Publications, 2017,
3.	Stephen Samuel, Stephen Bocutiu, “Programming Kotlin”, Packt Publishing Limited 2017.
Web References:	
1.	https://developer.android.com/kotlin
2.	https://kotlinlang.org/
3.	https://www.w3schools.com/kotlin/index.php
Online Resources:	
1.	https://onlinecourses.swayam2.ac.in/aic20_sp02/preview
2.	https://www.coursera.org/projects/learn-object-oriented-programming-with-kotlin
3.	https://www.udemy.com/course/complete-kotlin-android-developer-course-tutorial/

Tentative Assessment Methods & Levels (based on Revised Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks: 20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C008.1	Remember	Quiz	3
C008.2	Understand	Quiz	3
C008.4			
C008.3	Apply	Case study Presentation	7
C008.5			
C008.6	Analyze	Assignment	7

Summative assessment based on Continuous and End Semester Examination

Revised Bloom’s Level	Continuous Assessment			End Semester Examination (Theory) [50 marks]
	Theory			
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]	
Remember	20	20	10	20
Understand	40	30	30	30
Apply	40	30	40	30
Analyze	-	20	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

Course Outcomes (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C008.1	3	3	3		2	2			1		2	2	2	3	2
C008.2	3	3	3		2	2			1		2	2	3	3	3
C008.3	3	3	3	3	3	2		2	1		2	2	3	3	3
C008.4	3	3	3	2	2	2			1		2	2	2	3	3
C008.5	3	3	3	2	2	2		2	1		2	2	2	3	3
C008.6	3	3	3		2	2			1		2	2	2	3	3

20IT009	VIRTUAL AND AUGMENTED REALITY	3/0/0/3
Nature of Course	C (Theory Concept)	
Prerequisites	Multimedia Systems	

Course Objectives:

1.	To introduce the relevance of this course to the existing technology through demonstrations, case studies.
2.	To understand virtual reality, augmented reality and using them to build Biomedical engineering applications
3.	To know the intricacies of these platform to develop PDA applications with better optimality
4.	To understand virtual reality, augmented reality and using them to build Biomedical engineering applications
5.	To understand the various applications of Augmented reality

Course Outcomes

Upon completion of the course, students shall have ability to

C009.1	Classify the various input and the output devices of virtual reality.	[U]
C009.2	Illustrate the technical resources available for content creation.	[U]
C009.3	Analyze a system or process to meet given specifications with realistic engineering constraints.	[A]
C009.4	Apply the various side effects of exposures to virtual reality environment.	[AP]
C009.5	Identify the various requirements and characteristics of Augmented Reality.	[AP]
C009.6	Illustrate the various displays in augmented reality for gaming applications.	[U]

Course Contents:

Introduction and VR Development Process **15 Hours**

The three I's of virtual reality-commercial VR technology and the five classic components of a VR system - Input Devices: (Trackers, Navigation, and Gesture Interfaces): Three-dimensional position trackers, navigation and manipulation-interfaces and gesture interfaces-Output Devices: Graphics displays-sound displays & haptic feedback. Geometric modeling - kinematics modeling- physical modeling - behavior modeling - model Management.

Content Creation Considerations for VR & VR on the Web **15 Hours**

Methodology and terminology-user performance studies-VR health and safety issues-Usability of virtual reality system- cyber sickness -side effects of exposures to virtual reality environment. JS-pros and cons-building blocks (WebVR, WebGL, Three.js, device orientation events)- frameworks (A-frame, React VR)

Augmented Reality and Computer Vision **15 Hours**

Introduction to Augmented reality-Examples-Displays- Multimodal displays-Requirements & Characteristics-Spatial Display Model. Tracking, calibration and registration-characteristics-Stationary tracking systems-mobile sensors - Optical tracking–Sensor fusions. Computer vision for augmented reality.

Total Hours	**45**

Text Books:	
1.	C. Burdea, Philippe Coiffet, “Virtual Reality Technology”, 2nd Edition, Gregory, John Wiley & Sons, Inc.,2017.
2.	Dieter Schmalstieg, Tobias Hollerer, “Augmented Reality: Principles and Practice (Usability)” , Pearson Education (US), 2016.
Reference Books:	
1.	Jason Jerald, “The VR Book: Human-Centred Design for Virtual Reality”, Association for Computing Machinery and Morgan & Claypool, New York, NY, USA. 2015.
2.	Steve Aukstakalnis, “Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR (Usability)”, Addison-Wesley Professional, 1st Edition, 2016.
3.	Robert Scoble, Shel Israel, “The Fourth Transformation: How Augmented Reality & Artificial Intelligence Will Change Everything”, Patrick Brewster Press, 1st Edition, 2016.
Web References:	
1.	https://www.tutorialspoint.com/top-10-augmented-reality-ar-technologies
2.	https://www.pcmag.com/news/augmented-reality-ar-vs-virtual-reality-vr-whats-the-difference
3.	https://arvr.google.com/
Online Resources:	
1.	https://www.coursera.org/specializations/unity-xr
2.	https://nptel.ac.in/courses/106106138
3.	https://www.udacity.com/course/introduction-to-virtual-reality--ud1012

Tentative Assessment Methods & Levels (based on Revised Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks: 20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C009.3	Analyze	Assignment	10
C009.4, C009.5	Apply	Online Quiz	5
C009.1, C009.2, C009.6	Understand	Case Study	5

Summative assessment based on Continuous and End Semester Examination

Revised Bloom’s Level	Continuous Assessment Theory			End Semester Examination (Theory) [50 marks]
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]	
Remember	20	20	10	10
Understand	80	40	40	40
Apply	-	30	30	30
Analyse	-	10	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

Course Outcomes (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C009.1	-	-	2	-	-	-	-	-	-	-	-	-	1	-	-
C009.2	2	2	-	-	-	-	-	-	-	-	-	-	1	2	-
C009.3	2	-	1	-	3	-	-	-	-	-	-	-	2	-	1
C009.4	2	2	-	2	-	1	-	-	-	-	3	3	-	-	2
C009.5	1	2	-	-	-	-	-	-	-	-	3	-	1	-	-
C009.6	1	3	-	-	1	-	-	-	-	-	-	-	2	1	-

20IT010	COMPUTATIONAL METHODS IN SYNTHETIC BIOLOGY	3/0/0/3
Nature of Course	C (Theory Concept)	
Prerequisites	Nil	

Course Objectives:

1.	To study synthetic biology concepts in engineering.
2.	To learn engineering concepts of design, build and test in Genomics.
3.	To implement the practical application of synthetic biology concepts.
4.	To implement basic molecular biology lab skills.
5.	To understand and analyze experimental data.

Course Outcomes

Upon completion of the course, students shall have ability to

C010.1	Recall the concept of genes and the expression of genes in naturally occurring organisms.	[R]
C010.2	Interpret the regulation of the genes and properties of gene products can be altered with synthetic biology methods.	[U]
C010.3	Explain the properties of the cell using synthetic biology.	[U]
C010.4	Construct modern DNA assembly techniques to build biological circuits.	[AP]
C010.5	Build biological circuits with many levels of control such as Pre/post transcriptional regulation, RNA-based regulation, Protein-protein interactions.	[AP]
C010.6	Develop ethical perspectives in synthetic biology.	[AP]

Course Contents:

Basic Principles of Gene Cloning and DNA Analysis **15 Hours**

Why Gene Cloning and DNA Analysis are Important - Vectors for Gene Cloning: Plasmids and Bacteriophages -Purification of DNA from Living Cells - Manipulation of Purified DNA-Introduction of DNA into Living Cells-Cloning Vectors for Eukaryotes-How to Obtain a Clone of a Specific Gene-The Polymerase Chain Reaction.

Applications of Gene Cloning and DNA Analysis **15 hours**

Sequencing Genes and Genomes-Studying Gene Expression and Function-Studying Genomes-Studying Transcriptomes and Proteomes -Gene Cloning and DNA Analysis in Medicine-Gene Cloning and DNA Analysis in Agriculture - Gene Cloning and DNA Analysis in Forensic Science and Archaeology.

Designing and Building Biological Systems **15 hours**

Bioinformatic analysis and characterization of genes and biomolecules-Computational Modeling and biological systems-Genome Synthesis and Genome Editing-Controlling and Engineering Pathways in Synthetic Biology-Testing Biological Systems and Biological Debugging Using metabolics.

Total Hours	**45**

Text Books:

1.	T.A.Brown, “Gene Cloning and DNA Analysis: An Introduction”, Wiley, 8th Edition, September 2020.
2.	David W. Mount “Bioinformatics: Sequence and Genome Analysis”, Cold Spring Harbor Laboratory Press, 2nd Edition, 2004.

3.	Arthur M. Lesk, “Introduction to Bioinformatics”, 5th Edition, Oxford University Press, 2019.
Reference Books:	
1.	Baxevanis A.D. and Oullette, B.F.F. “A Practical Guide to the Analysis of Genes and Proteins”, 2nd Edition, John Wiley, 2002.
2.	Durbin, R. Eddy S., Krogh A., Mitchison G. “Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids”. Cambridge University Press, 1998.
3.	Andrew R. Leach, “Molecular Modeling Principles and Applications”, 2nd Edition, Prentice Hall, 2009.
Web References:	
1.	https://unctad.org/system/files/official-document/ditctedinf2019d12_en.pdf
2.	https://www.frontiersin.org/articles/10.3389/fbioe.2019.00175/full
3.	http://www.synbicite.com/synthetic-biology/examples/
Online Resources:	
1.	https://www.coursera.org/learn/genes
2.	https://www.coursera.org/learn/industrial-biotech
3.	https://www.edx.org/course/principles-of-synthetic-biology

Tentative Assessment Methods & Levels (based on Revised Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks: 20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C010.1	Remember	Assignment	10
C010.2, C010.3	Remember, Understand	Online Quiz	3
C010.4, C010.5	Apply	Online Quiz	3
C010.6		Case Study	4

Summative assessment based on Continuous and End Semester Examination

Revised Bloom’s Level	Continuous Assessment Theory			End Semester Examination (Theory) [50 marks]
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]	
Remember	20	20	10	10
Understand	80	40	40	40
Apply	-	40	50	50
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

Course Outcomes (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C010.1	2	3	1	2	1			2	2	1			2	2	2
C010.2	3	2	2	2	2			2	2	1			2	2	2
C010.3	3	3	3	3	3			3	2	2	2	2	3	3	2
C010.4	1	1	2	2	1			3	2	2	2	2	3	2	2
C010.5	2	1	2	2	1			3	1			2	2	2	2
C010.6	2	2	2	2	2			3	3			2	2	2	1

20IT011	PRINCIPLES OF INDUSTRY 4.0	3/0/0/3
Nature of Course	C (Theory Concept)	
Pre requisites	Nil	

Course Objectives:

1.	To describe the advancements in Industry 4.0
2.	To understand industry 4.0 applications in the business world.
3.	To distinguish and overcome the challenges in the business world.

Course Outcomes

Upon completion of the course, students shall have ability to

C011.1	Relate the drivers and enablers of Industry 4.0	[R]
C011.2	Define the smartness in Smart Factories, Smart cities, smart products and smart services.	[R]
C011.3	Understand the various systems used in a manufacturing plant and their role in an Industry 4.0 world.	[U]
C011.4	Choose the key IIoT technologies	[AP]
C011.5	Identify the opportunities and challenges brought about by Industry 4.0	[AP]
C011.6	Classify the security challenges involved in industry 4.0	[A]

Course Contents:

Introduction to the Industrial Internet and IIoT Reference Architecture: 15 Hours
Introduction to IIoT, Key IIoT Technologies Catalysts and Precursors of the IIoT, Innovation and the IIoT, Key Opportunities and Benefits, The Digital and Human Workforce. The IIC Industrial Internet Reference Architecture, Industrial Internet Architecture Framework (IIAF), Architectural Topology, The Three-Tier Topology, Connectivity, Key System Characteristics, Data Management.

Middleware IIoT, WAN and Securing the Industrial Internet: 15 Hours
Examining the Middleware Transport Protocols - Middleware Software Patterns: Publish/Subscribe Pattern - Delay Tolerant Networks (DTN) - Software Design: API - Web Services. Middleware Industrial Internet of Things Platforms - IIoT WAN Technologies and Protocols - Securing the Industrial Internet.

Industry 4.0 and Smart Factories: 15 Hours
Introducing Industry 4.0 - The Value Chain - Industry 4.0 Design Principles - Building Blocks of Industry 4.0 - Smart Manufacturing - Smart Factories - Real-World Smart Factories - Digital Transformation - Customer Experience - Transforming Operational Processes - Transforming Business Models - Increase Operational Efficiency - Adopt Smart Architectures and Technologies.

Total Hours	**45**

Text Books:

1.	Alasdair Gilchrist, “Industry 4.0: The Industrial Internet of Things”, Apress, 2016.

Reference Books:

1.	Elena G. Popkova, Yulia V. Ragulina, Aleksei V. Bogoviz, “Industry 4.0: Industrial Revolution of the 21st Century”, Springer, 2019.
2.	Dominik T. Matt, Vladimír Modrák, Helmut Zsifkovits, “Industry 4.0 for SMEs: Challenges, Opportunities and Requirements”, Palgrave MacMillan, 2020.

3.	Bruno S. Sergi, Elena G. Popkova, Aleksei V. Bogoviz, Tatiana N. Litvinova, “Understanding Industry 4.0: AI, the Internet of Things, and the Future of Work”, Emerald Group Publishing, 2019.
4.	Alp Ustundag, Emre Cevikcan, “Industry 4.0: Managing the Digital Transformation”, Springer, 2017.
Web References:	
1.	https://www.ibm.com/in-en/topics/industry-4-0
2.	https://www.sap.com/india/insights/what-is-industry-4-0.html
3.	https://www.classcentral.com/course/linkedin-learning-foundations-of-the-fourth-industrial-revolution-industry-4-0-76632
Online Resources:	
1.	https://onlinecourses.nptel.ac.in/noc21_cs66/preview
2.	https://www.udemy.com/course/fundamental-of-industry-40/
3.	https://www.tuvsud.com/en-in/landing/asmea/introduction-to-smart-industry-readiness-index-training

Tentative Assessment Methods & Levels (based on Revised Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks: 20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C011.1	Remember	Online Quiz	5
C011.2, C011.3	Remember, Understand	Online Quiz	5
C011.4, C011.5	Apply	Assignment	5
C011.6	Analyze	Assignment	5

Summative assessment based on Continuous and End Semester Examination

Revised Bloom’s Level	Continuous Assessment Theory			End Semester Examination (Theory) [50 marks]
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]	
Remember	20	20	10	10
Understand	80	40	40	40
Apply	-	40	40	40
Analyse	-	-	10	10
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

Course Outcomes (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C011.1	2	3	1		1								1	2	2
C011.2	1	2	2		2								2	1	1
C011.3	3	3	3	3	3								3	3	1
C011.4	1	1	2		1								1	1	1
C011.5	2	1	2	2	1								2	1	2
C011.6		2	2		2								1	1	1

20IT012	AUTONOMOUS ROBOTICS	3/0/0/3
Nature of Course	C (Theory Concept)	
Pre requisites	Nil	

Course Objectives:

1.	To introduce the functional elements of Robotics
2.	To impart knowledge on the direct and inverse kinematics
3.	To gain knowledge about Robotic sensors and signals.
4.	To educate on various path planning techniques
5.	To introduce the map representations and sampling.

Course Outcomes

Upon completion of the course, students shall have ability to

C012.1	Recall the basic concept of robotics.	[R]
C012.2	Demonstrate the design issues and solution methods.	[U]
C012.3	Summarize about different sensors in robotics	[U]
C012.4	Outline about vision sensors and basic image operations.	[U]
C012.5	Make use of various path planning techniques.	[AP]
C012.6	Identify various map representations and its applications	[AP]

Course Contents:

Basic Concepts of Robot: **15 Hours**

Brief History-Types of Robot–Technology-Robot classifications and Specifications-Design and control issues - Various manipulators – Sensors - work cell - Programming languages. Challenges of mobile autonomous robots – Direct and Inverse Kinematics: Mathematical representation of robots – Position and orientation – Degrees of freedom - SCARA robots – Solvability – Solution methods – Closed form solution.

Sensors: **15 Hours**

Robotic sensors – Proprioception of robot kinematics and Internal forces – Sensors using light - Sensors using sound – Inertia based sensors – Beacon based sensors. Vision: Images as 2 Dimensional signals – signals to Information – Basic image operations.

Path Planning: **15 Hours**

Definition-Joint Space Technique-Use of p-degree polynomial - Cubic polynomial - Cartesian space technique - Parametric descriptions - Straight line and circular paths - Position and orientation planning – Map representations – Path planning algorithms – Sampling based path planning – Path smoothing – Other path planning applications. **Case Study**: Elmer and Elsie.

Total Hours	**45**

Text Books:

1.	R.K.Mittal and I.J.Nagrath, “Robotics and Control”, Tata McGraw Hill, New Delhi, 4th Reprint, 2005.
2.	Nikolaus Correll “Introduction to Autonomous Robots”, Magellan Scientific, 2020.
3.	JohnJ. Craig, “Introduction to Robotics Mechanics and Control”, 3rd Edition, Pearson Education, 2009

Reference Books:	
1.	S.R. Deb, “Robotics Technology and flexible automation”, Tata McGraw-Hill Education., 2009.
2.	Richard D. Klafter, Thomas. A, ChriElewski, Michael Negin, “Robotics Engineering an Integrated Approach”, PHI Learning., 2009.
3.	Francis N. Nagy, Andras Siegler, "Engineering foundation of Robotics", Prentice Hall Inc., 1987.
Web References:	
1.	https://www.me.chalmers.se/~mwahde/courses/aa/2016/FFR125_LectureNotes.pdf
2.	https://www.sci.brooklyn.cuny.edu/~goetz/cisc1003/books/Introduction%20to%20Autonomous%20Robots.pdf
Online Resources:	
1.	https://nptel.ac.in/courses/107106090
2.	https://onlinecourses.nptel.ac.in/noc21_me76/preview

Tentative Assessment Methods & Levels (based on Revised Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks: 20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C012.1, C012.2	Remember, Understand	Assignment	10
C012.3, C012.4	Understand	Online Quiz	5
C012.5, C012.6	Apply	Case Study	5

Summative assessment based on Continuous and End Semester Examination

Revised Bloom’s Level	Continuous Assessment Theory			End Semester Examination (Theory) [50 marks]
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]	
Remember	20	20	10	10
Understand	80	40	40	40
Apply	-	40	50	50
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

Course Outcomes (CO)	Programme Outcomes (PO)											Programme Specific Outcomes (PSO)			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C012.1	2	3	1		1								1	2	2
C012.2	1	2	2		2								2	1	1
C012.3	3	3	3	3	3								3	3	1
C012.4	1	1	2		1								1	1	1
C012.5	2	1	2	2	1								2	1	2
C012.6		2	2		2								1	1	1

20MC103	SOFT SKILLS	2/0/0/0
Nature of Course:	Theory Concept	
Pre requisites:	Technical Communication Skills	

Course Objectives:

1.	To develop the students competency level and their capabilities.
2.	To teach the students to be effective in workplace and social environments.
3.	To create self confidence among the students and to resolve stress and conflict within themselves.
4.	To help the students to enhance their career skills by increasing their productivity and performances.
5.	To concentrate more on conversation skills, presentation skills, verbal ability, critical and creative thinking.

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

C103.1	Remember the principles of soft skills required for their profession.	[R]
C103.2	Understand the importance of Interpersonal communication Skills among individuals, groups and cultures.	[U]
C103.3	Apply verbal and non-verbal communication skills in corporate environment.	[AP]
C103.4	Analyse and apply creativity skills, critical thinking skills and problem solving skills.	[AN]
C103.5	Articulate oral and written messages in an appropriate and persuasive manner to suit specific purposes, audiences and contexts at work place.	[AP]
C103.6	Apply good teamwork skills and Leadership Skills	[AP]

Course Contents:

Module 1: Professional Communication Skills **10 Hours**

Introduction to the Soft Skills, Performance Evaluation 1 – Significance of Soft Skills - Understanding the basic Communication Principles –Listening Skills- Listening Exercises- Speaking Skills- How to start and Sustain a Conversation- Speaking in Groups- Understanding self and Personal Branding, attitude, types of attitude, Positive Attitude, Self Confidence and Self-Motivation - Personal Application/Action Taken. Advanced Writing Skills-Principles of Business Writing- E mails- Writing Reports- Types of Reports- Strategies for Report Writing- Personal Application/Action Taken. Verbal Ability- Analogy- Classification- Odd One Out- Idioms and Phrases- Sentence Correction- Empathy and its importance in career -Personal Application/Action Taken.

Module 2: Interpersonal Communication **10 Hours**

Nonverbal Communication- Individual, Groups and Cultures- Body Language- Attire and Etiquettes- Interpersonal Skills- dealing with diverse People- Networking- Emotional Intelligence and its importance. Personal Application/Action Taken. Developing Creativity- Critical Thinking and Problem Solving Skills- Making the Right Choice- Never Give Up- Begin to Grow- Personal Application/Action Taken. Interviews- Facing Job Interviews - Planning and Preparing- Effective Resume along with Covering Letter- Planning and Preparing- Personal Application/Action Taken. Self-Discipline - Self Presentation - Personal Application/Action Taken.

Module 3: Teamwork and Leadership Skills **10 Hours**

Industry Expectations- Universal Hiring Rule- Personal Application/Action Taken. Importance of Human Values-Importance of Team Work- Developing Key Traits in Motivation, Persuasion, Negotiation and Leadership Skills- Being an Effective Team Player- Personal Application/Action Taken. Planning- Prioritization - Delegation- Conflict Management- Decision and its necessity in crucial situations- Group Discussion- Personal Application/Action Taken. Essential Skills in working Strategies- Presentation and Interaction Skills- What to Present and How- Being Assertive- Multimedia Presentation-Making Effective Presentations. Interview Skills- Do's and Don'ts - Body Language – Answering the Common Questions of Interview- Performance Evaluation 2- Mock Interview

Total Hours:	**30**

Text Books:	
1.	Penrose, "Business Communication for managers: An advanced approach", Cengage learning.
2.	H.E. Sales, "Professional Communication in Engineering", Palgrave Macmillan 2009.
3.	W. P. Scott, Bertil Billing, "Communication for Professional Engineers", Thomas Telford, 1998.
Reference Books:	
1.	Peter Davson-Galle, "Reason and Professional Ethics", Ashgate Publishing, Ltd., 2009.
2.	William B. Gudykunst, "Cross Cultural and Inter Cultural Communication", Sage Publications India Pvt Ltd, New Delhi, 2003.
3.	Joep Cornelissen, "Corporate Communications: Theory and Practice", Sage Publications India Pvt Ltd, New Delhi, 2004.
Web References:	
1	https://onlinecourses.nptel.ac.in/noc16_hs15/preview
2	https://www.getinternship.switchidea.com/NTAT/syllabus/Interpersonal-Communication.
3	https://smude.edu.in/smude/programs/bca/soft-skills.html
Online Resources:	
1	https://swayam.gov.in/course/4047-developing-soft-skills-and-personality
2	https://www.clearias.com/interpersonal-skills-including-communication-skills-for-csat/
3	https://www.bizlibrary.com/soft-skills-training/

Assessment Methods & Levels (based on Revised Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:40)

Course Outcome	Revised Bloom's Level	Assessment Component	Marks
C103.1	Remember	Group Discussion	10
C103.2 & C103.3	Understand	Listening Skills	10
C103.4	Apply	Interview	10
C103.5 & C103.6	Apply	Formal Presentation	10

Summative assessment based on Continuous Assessment	
Revised Bloom's Level	**Term End Assessment [60 marks]**
Remember	30
Understand	40
Apply	20
Analyse	10
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**
C103.1						1	1	2	2	3	2	2			1
C103.2							1	1	3	3	2	2			1
C103.3									2	3	2	2			1
C103.4						1	1	1	2	3	3	2			1
C103.5						1	1		2	3	2	2			1
C103.6							1	2	3	3	2	2			1

20MC105	GENERAL APTITUDE	2/0/0/0
Nature of Course	Problem analytical	
Pre requisites	Basic Mathematical calculations	

Course Objectives:

1	To ensure that students learn to think critically about mathematical models for relationships between different quantities and use those models effectively to solve problems and reach conclusions about them.
2	To impart skills that enable students to effectively use and interpret data, formulas, and graphs in the workplace.
3	To instills confidence in facing technical aptitude questions interviewed by recruiters.

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

C105.1	To teach the basics of Quantitative Techniques in a graded manner.	[R]
C105.2	Understand the verbal and non-verbal nature of problems in reality and know the shortcut methods of solving it.	[U]
C105.3	Solve problems using their general mental ability.	[AP]
C105.4	To give intense focus on improving and increasing the ability of solving real problems.	[AP]
C105.5	Think critically about mathematical models for relating different quantities to reach conclusion.	[AP]
C105.6	Enable effective use of data interpretation, formulas, graphs and assumptions.	[AP]

Course Contents:

Module 1: Number Theory and Statistics **14 Hours**

Number Systems– HCF and LCM of Numbers – Decimal Fractions – Simplification – Square Root and Cube Root of a number – Surds and Indices – Problems on numbers – Percentage – Ratio and Proportion – Divisibility – Mixtures – Averages- Polynomials – Solving Equations and Inequalities – Discard's rule of signs – Problems on ages – Chain rule – Time and Work – Time and Distance – Problems on Trains – Problems on Boats and Streams- Measures of central tendency – Mean, Median and Mode – Variance and Standard deviation Logarithms – Profit and Loss – Simple Interest – Compound Interest.

Module 2: Logic and Decision Making **8 Hours**

Analogy – Classification – Series completion – Coding and Decoding – Blood Relations – Puzzle Test – Direction Sense test – Logical Venn Diagrams - Number Ranking and Time Sequence Test – Decision Making – Assertion and Reason– Inserting the missing one – Logical Sequence of words – Syllogisms.

Module 3: Reasoning **8 Hours**

Logic – Statement and Arguments – Statements and Assumptions – Statements and Course of Action – Statements and Conclusions – Deriving conclusions from passages – Functions – Different kinds of functions – Miscellaneous sets- Series – Analogy – Classifications – Analytical Reasoning – Problems on Cubes and Dice – Mirror Images – Water Images – Rule Detection.

Total Hours:	**30**

Text Books:

1	Aggarwal R. S, "Quantitative Aptitude" Revised Edition, S. Chand Publication.
2	Abhijit Guha, "Quantitative Aptitude" 5th Edition, McGraw Hill Education.

Reference Books:	
1	Edgar Thorpe “Mental Ability & Quantitative Aptitude” 3rd Edition, McGraw Hill Education.
Web References:	
1	https://www.wiziq.com/tutorial/815468-quantitative-aptitude-reasoning-data-interpretation-video-lectures
2	https://learningpundits.com/contest?referrer=harsh.cse15@nituk.ac.in
3	https://nptel.ac.in/courses/114106041/8
4	https://nptel.ac.in/courses/111103020/2
Online Resources:	
1	http://aptitudetraining.in/home/index.php
2	https://www.udemy.com/vedicmaths/
3	https://www.youtube.com/channel/UCtmn-DsF4BhPug-ff9LiDAA?disable_polymer=true

Tentative Assessment Methods & Levels (based on Revised Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:40)

Course Outcome	Revised Bloom’s Level	Assessment Component	Marks
C105.1	Remember	Classroom or Online Quiz	10
C105.2 & C105.3	Understand	Formal presentation	10
C105.4, C105.5 & C105.6	Apply	Formal interview tests	20

Summative assessment based on Continuous Assessment

Bloom’s Level	Term End Assessment [60 marks]
Remember	20
Understand	40
Apply	40
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
C105.1	3	3	1												
C105.2	3	2	1												
C105.3	3	3	1												
C105.4	3	2	1										2		
C105.5	3	3	1										2		
C105.6	3	2	1										2		

20MC106	LIFE SKILLS AND ETHICS	2/0/0/0
Nature of Course	Theory Concept	
Pre requisites	Nil	

Course Objectives:

1	To develop communication competence in prospective engineers.
2	To enable them to convey thoughts and ideas with clarity and focus.
3	To develop report writing skills.
4	To equip them to face interview & Group Discussion.
5	To inculcate critical thinking process.
6	To prepare them on problem solving skills.
7	To provide symbolic, verbal, and graphical interpretations of statements in a problem description.

Course Outcomes:

Upon completion of the course, students shall have ability to

C106.1	Define and Identify different life skills required in personal and professional life.	[U]
C106.2	Develop an awareness of the self and apply well-defined techniques to cope with emotions and stress.	[AP]
C106.3	Explain the basic mechanics of effective communication and demonstrate these through presentations.	[AN]
C106.4	Use appropriate thinking and problem solving techniques to solve new problems.	[AP]
C106.5	Understand the basics of teamwork and leadership	[U]

Course Contents:

Communication Skill:
Introduction to Communication, The Process of Communication, Barriers to Communication, Listening Skills, Writing Skills, Technical Writing, Letter Writing, Job Application, Report Writing, Non-verbal Communication and Body Language, Interview Skills, Group Discussion, Presentation Skills, Technology-based Communication.

Critical Thinking & Problem Solving:
Creativity, Lateral thinking, Critical thinking, Multiple Intelligence, Problem Solving, Six thinking hats Mind Mapping & Analytical Thinking. Teamwork: Groups, Teams, Group Vs Teams, Team formation process, Stages of Group, Group Dynamics, Managing Team Performance & Team Conflicts.

Ethics, Moral & Professional Values:
Human Values, Civic Rights, Engineering Ethics, Engineering as Social Experimentation, Environmental Ethics, Global Issues, Code of Ethics like ASME, ASCE, IEEE. **Leadership Skills:** Leadership, Levels of Leadership, Making of a leader, Types of leadership, Transactions Vs Transformational Leadership, VUCA Leaders, DART Leadership, Leadership Grid & leadership Formulation

Total Hours:	**30**

Reference Books:

1	Barun K. Mitra, “Personality Development & Soft Skills”, First Edition, Oxford Publishers, 2011.
2	Kalyana, “Soft Skill for Managers”, 1st Edition, Wiley Publishing Ltd, 2015.
3	Larry James, “The First Book of Life Skills”, 1st Edition, Embassy Books, 2016
4	Shalini Verma, “Development of Life Skills and Professional Practice”, 1st Edition, Sultan Chand (G/L) & Company, 2014
5	John C. Maxwell, “The 5 Levels of Leadership”, Centre Street, A division of Hachette Book Group Inc, 2014.

Web References:	
1	https://www.coursera.org/courses?query=ethics

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:40)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C106.1	Remember	Quiz	**5**
C106.2	Understand	Assignment	**15**
C106.3	Understand	Presentation	**10**
C106.4 C106.5	Apply	Group Discussion	**10**

Summative assessment based on Continuous Assessment	
Revised Bloom's Level	**Term End Assessment [60 marks]**
Remember	30
Understand	40
Apply	20
Analyse	10
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**
C106.1								1	2	1		2	1		
C106.2								1	2	1		2	1		
C106.3								2	2	3		1	1		
C106.4								1	1	1		1	3		
C106.5								1	3	2		2	1		

20MC107	STRESS MANAGEMENT	2/0/0/0
Nature of Course	Theory Concept	
Pre requisites	Nil	

Course Objectives:

1	Understand the basic principles of stress management
2	Recognize your stress triggers and how to manage them
3	Develop proactive responses to stressful situations
4	Use coping tips for managing stress both on and off the job
5	Learn to manage stress through diet, sleep and other lifestyle factors
6	Develop a long term action plan to minimize and better manage stress
7	Understand the basic principles of stress management

Course Outcomes:

Upon completion of the course, students shall have ability to

C107.1	Understand the basic principles of stress management	[U]
C107.2	Apply the concept of recognizing your stress triggers and find was to manage them.	[AP]
C107.3	Develop proactive responses to stressful situations	[AN]
C107.4	Develop a long term action plan to minimize and better manage stress	[AP]

Course Contents:

Scientific Foundations of Stress:
What is stress? – Sources of Stress – Types of Stress – Personality Factors and stress – Stress and the college student. Stress Psychophysiology: Stress and nervous system – Hypothalamic – Pituitary – Adrenal (HPA) Axis – Effect of Stress on Immune system – Health risk associated with chronic stress – Stress and Major Psychiatric disorders.

Developing Resilience to Stress:
Understanding you stress level – Role of personality pattern, Self-esteem, Locus of control – Role of Thoughts Beliefs and Emotions – I & II – Life situation Intrapersonal: (Assertiveness, Time Management).

Strategies for Relieving Stress:
Developing cognitive coping skills – Autogenic training, imagery and progressive relaxation – Other relaxation techniques – Exercise and Health – DIY strategies stress management.

Total Hours:	**30**

Reference Books:

1	Jonathan C. Smith, “Stress Management: A Comprehensive Handbook of Techniques and Strategies”, 1st Edition, Springer Publishing Company, 2011.
2	Bob Stahl, Elisha Goldstein, Jon Kabat-Zinn, “A Mindfulness–based Stress Reduction Workbook”, 2nd Edition, New Harbinger Publications, 2019.
3	Ryan M. Niemiec, “The Strengths-based Workbook for Stress Relief”, 1st Edition, New Harbinger Publications, 2019.

Web References:

1	https://thiswayup.org.au/courses/coping-with-stress-course/
2	https://www.classcentral.com/course/swayam-stress-management-14309

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:40)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C107.1	Remember	Quiz	**10**
C107.2	Understand	Group Discussion	**10**
C107.3	Understand	Class Presentation	**10**
C107.4	Apply	Assignment	**10**

Summative assessment based on Continuous Assessment	
Revised Bloom's Level	**Term End Assessment [60 marks]**
Remember	30
Understand	40
Apply	20
Analyse	10
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**
C107.1								1	3			1	1		
C107.2								1	2	1		1	1		
C107.3								1	3	1		2	2		
C107.4								1	3	1		3	2		

20MC108	CONSTITUTION OF INDIA	2/0/0/0

Nature of Course : Theory

Pre Requisites : Nil

Course Objectives:

1	To familiarize with basic information about Indian constitution
2	To understand the fundamental rights and duties as citizens of India

Course Outcomes:

Upon completion of the course, students shall have ability to

C108.1	Explain the objectives of the Constitution of India and its formation	[U]
C108.2	Recall state and central policies (Union and State Executive), fundamental Rights and their duties.	[R]
C108.3	Make use of legal directions in developing solutions to societal issues	[AP]
C108.4	Utilized for competitive exams that requires knowledge of Indian Constitution	[AP]

Course Contents:

Module 1 **10 Hours**

Historical perspective, The making of the Constitution, The Role of the Constituent Assembly - Preamble and Salient features of the Constitution of India. Fundamental Rights, Directive Principles of State Policy, Fundamental Duties, Citizenship Article 5-11.

Module 2 **10 Hours**

Federal structure, Powers of the Union and the states, Centre-State Relations, Union Executive – President, Prime Minister, Union Cabinet, Parliament, Supreme Court of India, State Executives – Governor, Chief Minister, State Cabinet, State Legislature, High Court and Subordinate Courts, Elections, Electoral Process, and Election Commission of India, Election Laws. Powers and Functions of Municipalities and Panchayat

Module 3 **10 Hours**

Amendments - Methods, Emergency Provisions, National Emergency, President Rule, Financial Emergency, Provisions for SC & ST, OBC, women, children and backward classes, Right to Property, Freedom of Trade and Commerce. Agricultural Law

Total Hours:	**30**

Text Books:

1	Dr. D. D. Basu, “Introduction to the Constitution of India”, LexisNexis, New Delhi, 22nd Edition, 2016.
2	“Bare act-constitution of India”, The universal Publications, LexisNexis 2020, New Delhi, India.

Reference Books:

1	Subhash. C. Kashyap, “Our Constitution: An Introduction to India’s Constitution and Constitutional Law”, National Book Trust, India, 5th Edition, 2019.
2	M. Laxmikanth, “Constitution of India”, Cengage Learning India, 1st Edition 2018.

Web References:

1	https://unacademy.com/course/the-indian-constitution/NSKQ8XXQ
2	https://unacademy.com/goal/upsc-civil-services-examination-ias-preparation/KSCGY

Assessment Methods & Levels (based on Blooms’ Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:40)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C108.1	Remember	Test	10
C108.4	Understand	Quiz	10
C108.3	Apply	Presentation	10
C108.2	Apply	Group Assignment	10

Summative assessment based on Continuous Assessment	
Revised Bloom's Level	**Term End Assessment [60 marks]**
Remember	30
Understand	40
Apply	30
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
C108.1						3	1	1	1			1	1	1	
C108.2						3	1	1	1			1	1	2	
C108.3						3	2	2	1			1	1	2	
C108.4						3	1	1	1			2	1	1	

20MC109	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	2/0/0/0
Nature of Course : Theory		
Pre Requisites : Nil		

Course Objectives:

1	To make understand the contribution of Indian mind in various fields.
2	To cultivate critical appreciation of the thought content and provide insights relevant for promoting cognitive ability, health, good governance, aesthetic appreciation and right values.

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

C109.1	Relate classical Indian traditions with contemporary traditions and culture.	[R]
C109.2	Outline the thoughts of Indians in different disciplines.	[U]
C109.3	Apply the knowledge to the present context.	[AP]
C109.4	Develop a better appreciation and understanding of Indian traditions.	[AP]

Course Contents:

Indian Ethics: Individual and Social – Society state and Polity (Survey) - Education systems – Agriculture (Survey) – Early & Classical Architecture – Medieval & Colonial Architecture.

Astronomy in India – Martial Arts Traditions (Survey) - Indian Literatures - Indian Philosophical Systems - Indian Traditional Knowledge on Environmental Conservation

Ayurveda for Life, Health and Well-being - The Historical Evolution of Medical Tradition in Ancient India- Music in India - Classical & Folk

Total hours:	**30**

Text Books:

1	Kapil Kapoor and Michel Danino, “Knowledge Traditions and Practices of India”, Central Board of Secondary Education, 2017.
2	Yogesh Atal, “Indian Society: Continuity and Change”, Pearson Education India, 2016.

Reference Books:

1	Douglas Osto, “An Indian Tantric Tradition and Its Modern Global Revival”, Routledge publications, 2020.
2	Rao C.N. Shankar, “Sociology: Principles of Sociology with an Introduction to Social Thoughts”, S Chand Publisher, 2019.

Web References:

1	http://nopr.niscair.res.in/handle/123456789/43
2	https://nptel.ac.in/courses/109/104/109104102/

Assessment Methods & Levels (based on Blooms’ Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:40)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C109.1	Remember	Quiz	10
C109.2	Understand	Group Assignment	10
C109.3	Apply	Presentation	10
C109.4	Create	Survey	10

Summative assessment based on Continuous Assessment	
Revised Bloom's Level	**Term End Assessment [60 marks]**
Remember	30
Understand	40
Apply	30
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
C109.1						2	1	1	1			2	3	1	
C109.2						2	1	1	2			1	2	1	
C109.3						1	1	1	1			1	1	1	
C109.4						2	1	1	2			2	1	1	