GOVERNMENT COLLEGE OF ENGINEERINGSALEM – 636 011

Regulations 2018A

B.E. COMPUTER SCIENCE AND ENGINEERING– Full Time

Course code	Name of the Course	Hours/Week						Maximum Marks		
		Category	Contact periods	Lecture	Tutorial/ Demo*	Practical	Credit	CA	FE	Total
SEMESTER-I										
THEORY										
18EN101	Professional English	HS	2	2	0	0	2	40	60	100
18MA101	Matrices and Calculus	BS	4	3	1	0	4	40	60	100
18CY101	Chemistry	BS	4	3	1	0	4	40	60	100
18CS101	Fundamentals of Problem Solving and C Programming	ES	3	3	0	0	3	40	60	100
PRACTICAL										
18EN102	Professional English Laboratory	HS	2	0	0	2	1	60	40	100
18CS102	Computer Practice Laboratory	ES	4	0	0	4	2	60	40	100
18ME102	Workshop Manufacturing Practices	ES	4	1	0	4	3	60	40	100
18MC101	Induction Program - 21 Days	MC					0			
TOTAL							**19**			
SEMESTER-II										
THEORY										
18MA202	Differential Equations and Linear Algebra	BS	4	3	1	0	4	40	60	100
18PH201	Semiconductor Physics and Optoelectronics	BS	4	3	1	0	4	40	60	100
18EE101	Basic Electrical and Electronics Engineering	ES	4	3	1	0	4	40	60	100
18ME101	Engineering Graphics & Design	ES	3	1	0	4	3	40	60	100
PRACTICAL										
18PH103	Physics Laboratory	BS	3	0	0	3	1.5	60	40	100
18CY102	Chemistry Laboratory	BS	3	0	0	3	1.5	60	40	100
18EN103	Professional Communication Laboratory	HS	2	0	0	2	1	60	40	100
18EE102	Basic Electrical and Electronics Engineering Laboratory	ES	2	0	0	2	1	60	40	100
	TOTAL						**20**			

SEMESTER-III										
THEORY										
18MA301	Probability and Statistics	BS	4	3	1	0	4	40	60	100
18CS301	Digital Principles and System Design	ES	3	3	0	0	3	40	60	100
18CS302	Data Structures and Algorithms	PC	3	3	0	0	3	40	60	100
18CS303	Computer Organization and Architecture	PC	3	3	0	0	3	40	60	100
18CS304	Operating Systems	PC	3	3	0	0	3	40	60	100
PRACTICAL										
18CS305	Data Structures and Algorithms Laboratory	PC	4	0	0	4	2	60	40	100
18CS306	Operating Systems Laboratory	PC	4	0	0	4	2	60	40	100
	TOTAL						**20**			
SEMESTER-IV										
THEORY										
18MA401	Numerical Methods and Linear Programming Problem	BS	4	3	1	0	4	40	60	100
18CS401	Computer Networks	PC	3	3	0	0	3	40	60	100
18CS402	Design and Analysis of Algorithms	PC	3	3	0	0	3	40	60	100
18CS403	Object Oriented Programming using C++	PC	3	3	0	0	3	40	60	100
18CS404	Software Engineering	PC	3	3	0	0	3	40	60	100
18CS405	Microprocessors and Microcontrollers	ES	3	3	0	0	3	40	60	100
PRACTICAL										
18CS406	Object Oriented Programming using C++ Laboratory	PC	4	0	0	4	2	60	40	100
18CS407	Microprocessors and Microcontrollers Laboratory	ES	4	0	0	4	2	60	40	100
18CYMC01	Environmental Science	MC		0	0	1	0			
	TOTAL						**23**			

SEMESTER-V										
THEORY										
18CS501	Database Management Systems	PC	3	3	0	0	3	40	60	100
18CS502	Theory of Computation	PC	3	3	0	0	3	40	60	100
18CS503	Java Programming	PC	3	3	0	0	3	40	60	100
18MG501	Principles of Management	HS	3	3	0	0	3	40	60	100
18CSOExx	Open Elective I	OE	3	3	0	0	3	40	60	100
PRACTICAL										
18CS504	Database Management Systems Laboratory	PC	4	0	0	4	2	60	40	100
18CS505	Java Programming Laboratory	PC	4	0	0	4	2	60	40	100
18EN501	Communication Skills and Language Laboratory	BS	4	0	0	4	2	60	40	100
18MC301	Indian Constitution	MC		2	0	0	0	100		100
18MCIN01	Ideation Sprints	EEC	2	0	0	2	1	100		100
	TOTAL						**22**			
SEMESTER-VI (Regular Stream)										
THEORY										
18CSPExx	Professional Elective - I	PE	3	3	0	3	3	40	60	100
18CSPExx	Professional Elective - II	PE	3	3	0	3	3	40	60	100
18CSPExx	Professional Elective - III	PE	3	3	0	3	3	40	60	100
18CSOExx	Open Elective - I	OE	3	3	0	3	3	40	60	100
18CSOExx	Open Elective - II	OE	3	3	0	3	3	40	60	100
18CSOExx	Open Elective - III	OE	3	3	0	3	3	40	60	100
18CS605	Mini Project	EEC	6	0	0	6	3	40	60	100
							21			
SEMESTER VI (protosem stream)										
18MEPS11	Applied Design Thinking	Proto Sem	**3**	**0**	**0**	**3**	3	100	-	100
18MEPS12	Startup Fundamentals	Proto Sem	3	0	0	3	3	100	-	100
18MEPS13	Computational Hardware	Proto Sem	3	0	0	3	3	100	-	100
18MEPS14	Coding for Innovators	Proto Sem	3	0	0	3	3	100	-	100
18MEPS15	Industrial Design & Rapid Prototyping Techniques	Proto Sem	3	0	0	3	3	100	-	100
18MEPS16	Industrial Automation/ Data Life Cycle Management	Proto Sem	3	0	0	3	3	100	-	100
18MEPS17	Robotics /ML& MLOps	Proto Sem	3	0	0	3	3	100	-	100
	Total						**21**			

SEMESTER-VII										
18CS701	Cryptography and Network Security	PC	3	3	0	0	3	40	60	100
18CS704	Mobile Computing	PC	3	3	0	0	3	40	60	100
18CS601	Principles of Compiler Design	PC	3	3	0	0	3	40	60	100
18CS602	Web Technology	PC	3	3	0	0	3	40	60	100
18CSPExx	Professional Elective IV	PE	3	3	0	0	3	40	60	100
18CS702	Network Security Laboratory	PC	4	0	0	4	2	40	60	100
18CS603	Compiler Design Laboratory	PC	4	0	0	4	2	40	60	100
18CS604	Web Technology Laboratory	PC	4	0	0	4	2	40	60	100
	Total						**21**			
SEMESTER-VIII										
18CSPExx	Professional Elective V	PE	3	3	0	0	3	40	60	100
18CSPExx	Professional Elective VI	PE	3	3	0	0	3	40	60	100
18CS801	Project Work	EEC	16	0	0	16	8	80	120	200
	TOTAL						**14**			

Total Number of Credits = 160

18EN101	PROFESSIONAL ENGLISH	L	T	P	C
		2	0	0	2

Course Objectives:

1.	Master basic reading skills such as phonics, word recognition and meaningful division of sentences.
2.	Read fast, decode accurately and remove oral reading errors that affect text meaning
3.	Acquire and develop writing skills for academic, social and professional purposes
4.	Gain skills in academic and functional writing tasks.

WRITING

1. Word Formation with Prefix and Suffix, Synonyms and Antonyms, Tenses, Parts of Speech, Common Errors in English (Subject –Verb Agreement, Noun-Pronoun Agreement, Prepositions, Articles, Conditional statements, Redundancies, Clichés etc), Voices

2. Email — Training Programme and related details, paper submission for seminars and conferences, Fixing an appointment, Arranging and Cancelling a meeting with team members, conference details, hotel accommodation, Reminder mails, Raising queries with team members, Congratulatory mails at work, arranging for a meeting with a foreign client, personal emails.

3. Letter Writing – Business and need based communication – Formats of official, personal and business letters, official leave and request applications (Bonafide certificate, course completion, conduct certificate, permission to arrange industrial visits) complaints, replies to queries from business customers, inviting dignitaries, accepting and declining invitations, placing orders, cover letter for a job application with resume.

4. Technical Report Writing — status reports — Work Done in the Project, Feasibility Reports on Office Accommodation, Introduction of New Products, Sales Promotion, Customers Feedback, Starting a New Company, Event Reports- Seminars, Conferences, Meeting, Recommendations and Checklists.

5. Charts- interpreting pie charts, graphs etc.,

READING

1. Understanding notices, messages, timetables, adverts, graphs, etc.- understanding meaning and purpose of short texts.
2. Gapped sentences – Meanings, collocations and meanings of individual words.

3. Reading passage with multiple choice questions – reading for gist and reading for specific information – skimming for general idea of and meaning and contents of the whole text.

4. Short reading passage; gap-filling – Grammar, especially prepositions, articles, auxiliary verbs, modalverbs, pronouns, relative pronouns and adverbs.

5. Short reading passages; sentence matching – Scanning – ability to pick out specific information in ashort text.

METHODOLOGY

Objective Type:

1. Vocabulary of business communication.
2. Collocations related to technical and business.
3. Coherence in paragraphs – use of sequence clues.
4. Conversations and appropriate responses.
5. Tenses with time makers.
6. Verbal phrases
7. Description of objects in a sentence or two
8. Products and likely slogans
9. Tone, vocabulary, expressions in formal and informal letters.
10. Email writing- tone, vocabulary, expressions, mail ID., creation, CC, BCC.

Descriptive Writing:

1. Skimming and scanning to look for specific information.
2. Spotting Errors.
3. Email writing in different work place/ profession based contexts with hints.
4. Letter writing in different business based contexts with hints.
5. Report writing: feasibility report, progress in project reports, accident reports andevent reports.
6. Checklists in business, office and profession based context.
7. Recommendations in business, office and profession based context.
8. Resume and Cover letter.
9. Mind mapping visuals on social and environmental issues – essay writing based onthe given mind map visual.

Total (L+T)= 30 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Read and summarize the main ideas, key details and inferred meanings from a passage
CO2	:	Internalize the grammar items such as prepositions, articles, tenses, verbs, pronouns, and adverbsadjectives through contexts and apply them to spot errors.
CO3	:	Develop the ability to classify, check information and prepare reports.
CO4	:	Apply the academic and functional writing skills in new contexts
CO5	:	Interpret pictorial representation of data and statistic

Text Books:

1.	Norman Whitby. Business Benchmark –Pre - Intermediate to Intermediate, Students Book, CambridgeUniversity Press, 2014

Recommended Readings and Reference sources:	
1.	M. Ashraf Rizvi, Effective Technical Communication, McGraw Hill
2.	Farhathullah, T.M. Communication Skills for Technical Students
3.	Meenakshi Raman and Sangeetha Sharma, Technical Communication: Principles and Practice, OxfordUniversity Press, New Delhi, 2004
4.	David F. Beer and David McMurray, Guide to Writing as an Engineer, John Willey. New York, 2004
5.	Collins Cobuild- Student's Grammar: Self-Study Edition with Answers (Collins Cobuild Grammar) paperback- 6 May 1991
6.	Essential English Grammar paperback Raymond Murphy CUP 2007
7.	Android App for Grammar: https://play.google.com/store/apps/details?id=com.zayaninfotech.english.grammar http://www.onestopenglish.com/grammar/
8.	Speak Better Write Better English paperback — Nov 2012, Norman Lewis, Goyal Publishers and Distributors
9.	Essential English Grammar Paperback Raymond Murphy CUP 2007
10	English Reading Comprehension 2014 RPH Editorial Board
11	Proficiency in Reading Comprehension Simplifying the 'Passage' for you, 2008 Ajay Singh.

18MA101	MATRICES AND CALCULUS	L	T	P	C
		3	1	0	4

Course Objectives:

1.	To know the use of matrix algebra needed by engineers for practical applications.
2.	To understand effectively the geometrical application of differential calculus and Beta, Gamma functions
3.	To familiarize with partial differentiation concepts and its applications
4.	To obtain the knowledge of multiple integration and their related applications
5.	To acquire the knowledge of vector differentiation and integration and its applications

UNIT I	MATRICES	9	+	3

Symmetric, Skew Symmetric and Orthogonal Matrices – Characteristic equation of a Matrix – Eigen values and Eigen vectors – Properties – Cayley-Hamilton theorem (excluding proof) – Diagonalization of Matrices -Reduction of quadratic form to canonical form by orthogonal transformation

UNIT II	CALCULUS	9	+	3

Curvature , Radius of Curvature (Cartesian coordinates) — Centre and Circle of curvature - Evolutes andInvolutes- Definite integrals and their properties – Beta and Gamma functions and their properties.

UNIT III	MULTIVARIABLE CALCULUS (DIFFERENTIATION)	9	+	3

Partial derivatives – Euler's theorem for homogenous functions – Total Derivatives –Jacobians – Maxima,Minima and Saddle point- – Method of Lagrangian multipliers- Taylor's series.

UNIT IV	MULTIVARIABLE CALCULUS (INTEGRATION)	9	+	3

Multiple integrals- Double integrals – Change of order of integration in double integrals – Change of variables(Cartesian to Polar) – Application to Areas – Evaluation of Triple integrals – Application to volumes

UNIT V	VECTOR CALCULUS	9	+	3

Vector differentiation- Gradient- Directional derivative - Divergence - Curl , Vector integration- Line integration- work done — Surface and Volume integrals - Green's theorem , Gauss divergence and Stokes theorem (without proof) – Simple applications involving cubes and rectangular parallelepipeds.

Total (L+T)= 60 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	:	Learn the fundamental knowledge of Matrix theory
CO2	:	Familiar with the concept of the differentiation and integration and its applications
CO3	:	Acquire skills in applications of Integral and Vector Calculus

Text Books:

1.	Grewal. B.S, "Higher Engineering Mathematics", 43rd Edition, Khanna Publications, Delhi, (2015).
2.	Veerarajan T., "Engineering mathematics for first year", Tata McGraw Hill Education Pvt. Ltd., New Delhi,2009

Reference Books:

1.	James Stewart, "Essential Calculus", Cengage Learning, New Delhi, 2nd edition, 2013
2.	P. Kandasamy, K. Thilagavathy and K. Gunavathy," Engineering Mathematics (For I year B.E., B.Tech)",Nineth Edition, S. Chand & Co. Ltd. New Delhi, 2010
3.	Srimanta pal and Subath.C.Bhumia, "Engineering Mathematics", Oxford university publications, NewDelhi, 2015
4.	Ewinkreyzig, "Advanced Engineering Mathematics", 9th edition, John Wiley & Sons, 2006
5.	Sivaramakrishnadas.P, Ruknmangadachari.E. "Engineering Mathematics", Pearson, Chennai & Delhi,2nd edition, 2013

18CY101	CHEMISTRY	L	T	P	C
		3	1	0	4

Course Objectives:

1.	Analyze microscopic chemistry in terms of atomic and molecular orbitals.
2.	Rationalize periodic properties of elements and the knowledge of acids and bases.
3.	Analyze the stereo chemical aspects of organic molecules and chemical reactions that are used in the synthesis of organic molecules
4.	Rationalize bulk properties and processes in thermodynamic aspects and its extension in electrochemical processes
5.	Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques

UNIT I	MOLECULAR STRUCTURE	9	+	3

Formation of molecular orbitals of diatomic molecules - energy level diagrams of – H_2, He_2, N_2, O_2, CO andNO - pi-molecular orbitals of butadiene and benzene;

Aromaticity- Huckel rule - concept of aromaticity - aromatic, non-aromatic and anti-aromatic molecules;

Crystal field theory - energy level diagrams for transition metal ions – octahedral and tetrahedral geometries -magnetic properties;

Band theory - band structure of solids- Fermi level - role of doping on band structures.

UNIT II	PERIODIC PROPERTIES AND ACID-BASE CONCEPTS	9	+	3

Effective nuclear charge – shielding effect, penetration of orbitals - variations of s, p, d and f orbital energies of atoms – Aufbau principle - electronic configuration of elements — periodic properties - atomic and ionic size, ionization energy, electron affinity and electro negativity - anomalous properties of second period elements - diagonal relationship;

Acids and bases - Bronsted-Lowry concept - Lewis concept - pH and pKa — problems — HSAB - buffer solutions – types- mechanism of buffer action- Henderson–Hasselbalch equation- derivation and problems.

UNIT III	STEREOCHEMISTRY AND ORGANIC REACTIONS	9	+	3

Stereoisomerism – geometrical isomerism – cis-trans and E-Z nomenclature – optical isomerism – symmetry, chirality, optical activity, enantiomer and diastereomers — absolute configuration - R-S notation - conformational analysis – Ethane, butane, cyclohexane;

Addition reaction — hydrogenation, halogenations - Markovnikov rule — Kharasch effect - hydration,hydrohalogenation, hydroboration;

Aliphatic nucleophilic substitution reaction –SN_1, SN_2 and SN_imechanism – electrophilic substitution reaction in benzene– mechanism - nitration, halogenations, sulfonation, alkylation and acylation;

Elimination reaction –E_1, E_2 and E_1CB- mechanism- Saytzeff rule – examples.

UNIT IV	USE OF FREE ENERGY IN CHEMICAL EQUILIBRIA	9	+	3

Thermodynamic functions- internal energy, enthalpy, entropy and free energy- first and second law of thermodynamics - partial molar properties - Gibbs Duhem equation — variation of chemical potential with temperature and pressure – Third and Zeroth law of thermodynamics – definition only;

Free energy and EMF relation - single electrode potential - electrochemical series and its significance.- cell potential and its measurement (Poggendorff method only) - Nernst equation-derivation and problems- Standard cell potential and equilibrium constant relation- problems.

UNIT V	SPECTROSCOPY TECHNIQUES AND APPLICATIONS	9	+	3

Vibrational spectroscopy — principle - selection rule - harmonic and unharmonic oscillators -number of vibrational modes of poly-atomic molecules – overtones - Fermi resonance - instrumentation (block diagramonly);

Rotational spectroscopy- rotational spectra of rigid and non rigid diatomic rotators, simple polyatomic molecules like CO_2, NH_3,CH_4 and H_2O;

NMR - origin of NMR signal - chemical shift - factors affecting chemical shift and spin-spin coupling — application to ethanol, acetone and ethyl methyl ether.

Total (L+P)= 60 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Understand in-depth knowledge of atomic and molecular orbitals based chemical aspects.
CO2	:	Realize the nature of periodic properties of elements and the knowledge of acids and bases
CO3	:	Grasp the knowledge of 3D structural aspects of organic molecules and chemical reactions that areused in the synthesis of organic molecules.
CO4	:	Substantiate the various processes involved in thermodynamic considerations and its involvement in electrochemical aspects
CO5	:	Aware of spectroscopic techniques in the field of molecular identification of materials

Text Books:

1.	P.R. Puri, L.R.Sharma and Madan S. Pathania,"Principle of physical chemistry" 47th Vishal PublishingCo, Jalandhar-8
2.	C. N. Banwell and E. M. Mccash, "Fundamentals of Molecular Spectroscopy", Tata McGraw-HillPublishing Company Limited, New Delhi, 2009.
3.	Raj. K. Bansal — "A Text Book of Organic Chemistry" Revised 4th Ed.,(2005), New Age International Publishers Ltd., New Delhi.
4.	P.S. Kalsi — "Stereochemistry conformation and Mechanism", 6th Ed., (2005), New Age International Publishers Ltd., New Delhi.

5.	J.D. Lee – "A New Concise Inorganic Chemistry", 5th Edn., Oxford University Press, 2011.
6.	Wahid Malik, G.D.Tuli and R.D.Madan, "Selected Topic in Inorganic Chemistry",S.Chand& Co., Ltd(2011).
Reference Books:	
1.	David.W.Ball, Physical Chemistry, Cengage Learning India Pvt. Ltd., New Delhi, 2009
2.	G.Aruldhas, Molecular structure and spectroscopy, second edition, PHI learning Pvt. Ltd., New Delhi,2008
3.	Cotton and Wilkinson – "Advanced Inorganic Chemistry", 6th Ed., John Wiley & Sons, New York- 2004
4.	James E. Huheey, Ellen A. Keiter and Richard L. Keiter — "Inorganic Chemistry-Principles of Structureand Reactivity", 4 thEdn., Pearson Education, 11th Impression, 2011.
5.	F.A. Carey and R.J. Sund berg – "Advanced organic chemistry" Vol. I and II– 3rd Ed.,(1984), Plenum Publications
6.	Ernest. Eliel and Samuel H. Wilen — "Stereochemistry of Organic Compounds" — Wiley Student Ed.,(2006). John Wiley and Sons Pvt. Ltd., Singapore.

18CS101	FUNDAMENTALS OF PROBLEM SOLVING AND C PROGRAMMING	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To express problem solving through programming
2.	To practice the basic concepts of C programming language.
3.	To provide the basics knowledge about array and strings to solve simple applications.
4.	To use pointers and functions in the simple applications.
5.	To review the elementary knowledge of structures and unions.

UNIT I	INTRODUCTION TO COMPUTER AND PROBLEM SOLVING	9	+	0

Problem formulation, Problem Solving methods, Need for logical analysis and thinking – Algorithm – Pseudocode — Flow Chart - Need for computer languages, Generation and Classification of Computers - Basic Organization of a Computer.

UNIT II	C PROGRAMMING BASICS AND CONTROL STATEMENTS	9	+	0

C Character set- Identifies and Keywords- Data Type- Declarations-Expressions-Statements and Symbolic constants-Operators – Arithmetic Operators – Unary operators – Relational and Logical Operators – Assignment operators – Conditional operators- Managing Input and Output operations- Decision Making- Branching and Looping statements.

UNIT III	ARRAYS AND STRINGS	9	+	0

Pre-processor directives-Storage classes-Arrays – Initialization – Declaration – one dimensional and two dimensional arrays. Strings - String operations – String handling functions-Simple programs-sorting-searching.

UNIT IV	FUNCTIONS AND POINTERS	9	+	0

Function – Library functions and user-defined functions – Function prototypes and function definitions – Call by value –Call by reference – Recursion – Pointers - Definition – Initialization – Pointers arithmetic – Pointers and arrays.

UNIT V	STRUCTURES, UNIONS AND FILE	9	+	0

Introduction – need for structure data type – structure definition – Structure declaration – Structure within a structure – Passing structures to functions – Array of structures – Pointers to structures-Union-basic file operation.

Total (L+ T)= 45 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	:	Formulate and apply logic to solve basic problems.
CO2	:	Write, compile and debug programs in C language.
CO3	:	Apply the concepts such as arrays, decision making and looping statements to solve real time applications
CO4	:	Solve simple scientific and statistical problems using functions and pointers
CO5	:	Write programs related to structures and unions for simple applications.

Text Books:

1.	Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", Dorling Kindersley (India)Pvt. Ltd., Pearson Education in South Asia, 2011. (Unit-I).
2.	E.Balagurusamy, "Programming in ANSI C" fourth Edition, Tata McGraw-Hill, 2008 (Unit II-V).

Reference Books:

1.	Byron S Gottfried, "Programming with C", Schaum's Outlines, Second Edition, Tata McGraw-Hill, 2006
2.	Kernighan,B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education,2006
3.	Yashavant P. Kanetkar. "Let Us C", BPB Publications, 2011.

18EN102	PROFESSIONAL ENGLISH LABORATORY	L	T	P	C
		0	0	2	1

Course Objectives:

1.	To acquire and develop listening skills for academic, social and professional purposes.
2.	To understand short conversations or monologues
3.	To master basic reading skills such as phonics, word recognition, and fluency
4.	Acquire and develop pre-intermediate level fluency in oral skills such as discourse management, grammar and vocabulary, pronunciation and interactive communication for academic, social and professional purposes
5.	Address an audience and present a topic.
6.	Express an opinion and justify it

Methodology - Listening

List of Audio files:

1. Job Responsibilities
2. Conversation between two employees on company culture
3. Emails
4. Description of gadgets
5. Interview with a leading industrialist
6. Office procedures – applying for permission, placing an order for office equipment,
7. Enquiries about orders and deliveries
8. Conversation between two people on general topics
9. Telephone Messages
10. Fixing and Cancelling appointments
11. Asking for directions
12. Rescheduling a travel plan
13. Tones : Rude and Polite
14. Conversation : Statements, Discussions, Debating, Accepting, Negotiating
15. Conferences ; Announcements about changes in schedules and sessions
16. Motivational Speech
17. TED Talk on Team Work
18. Describing charts and data
19. Presentation at an office
20. Short self-descriptions

METHODOLOGY: - Speaking

1. Self-Introduction — Personal information –Name, Home background, study details, area of interest, hobbies, strengths and weaknesses, projects and paper presentations if any, likes and dislikes in food, clothes, Special features of home town, Personal role models in life, goals and dreams, favorite inspirational quote.

2. Situational Role Play between Examiner and Candidate — Customer and Sales Manager, Hotel Manager and Organiser, Team Leader and Team member, Bank Manager and Candidate, Interviewer and Applicant, Car Driver and Client, Industrialist and Candidate, Receptionist and Appointment Seeker, New Employee and Manager, Employee and Employee, P.A. and Manager Schedule for training,

	Asking for directions, Seeking help with office equipment, Clarifying an error in the bill, Quality of Products, Buying a Product, Selling a Product, cancelling and fixing appointments, hotel accommodation, training facilities, dress code, conference facilities, faculty advisors and student, student and student, college Office personnel and student.

Total (L)= 30 Periods

Course Outcomes:

After the successful completion of the practical session, the students will be able to

CO1	:	Infer, interpret and correlate routine, classroom-related conversation
CO2	:	Use a range of common vocabulary and context based idioms.
CO3	:	Comprehend native speakers when they speak quickly to one another, although the student mightstill have trouble.
CO4	:	Identify the most important words in a story/article.
CO5	:	Summarize the main ideas, key details, and inferred meanings from listening passages of up to fiveminutes.
CO6	:	Vocalize words without the aid of pictures
CO7	:	Make effective self-introductions
CO8	:	Study options, compare and contrasts the options
CO9	:	Exercise a choice, justify it by giving examples and illustrations.
C010	:	Construct a situation and to participate in conversations.

Text Books:

1.	Norman Whitby. Business Benchmark –Pre - Intermediate to Intermediate, Students Book, CambridgeUniversity Press, 2014

Recommended Reading and Reference Sources:

1.	Spoken English: A Self-Learning Guide. V. Sasikumar and P V Dhamija.
2.	English Conversation Practice: Grant Taylor Paperback 1976ely. Krishna Mohan, N P Singh
3.	Discussions that Work. Penny Ur. CUP, 1981
4.	http://www.onestopenglish.com/skills/speaking/speaking-matters/
5.	Speak Better Write Better English Paperback - November 2012 Norman Lewis, Goyal Publishers andDistributors.

18CS102	COMPUTER PRACTICE LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives:

1.	To provide basic knowledge of creating Word documents and also producing mail merge
2.	To make use of basic functions, formulas and charts in Spread sheet
3.	To implement problem solving techniques.
4.	To promote the programming ability to develop applications for real world problems

EXPERIMENTS

A. Word Processing

1. Document creation, Text manipulation with Scientific notations, Table creation, Table formatting and Conversion
2. Letter preparation using Mail merge and Draw flow Charts using tools

B. Spread Sheet

3. Chart - Line, XY, Bar and Pie.
4. Formula - formula editor, Sorting and Import and Export features.
5. Spread sheet - inclusion of object, Picture and graphics, protecting the document and sheet.

C. Simple C Programming

6. Program using Control statements.
7. Program using Looping.
8. Program using Array.
9. Program using String.
10. Program using Function.
11. Program using Structures.
12. Program using Pointers.
13. Program using Files.

*** For programming exercises Flow chart and pseudo code are essential**

Total (P)= 60 Periods

Course Outcomes:

After the successful completion of the practical session, the students will be able to

CO1	:	Demonstrate the basic mechanics of Word documents and working knowledge of mail merge.
CO2	:	Demonstrate the use of basic functions and formulas in Spread sheet.
CO3	:	Apply good programming methods for program development.
CO4	:	Implement C programs for simple applications.

18ME102	WORKSHOP MANUFACTURING PRACTICES	L	T	P	C
		1	0	4	3

Course Objectives:

1.	To provide an exposure of basic engineering practices to the student
2.	To provide exposure to the students with hands on experience on various basic engineering practices inCivil and Mechanical Engineering

EXPERIMENTS

1.	Introduction to Safety measures and First aid.
2.	Study of Lathe -Welding methods and equipment's- Casting process and tools- Sheet metal and fittingtools- Carpentry tools and joints.
3.	Fitting: V-fitting, Square fitting, Curve fitting.
4.	Lathe: Facing, turning, taper turning and knurling.
5.	Welding: BUTT, LAP and T- joints.
6.	Foundry: Green sand preparation- mould making practice.
7.	Sheet metal: Cone, tray, cylinder.
8.	Carpentry: CROSS, T and DOVETAIL joints.
9.	Drilling: simple exercises.

Total (P)= 60 Periods

Course Outcomes:

After the successful completion of the practical session, the students will be able to

CO1	:	Prepare fitting of metal and wooden pieces using simple fitting and carpentry tools manually.
CO2	:	Prepare simple lap, butt and tee joints using arc welding equipment.
CO3	:	Prepare green sand moulding.
CO4	:	Prepare sheet metal components.
CO5	:	Prepare simple components using lathe and drilling machine.

Reference Books:

1.	Bawa, H.S, "Work shop Practice", Tata McGraw Hill Publishing Company Limited, 2007.
2.	Jeyachandran, K, Natarajan, K and Balasubramanian, S, "A Primer on Engineering PracticesLaboratory", Anuradha Publications, 2007.
3.	Jeyapoovan, T, SaravanaPandian, M and Pranitha, S, "Engineering Practices Lab Manual",VikasPuplishing House Pvt. Ltd, 2006.

SEMESTER-II

18MA202	DIFFERENTIAL EQUATIONS AND LINEAR ALGEBRA	L	T	P	C
		3	1	0	4

Course Objectives:

1.	To obtain the knowledge to solve second order differential equations with constant and variablecoefficients.
2.	To familiarize with formation and solutions of first order partial differential equations.
3.	To familiarize with the solutions of higher order partial differential equations.
4.	To develop the use of matrix algebra needed by engineers for practical applications
5.	To obtain the knowledge about the vector spaces, inverse of a linear transformation and composition oflinear maps.

UNIT I	ORDINARY DIFFERENTIAL EQUATIONS OF HIGHER ORDER	9	+	3

Second order linear differential equations with constant and variable coefficients –Cauchy-Euler equation and Cauchy- Legendre's linear equation - Method of variation of parameters –Simultaneous first order linearequations with constant coefficients.

UNIT II	PARTIAL DIFFERENTIAL EQUATIONS – FIRST ORDER	9	+	3

Formation of partial differential equations by elimination of arbitrary constants and functions – Solutions to first order partial differential equations — Standard types of first order linear and non-linear PDE- Lagrange's linear PDE.

UNIT III	PARTIAL DIFFERENTIAL EQUATIONS – HIGHER ORDER	9	+	3

Solution to homogeneous and non-homogeneous linear partial differential equations of second and higher order by complementary function and particular integral method - Separation of variables method: simple problems in Cartesian coordinates, Laplace equation in Cartesian and polar coordinates, one dimensional diffusion equation, one dimensional wave equation.

UNIT IV	MATRICES	9	+	3

Matrices - Linear system of equations – rank of a matrix- Cramer's rule- Gauss elimination and Gauss- Jordan elimination- Inverse of a matrix by Gauss- Jordan method- Solution of Algebraic and Transcendentalequations by Newton-Raphson method.

UNIT V	VECTOR SPACES	9	+	3

Vector space - linear dependence of vectors, basis and dimension- Linear transformations (maps) - range andkernel of linear transformation- rank and nullity- Inverse of linear transformation- rank-nullity theorem – Composition of linear maps- Matrix associated with linear map.

Total (L+T)= 60 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	:	Learn the techniques of solving ordinary and partial differential equations of second and higherorder that arise in engineering problems.
CO2	:	Familiar with the concept of Laplace transforms method to solve second order differentialequations.
CO3	:	Learn the fundamental knowledge of Matrices and acquired the knowledge about the vector spacesand inverse of linear transformation and composition of linear maps.

Text Books:

1.	Grewal. B.S, "Higher Engineering Mathematics", 43rd Edition, Khanna publications, Delhi, 2015
2.	Veerarajan T., "Engineering mathematics for first year", Tata McGraw Hill Education Pvt. Ltd., New Delhi,2009
3.	Gilbert Strang, "Linear Algebra and its applications", Cengage Learning, New Delhi, 4th edition, 2006.

Reference Books:

1.	James Stewart, "Essential Calculus", Cengage Learning, New Delhi, 2nd edition, 2013.
2.	P. Kandasamy, K. Thilagavathy and K. Gunavathy," Engineering Mathematics (For I year B.E., B.Tech)",Nineth Edition, S. Chand & Co. Ltd. New Delhi, 2010.
3.	Srimanta pal and Subath.C.Bhumia, "Engineering Mathematics", Oxford university publications, NewDelhi, 2015
4.	Ewinkreyzig, "Advanced Engineering Mathematics", 9th edition, John Wiley & Sons, 2006.
5.	D.Poole, "Linear Algebra, A Modern introduction", 2nd edition, Brooks, 2005.
6.	V.Krishnamurthy, V.P.Mainra and J.L.Arora, "An introduction to Linear Algebra", East-West press,Reprint 2005

18PH201	SEMICONDUCTOR PHYSICS ANDOPTOELECTRONICS	L	T	P	C
		3	1	0	4

Course Objectives:

1.	Classical free electron theory and band theory of solids
2.	Basic concepts of semiconductors
3.	Physics of p-n junction, breakdown mechanism in semiconductors
4.	Principle and working of semiconductor laser, LED and LCD
5.	Construction and characteristics of solar cell and photo detectors

UNIT I	FREE ELECTRON THEORY AND BAND THEORY OF SOLIDS	9	+	3

Classical free electron theory of metals - drawbacks of classical free electron theory; Quantum theory ; Fermi distribution function - effect of temperature on Fermi function ; Density of energy states - carrier concentration; Band theory of solids - E-k diagram - Brillouin zones -distinction between conductors, semiconductors and insulators.

UNIT II	SEMICONDUCTORS	9	+	3

Properties of semiconductor ; Bonds in semiconductors ; Intrinsic semiconductors ; Extrinsic semiconductors - N-type and P-type semiconductors ; Ionization energy ; Holes and electrons in semiconductors; Carrier concentration in intrinsic semiconductor (derivation) ; Electrical conductivity and band gap determination in intrinsic semiconductors ; Carrier concentration in N-type semiconductor (derivation) ; Variation of Fermi level with temperature and doping concentration ; Generation and recombination of charge carriers in semiconductors ; Direct and indirect band gap semiconductors ; Equation of continuity.

UNIT III	PHYSICS OF P-N JUNCTION	9	+	3

Formation of p-n junction-barrier potential ; Forward bias - reverse bias - current flow in a forward biased p-n junction - VI characteristics of p-n junction diode both in forward and reverse bias ; Drift current in semiconductors ; Diffusion current in semiconductors ; Types of breakdown in semiconductor devices - avalanche breakdown - Zener breakdown - thermal breakdown ; Zener diode-characteristics and applications ;
Hall effect-determination of Hall co-efficient ; Applications.

UNIT IV	PHYSICS OF OPTOELECTRONICS	9	+	3

Principle of laser-absorption-spontaneous emission-stimulated emission ; Semiconductor laser — homojunction and heterojunction Semiconductor laser - construction, working and energy level diagram ; Light emitting diode (LED) - construction, working and characteristics - seven segment display ; Liquid crystal display (LCD) - principle and working ; Optical switching – self electro optic effect device (SEED).

UNIT V	PHYSICS OF OPTOELECTRONICS	9	+	3

Photovoltaic effect - solar cell-construction, working and applications ; Photo detector -photo conductors - photo diodes - pin photo diode - avalanche photo diode - photo transistors ; Quantum well, dot, wire (qualitative) ; Modulators - Franz-Keldysh and Stark effect electro absorption modulators - quantum well electro absorption modulators - electro optic modulators.

Total (L+T)= 60 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	The free electron theory and difference between the electronic materials
CO2	:	The basics of semiconductors and to apply continuity equation for various devices
CO3	:	The concept of p-n junction and breakdown mechanism in semiconductors
CO4	:	The principle and working of semiconductor laser, LED, LCD and switching device
CO5	:	The Construction and characteristics of solar cell, photo conductors, photo diodes, photo transistorsand modulators

Text Books:

1.	Pallab Bhattacharya, "Semiconductor optoelectronic devices", Pearson Education publications, New Delhi, 2002.
2.	Mehta V K, Rohit Mehta, "Principles of electronics" S.Chand & co publications, New Delhi, 2007
3.	Arumugam M, "Materials Science", Anuradha publications,kumbakonam, 2006
4.	Rajendran V and Marikani A, "Materials Science", Tata McGraw publications, New Delhi, 2004.

Reference Books:

1.	David A.Bell, "Electronic Devices and Circuits", Oxford University press publications, New Delhi,2008
2.	Lal Kishore K,"Electronic Devices and Circuits", BS publications, Hyderabad, 2008
3.	Pillai S O, "Solid State Physics", New age international publishers, Chennai, 2005.
4.	Arumugam M, "Semiconductor Physics and Optoelectronics", Anuradha publications, kumbakonam, 2006
5.	Palanisamy P K, "Materials Science",Scitech publications(India), chennai,2007.

18EE101	BASIC ELECTRICAL AND ELECTRONICSENGINEERING	L	T	P	C
	(Common to Civil and Computer Science and Engineering)	3	1	0	4

Course Objectives:

1.	To understand and analyze basic electric circuits
2.	To study working principle of Electrical machines and transforms.
3.	To study basics of Electronics System
4.	To understand the concepts of Electrical Installation

UNIT I	DC CIRCUITS	9	+	3

Electrical circuit elements (R, L and C), voltage and current sources, Ohm's law, Kirchoff current and voltage laws, series and parallel circuits, analysis of simple electrical circuits with DC excitation, Simple problems. Superposition , thevenin's and Norton's theorem, Star — Delta transformation.

UNIT II	AC CIRCUITS	9	+	3

Introduction to single phase AC circuits, Representation of sinusoidal waveforms, peak and RMS values, phasor representation, real power, reactive power, apparent power, power factor. Three phase AC circuits, voltage and current relations in star and delta connections.

UNIT III	ELECTRICAL MACHINES AND TRANSFORMERS	9	+	3

Construction, operation, types, Speed control of Shunt motor and applications of DC Motor, Construction and working of a three-phase induction motors. Working of single-phase induction motor and its applications. Ideal and practical transformer, Construction and working, losses and efficiency in transformers, Introduction to Three phase transformers.

UNIT IV	BASICS ELECTRONICS SYSTEM	9	+	3

Introduction - Basic structure of semiconductors devices- PN junction diode, Zener diode and V-I characteristics- BJT — CE, CB, CC configuration and working principle .Operational Amplifier-principle of operation ,Characteristics , Applications-Inverting Amplifier, Non inverting Amplifier, summing amplifier and differential amplifier.

Unit V	ELECTRICAL INSTALLATIONS	9	+	3

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthling, Basics of house wiring tools and components, types of house wiring. Batteries-Principle characteristics-Types and its applications- Introduction to UPS and SMPS.

Total (L+T)= 60 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	:	Analyse the simple DC circuits.
CO2	:	Analyse the single and three phase AC circuits.
CO3	:	Understand the working principle of Electrical machines and transformers.
CO4	:	Analyse the fundamentals and characteristics of Diode , BJT and OPAMP .
CO5	:	Understand the concept of Electrical Installations.

Text Books:	
1.	R.Muthu Subramaniyam, R. Salivaganan and K. A Muralidharan , "Basic Electrical and ElectronicsSecond Edition Engineering", Tata McGraw Hill, 2010.
2.	D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
3.	D.C.Kulshreshtha, "Basic Electrical Engineering", Tata McGraw Hill, 2009.
Reference Books:	
1.	L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
2.	E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.

18ME101	ENGINEERING GRAPHICS & DESIGN	L	T	P	C
		1	0	4	3

Course Objectives:

1.	To impart knowledge on concepts, ideas and design of engineering products and to provide anexposure to CAD Modelling.
2.	Standards of Engineering Drawing: Size, layout and folding of drawing sheets, lettering - Use of drafting instruments

UNIT I	PROJECTION OF POINTS, LINES AND PLANE SURFACES	9	+	3

General principles of orthographic projection- Projection of points, located in all quadrants — Projection of straight lines located in first quadrant — Determination of true lengths and true inclinations — Projection of polygonal surface and circular lamina inclined to both reference planes.

UNIT II	PROJECTION OF SOLIDS	9	+	3

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is perpendicular to onereference plane and also inclined to one reference plane by change of position method.

UNIT III	SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES	9	+	3

Sectioning of above solids in simple vertical position by cutting planes inclined to one reference plane and perpendicular to other — solids inclined position with cutting planes parallel to one reference plane- Obtaining true shape of section.

Development of lateral surfaces of simple and truncated solids — Prisms, pyramids cylinders and cones- Development of lateral surfaces of solids with square and cylindrical cutouts, perpendicular to the axis.

UNIT IV	ISOMETRIC PROJECTION	9	+	3

Principles of isometric projection –isometric scale - isometric projections of simple solids, truncated prisms,pyramids, cylinders and cones.

UNIT V	PERSPECTIVE PROJECTION	9	+	3

Perspective projection of prisms, pyramids and cylinders by visual ray and vanishing point methods.

Total (L+T)= 60 Periods

Note: Study of drafting software – Auto CAD – Coordinate System (Absolute, relative and polar)
Creation of simple figures like polygon, Drawing a plan of residential building, Creation of 3-D Models ofsimple objects and obtaining 2-D multi view drawing from 3-D model. (**Internal Assessment only)**

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Understand the conventions and the methods of engineering drawing.
CO2	:	Understand the fundamental concepts of theory of projection.
CO3	:	Understand the development of different surfaces.
CO4	:	Develop the relationships between 2D and 3D environments.
CO5	:	Demonstrate computer aided drafting.

Text Books:

1.	Bhatt N.D, "Engineering Drawing", Charotar publishing House, 2003
2.	Natarajan, K.V, "A Text book of Engineering Graphics", Dhanalakshmi Publishers, 2006.

Reference Books:

1.	Gopalakrishnana K.R, "Engineering Drawing", Vol. I and II, Subhas Publications, 1999.
2.	Dhananjay A. Jolhe, "Engineering Drawing with an Introduction to AutoCAD", Tata McGraw HillPublishing Company Limited, 2008.
3.	Venugopal, K and Prabhu Raja, V., "Engineering Graphics", New Age International (P) Ltd, 2008.
4.	Gill, P.S, "Engineering Drawing-Geometrical Drawing", S.K Kataria and Sons, 2008.
5.	CAD Software Theory and User Manuals

18PH103	PHYSICS LABORATORY	L	T	P	C
	(Common to All Branches of Engineering)	0	0	3	1.5

Course Objectives:

1.	To handle different measuring instruments.
2.	To understand the basic concepts of interference, diffraction, heat conduction and to measure theimportant parameters.

EXPERIMENTS

(Any EIGHT Experiments)

1.	Newton's rings – Determination of radius of curvature of a Plano convex lens.
2.	Carey Foster's bridge – Determination of specific resistance of the material of the wire
3.	Poiseuille's flow – Determination of Coefficient of viscosity of a liquid
4.	Spectrometer – Grating – Normal incidence – Determination of Wavelength of Mercury lines.
5.	Lee's disc – Determination of thermal conductivity of a Bad conductor.
6.	Ultrasonic interferometer – Determination of velocity of Ultrasonic Waves in Liquid
7.	Non-uniform bending – Determination of young's modulus of the material of the Bar
8.	Determination of Band gap of a given semi conductor
9.	Determination of Wavelength of laser using grating and determination of particle size using Laser
10.	Determination of Acceptance angle and Numerical Aperture of fiber

Total (P)= 45 Periods

Course Outcomes:

After the successful completion of the practical session, the students will be able to

CO1	:	Handle different measuring instruments and to measure different parameters
CO2	:	Calculate the important parameters and to arrive at the final result based on the experimental measurements

18CY102	CHEMISTRY LABORATORY	L	T	P	C
(Common to all branches of Engineering For student admitted from 2018-2019 andonwards)		0	0	3	1.5

Course Objectives:

1.	To gain practical knowledge by applying theoretical principles and performing the following experiments

EXPERIMENTS

1.	Estimation of hardness of Water by EDTA
2.	Estimation of Copper in brass by EDTA
3.	Estimation of Alkalinity in water
4.	Estimation of Chloride in water sample (Iodimetry)
5	Conductometric titration of Strong Acid and Strong Base
6.	Conductometric titration of Mixture of acids and Strong base
7.	Determination of strength of Iron by Potentiometric method
8.	Estimation of Iron by Spectrophotometry
9.	Determination of molecular weight and degree of Polymerisation by Viscometry.
	NOTE: ➢ All the nine experiments shall be offered.

Total (P)= 45 Periods

Course Outcomes:

After the successful completion of the practical session, the students will be able to

CO1	:	To know the applicability of the practical skill gained in various fields.
CO2	:	To know the composition of brass quantitatively and the molecular weight of polymers.
CO3	:	To understand the principle and applications of conductometric titrations, spectrometer and potentiometric titrations.

18EN103	PROFESSIONAL COMMUNICATION LABORATORY	L	T	P	C
	(Common to All Branches)	0	0	2	1

Course Objectives:

1.	Improve their reading skills.
2.	Address an audience and present a topic.
3.	Acquire speaking competency in English.
4.	Strengthen their fluency in speaking

EXPERIMENTS

Methodology – Reading

1) Reading a story aloud with exact pronunciation, with intonation, and with expressing sense.
2) Reading poems for improving verbal skills, memory, and critical thinking.
3) Reading newspaper articles for strengthening the vocabulary and writing skills.
4) Reading homophones with exact pronunciation for expressing different meanings

Methodology – Speaking

1) Power point presentation – on general topics - for organising and structuring presentation.
2) Oral presentation -on basic technical ideas related to engineering.
3) Speaking on a given topic – current affairs, expressing opinion on social issues.
4) Describing a process – booking Ticket online, survey for starting a new office, sending an e-mail, etc.
5) Organising official events –compering,presenting welcome address, proposing vote of thanks

Total (P)= 30 Periods

Course Outcomes:

After the successful completion of the practical session, the students will be able to

CO1	:	read short passages fluently, avoiding mispronunciation, substitution, omission and transposition ofword-pairs
CO2	:	vocalize words without the aid of pictures.
CO3	:	develop a well-paced, expressive style of reading.
CO4	:	make effective oral presentations on technical and general contexts
CO5	:	describe a process with coherence and cohesion.

Text Books:	
1.	Norman Whitby. Business Benchmark — Pre-Intermediate to Intermediate, Students book, Cambridge University Press, 2014
Recommended Reading and Reference Sources:	
1.	Spoken English: A Self-Learning Guide. V.Sasikumar and P V Dhamija
2.	English Conversation Practice: Grant Taylor Paperback 1976ly. Krishna Mohan, N P Singh
3.	Discussions that Work. Penny Ur.CUP, 1981
4.	http://www.onestopenglish.com/skills/speaking/speaking-matters/
5.	Speak Better Write Better English Paperback – November 2012 Norman Lewis, Goyal Publishers andDistributors

18EE102	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY	L	T	P	C
		0	0	2	1

Course Objectives:

1.	To impart hands on experience in use of measuring instruments, testing in transformers, and housewiring practices

EXPERIMENTS

1.	Verification of Kirchhoff's laws.
2.	Verification of Superposition theorem.
3.	Measurement of three-phase power in three-phase circuits
4.	Determination losses in single phase Transformer
5	Demonstration of cut-out sections of machines: induction machine (squirrel cage rotor), and single-phase induction motor
6.	Speed control of DC shunt motor
7.	Study of basic safety precautions, measuring instruments – voltmeter, ammeter, multi-meter, andElectrical components.
8.	VI Characteristics of PN Junction diode.
9.	House wiring
10.	Wiring for Fluorescent lamp.

Total (P)= 30 Periods

Course Outcomes:

After the successful completion of the practical session, the students will be able to

CO1	:	Get an exposure to DC and AC circuits.
CO2	:	Understand the loading characteristics of transformers
CO3	:	Know the parts of single-phase and three phase induction motors.
CO4	:	Get an exposure Electron devices
CO5	:	Make electrical connections by wires of appropriate ratings.

SEMESTER-III

18MA301	PROBABILITY AND STATISTICS	L	T	P	C
		3	1	0	4

Course Objectives:

1.	To familiar with basic concepts of probability and random variables
2.	To obtain the knowledge about discrete and continuous distributions
3.	To acquire knowledge of bivariate distributions and the problems related to coefficient of correlation
4.	To understand the statistical averages and fitting of curve.
5.	To gain the knowledge of significance test for large and small samples.

UNIT I	PROBABILITY AND RANDOM VARIABLES	9	+	3

Axioms of Probability, Conditional Probability, Total Probability, Baye's theorem- Random variables: Discrete and Continuous random variables - Moments – Moment generating functions and their properties.

UNIT II	STANDARD DISTRIBUTION	9	+	3

Binomial, Poisson, Exponential, Gamma and Normal Distributions and their properties - Cheybyshev'sinequality.

UNIT III	TWODIMENSIONAL RANDOM VARIABLES	9	+	3

Joint distributions – Marginal and Conditional distributions – Correlation, Regression and rank correlation.

UNIT IV	BASIC STATISTICS	9	+	3

Measures of Central tendency: Moments, Skewness and Kurtosis, Curve fitting by the method of LeastSquares – Fitting of straight lines, second degree parabolas and curves reducible to linear forms

UNIT V	TEST OF HYPOTHESIS	9	+	3

Test of significance: Large Sample tests for Single proportion, difference of proportion, single mean anddifference of means- Small Sample test for single mean, difference of means and correlation coefficients, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.

Total (L+T)= 60 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	:	Acquire the concepts of probability and random variables and the knowledge of standarddistributions.
CO2	:	Learn about the correlation and regression of two dimensional random variables.
CO3	:	Familiar with fitting a curve by least squares method.

Text Books:

1.	Veerarajan T, "Probability and Random Process (With Queuing theory)", 4th Edition, Tata McGraw HillEducation Pvt. Ltd., New Delhi, 2016
2.	Jay, L. Devore, "Probability and Statistics for Engineering and Sciences", Cengage Learning, New Delhi,8th edition, 2012.

Reference Books:

1.	Fruend John, E. and Miller, Irwin, "Probability and Statistics for Engineering", 5th Edition, Prentice Hall,1994.
2.	Grewal, B.S., "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, Delhi, 2014.
3.	Gupta, S.C. and Kapur, V.K. "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, NewDelhi, 2015

18CS301	DIGITAL PRINCIPLES AND SYSTEMDESIGN	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To comprehend digital languages, Boolean laws and Boolean functions
2.	To understand the design of fundamental combinational and sequential circuits of a computing device
3.	To analyse and design combinational and sequential circuits

UNIT I	BOOLEAN ALGEBRA AND LOGIC GATES	9	+	0

Number systems – Decimal – Binary – Octal – Hexadecimal – Binary Arithmetic – Binary codes – Boolean algebra and theorems – Boolean functions – Simplifications of Boolean functions using Karnaugh map and Quine-Mc-cluskey method — logic gates.

UNIT II	COMBINATIONAL LOGIC	9	+	0

Combinational circuits – Analysis and design procedures – Circuits for arithmetic operations – Half Adder –Full Adder – Half Subtractor – Full Subtractor – Adder-Subtractor – Carry Look ahead adder – Decimal Adder – Binary Multiplier – Magnitude Comparator – Code conversion circuits.

UNIT III	MSI COMBINATIONAL LOGIC & SYNCHRONOUS SEQUENTIAL LOGIC	9	+	0

Decoders – Encoders – Multiplexers – De-multiplexers – Realizing Boolean Functions with Multiplexers – Sequential circuits – Latches – SR latch – Flip flops – D Flip flop – JK Flip Flop – T Flip Flop – Analysis and Design Procedures – State reduction and state assignment – Transition table – Circuit Design

UNIT IV	MEMORY AND PROGRAMMABLE LOGICS	9	+	0

Registers – Shift Registers – Ripple Counters – Synchronous Counters – Counters with unused states – RingCounter – Johnson Counter – Random Access Memory – Memory Decoding – Error Detection and Correction – Read only Memory – Programmable Logic Array – Programmable Array Logic

UNIT V	ASYNCHRONOUS SEQUENTIAL LOGIC	9	+	0

Analysis and Design procedure for asynchronous sequential circuits – Reduction of state and flow tables – Race Free State assignment – Hazards.

Total (L+T)= 45 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	:	Apply Boolean laws to derive simplified Boolean function and implement the circuit with logiccomponents.
CO2	:	Reproduce the existing design of combinational or sequential circuits of a computing device andscale them in size
CO3	:	Analyse and design simple combinational or sequential circuits

Text Books:	
1.	M.Morris Mano and Michael Ciletti, "Digital Design with an Introduction to the Verilog HDL", Fifth Edition, Pearson Education, 2013.
Reference Books:	
1.	Stephen Brown and Zvonko Vranesic, "Fundamentals with Digital Logic Design with VERILOG", ThirdEdition, McGraw-Hill Education 2014.
2.	Donald D.Givone, "Digital Principles and Design", McGraw Hill Higher Education,2003.
3.	Charles H.Roth, Jr and Larry L. Kinney "Fundamentals of Logic Design" Seventh Edition, JaicoPublishing House, 2014.
E-References:	
1.	https://nptel.ac.in/courses/117105080/
2.	https://nptel.ac.in/courses/117106086/

18CS302	DATA STRUCTURES AND ALGORITHMS	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To understand the concepts of ADTs
2.	To Learn linear data structures – lists, stacks, and queues
3.	To have knowledge about non-linear data structures like trees and graphs
4.	To understand concepts about searching and sorting and hashing techniques

UNIT I	LINEAR DATA STRUCTURES – LIST	9	+	0

Abstract Data Types (ADTs) – List ADT - Array based Implementation - Linked List Implementation – Singly Linked Lists - Circularly Linked Lists - Doubly-Linked Lists - Applications of Lists – Polynomial Manipulation –All operations (Insertion, Deletion, Merge, Traversal).

UNIT II	LINEAR DATA STRUCTURES –STACKS AND QUEUES	9	+	0

Stack ADT - Operations - Applications of Stacks - Evaluating Arithmetic Expression - Conversion of infix to postfix Expression - Queue ADT - Operations - Circular Queue - DeQueue - Applications of Queue

UNIT III	NON LINEAR DATA STRUCTURES – TREES	9	+	0

Tree ADT – Tree traversals – Binary Tree ADT – Expression Trees – Applications of Trees – Binary Search Tree ADT –Threaded Binary Trees- AVL Trees — B-Tree — Heaps - Operations of Heaps - Priority Queues -Binary Heap - Max Heap - Min Heap - Applications of Heap.

UNIT IV	NON LINEAR DATA STRUCTURES – GRAPHS	9	+	0

Definition — Representation of Graphs –Types of Graphs - Graph Traversals - Breadth First Search - Depth First Search - Application of Graph Structures: Shortest Path Problem: Dijkstra's Algorithm - Minimum Spanning Trees: Prim's Algorithm - Kruskal's Algorithms

UNIT V	SEARCHING, SORTING AND HASHING TECHNIQUES	9	+	0

Searching: Linear Search - Binary Search - Sorting Algorithms - Insertion Sort - Selection Sort - Shell Sort -Bubble Sort - Quick Sort - Merge Sort - Radix Sort - Hashing: Hash Functions — Separate Chaining — Open Addressing – Rehashing – Extendible Hashing.

Total (L+T)= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Implement various abstract data types to solve real time problems by using Linear Data Structures.
CO2	:	Apply the different Non-Linear Data Structures to solve problems.
CO3	:	Analyze and implement graph data structures to solve various computing problems.
CO4	:	Critically analyze the various sorting and searching algorithms.

Text Books:

1.	Mark Allen Weiss, " Data Structures and Algorithm Analysis in C ", 4/E Pearson Education, 2013.

Reference Books:

1.	Seymour Lipschutz, "Data Structures With C ",(Schaum`s Outline Series) Published by Tata McGraw-HillEducation Pvt. Ltd., 2015
2.	Ellis Horowitz, Sartaj Sahni, Dinesh Mehta, "Fundamentals of Data Structures In C", Second Edition,Silicon Press, 2008.
3.	Richard F.Gilberg & Behrouz A.Forouzan, "Data Structures: A Pseudo code Approach With C", SecondEdition, Cengage Learning Publishers,2005.
4.	Classic Data Structures", Second Edition by Debasis Samanta, PHI Learning, 2009.

18CS303	COMPUTER ORGANIZATION ANDARCHITECTURE	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To understand the basic structure and operations of digital computer
2.	To learn the working of different arithmetic operations
3.	To understand the different types of control and the concept of pipelining
4.	To study the hierarchical memory system including cache memory and virtual memory
5.	To understand the different ways of communication with I/O devices and standard I/O interfaces

UNIT I	INTRODUCTION	9	+	0

Functional units ,Basic Operational Concepts, Bus Structure ,Memory Locations and Addresses, MemoryOperations, Instruction and Instruction Sequencing, Addressing modes.

UNIT II	ARITHMETIC UNIT	9	+	0

Addition and Subtraction of Signed Numbers, Design of Fast Adders, Multiplication of Positive Numbers, Booth Algorithm, Fast Multiplication, Integer Division, Floating point number operations.

UNIT III	PROCESSOR UNIT AND PIPELINING	9	+	0

Fundamental Concepts, Execution of Instruction, Multi Bus Organization, Hardwired control, Micro programmed control, Basic Concepts of pipelining, Data Hazards, Instruction Hazards, Data path & Control Considerations.

UNIT IV	MEMORY SYSTEMS	9	+	0

Basic Concepts, Semiconductor RAM, ROM, Cache memory, Improving Cache Performance, Virtual memory,Memory Management requirements, Secondary Storage Device.

UNIT V	INPUT AND OUTPUT ORGANIZATION	9	+	0

Accessing I/O devices, Programmed I/O, Interrupts, Direct Memory Access, Interface circuits, Standard I/OInterfaces (PCI, SCSI, USB).

Total (L+T)= 45 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	:	Explain the working principle and implementation of computer hardware components and its variousfunctional units
CO2	:	Apply the operations of arithmetic unit to perform specific task
CO3	:	Analyze the different types of control and the concept of pipelining
CO4	:	Illustrate various memory components including Cache memory and Virtual memory
CO5	:	Explain the different ways of communication with I/O devices and standard I/O interfaces

Text Books:

1.	Carl Hamacher V.,Zvonko G.Vranesic, Safwat G. Zaky, " Computer organization ", Tata McGraw Hill,5th Edition, 2008.

Reference Books:

1.	Patterson and Hennessey, “Computer Organization and Design ". The Hardware/Software interface,Harcourt Asia Morgan Kaufmann, 3rd Edition, 2007
2.	Hayes, “Computer Architecture and Organization ", 3rd edition,Tata McGraw Hill, 2006
3.	Heuring V.P., Jordan H.F., " Computer System Design and Architecture ", 6th edition ,Addison Wesley,2008

18CS304	OPERATING SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives:

1	To understand the structure and functions of Operating systems
2	To understand the process concepts and scheduling algorithms
3	To understand the concept of process synchronization and deadlocks
4	To learn various memory management schemes
5	To illustrate various file systems and disk management strategies

UNIT I	INTRODUCTION AND OPERATING SYSTEM STRUCTURES	9	+	0

Main frame Systems, Desktop Systems, Multiprocessor Systems, Distributed Systems, Clustered Systems,Real Time systems, Hand held Systems; Operating Systems Structures - System Components, Operating System Services, System calls, System Programs, System Design and Implementation.

UNIT II	PROCESS MANAGEMENT	9	+	0

Processes-Process Concepts, Process Scheduling, Operation on Processes, Co-Operating Processes, Inter Process Communication; Threads- Multithreading Models, Threading Issues; CPU Scheduling-Basic Concepts,Scheduling Criteria, Scheduling Algorithms.

UNIT III	PROCESS SYNCHRONIZATION AND DEADLOCKS	9	+	0

Process Synchronization- The Critical Section Problem, Synchronization Hardware, Semaphores, Classical Problem of Synchronization, Monitors; Deadlocks- Deadlock Characterization, Methods for handling Deadlocks, Deadlock Prevention, Deadlock Avoidance ,Deadlock Detection, Recovery from Deadlock.

UNIT IV	MEMORY MANAGEMENT AND VIRTUAL MEMORY	9	+	0

Memory Management- Background, Swapping, Contiguous Memory Allocation, Paging, Segmentation, Segmentation with paging; Virtual Memory - Demand paging, Page Replacement, Thrashing.

UNIT V	FILE SYSTEM AND MASS-STORAGE STRUCTURE	9	+	0

File System Interface - File Concepts, Access methods, Directory Structure, File Sharing, File Protection; File System Implementation- File System Structure and Implementation, Directory Implementation, Allocation Methods, Free Space Management; Mass-Storage Structure - Disk Structure, Disk scheduling, Disk Management, RAID Structure; Case study: Linux system.

Total (L+T)= 45 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	:	Identify the components and their functionalities in the operating system
CO2	:	Apply various CPU scheduling algorithms to solve problems
CO3	:	Analyze the needs and applications of process synchronization and deadlocks
CO4	:	Apply the concepts of memory management including virtual memory and page replacement tothe issues that occur in real time applications
CO5	:	Solve issues related to file system implementation and disk management

Text Books:	
1.	Abraham Silberschatz, P.B.Galvin, G.Gagne ―Operating System Concepts 6th edition, John Wiley & Sons, 2003.

Reference Books:	
1.	Andrew S. Tanenbaum, ―Modern Operating Systems, PHI , 2nd edition, 2001
2.	D.M.Dhamdhere, "Systems Programming and Operating Systems ", 2nd edition, Tata McGraw HillCompany, 1999.
3.	Maurice J. Bach, ―The Design of the Unix Operating System, 1st edition, PHI, 2004.

18CS305	DATA STRUCTURES AND ALGORITHMSLABORATORY	L	T	P	C
		0	0	4	2

Course Objectives:

1.	To understand basic concepts about stacks, queues and linked list.
2.	To have knowledge about non-linear data structures like trees and graphs.
3.	To design and implementation of various basic and advanced data structures.
4.	To understand about writing algorithms and step by step approach in solving problems with the help of fundamental data structures.
5.	To understand concepts about searching and sorting techniques.

EXPERIMENTS

1.	Implementation of List (Single, Double)
2.	Implementation of Stack
3.	Implementation of Queue
4.	Implementation of Binary Search Tree
5.	Implementation of Tree Traversal
6.	Implementation of Heap Tree
7.	Implementation of Breadth First Search Techniques
8.	Implementation of Depth First Search Techniques
9.	Implementation of Dijkstra's Algorithm
10.	Implementation of Sorting Techniques (Internal Sort- Bubble sort, Quick Sort & External Sorting: MergeSort)
11.	Implementation of Searching Techniques (Linear Search & Binary Search)

Total (P) = 60 Periods

Course Outcomes:

After the successful completion of the practical session, the students will be able to

CO1	:	Understand the importance of structure and abstract data type, and their basic usability indifferent applications using programming languages
CO2	:	Understand the linked implementation, and its uses both in linear and non-linear data structure
CO3	:	Understand various data structure such as stacks, queues, trees, graphs, etc. to solve variouscomputing problems
CO4	:	Demonstrate understanding of various sorting techniques, including bubble sort, insertion sort, selection sort and quick sort
CO5	:	Decide a suitable data structure and algorithm to solve a real world problem

18CS306	OPERATING SYSTEMS LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives:

1.	To understand and implement basic services and functionalities of the operating system
2.	To analyze CPU Scheduling Algorithms
3.	To implement the concept of deadlock, memory management schemes and page replacementschemes
4.	To analyze file allocation methods

EXPERIMENTS

(Implement the following on LINUX platform. Use C for high level language implementation)

1.	Basics of UNIX Commands
2.	Shell programming
3.	Write programs using the following system calls of Ubuntu operating system: fork, exec, getpid, exit,wait, close, opendir, readdir
4.	Write C program to simulate grep command
5.	Implementation of CPU scheduling algorithms: FCFS & SJF
6.	Implementation of CPU scheduling algorithms: Round Robin & Priority
7.	Implement the Producer – Consumer problem using semaphores
8.	Write a C program to simulate Bankers algorithm for the purpose of deadlock avoidance
9.	Implementation of memory management schemes (First fit, Best fit & Worst fit)
10.	Implement page replacement algorithms (FIFO & LRU)
11.	Implementation of File allocation techniques

Total (P)= 60 Periods

Course Outcomes:

After the successful completion of the practical session, the students will be able to

CO1	:	Identify basic services and functionalities of the operating system using system calls.
CO2	:	Apply CPU Scheduling Algorithms like FCFS, Round Robin, SJF, and Priority for applications
CO3	:	Apply the concepts of deadlock in operating systems and implement them in multiprogramming system.
CO4	:	Apply memory management schemes and page replacement schemes.
CO5	:	Experiment with file allocation and organization techniques

Reference Books:	
1.	Abraham Silberschatz, P.B.Galvin, G.Gagne ―Operating System Concepts 6th edition, John Wiley &Sons, 2010
E-References:	
1.	https://www.unixtutorial.org/basic-unix-commands
2.	http://mally.stanford.edu/~sr/computing/basic-unix.html

SEMESTER-IV

18MA401	NUMERICAL METHODS AND LINEARPROGRAMMING PROBLEM	L	T	P	C
		3	1	0	4

Course Objectives:

1.	To gain the knowledge about numerical interpolation, differentiation and integration.
2.	To acquire the knowledge about numerical solution to ODE using single step and multi step methods.
3.	To gain the knowledge of numerical solution to partial differential equations by using explicit and implicit methods.
4.	To acquire knowledge to find the solution of LPP using graphical and simplex methods.
5.	To solve the transportation and assignment models of LPP

UNIT I	INTERPOLATION, NUMERICAL DIFFERENTIATION AND INTEGRATION	9	+	3

Finite differences - Relation between operators - Interpolation using Newton's Forward and Backward formulae. Interpolation with unequal intervals: Newton's divided difference and Lagrange's formulae Numerical Differentiation and Integration: Trapezoidal rule and Simpson's 1/3 rule, Simpson's 3/8 rule.

UNIT II	NUMERICAL SOLUTION FOR ORDINARY DIFFERENTIAL EQUATIONS	9	+	3

Numerical methods for initial value problems- Taylor's series method- Euler's and modified Euler's method-Runge-Kutta method of fourth order, Multi-step method: Milne's predictor - corrector method- Solution of second order boundary value problems by finite difference method.

UNIT III	NUMERICAL SOLUTION FOR PARTIAL DIFFERENTIAL EQUATION	9	+	3

Partial differential equations: Finite difference solution of two dimensional Laplace and Poisson equations- Implicit and Explicit methods for one dimensional heat equation (Bender Schmidt and Crank-Nicholson methods) - Finite difference explicit method for wave equation.

UNIT IV	INTRODUCTION TO LINEAR PROGRAMMING	9	+	3

Linear programming – formulation , solution by graphical and simplex methods (Primal- Penalty, Two Phase), Special cases- Dual Simplex method- Principles of Duality

UNIT V	LINEAR PROGRAMMING EXTENSIONS	9	+	3

Transportation models (Minimizing and Maximizing Problems) – Balanced and unbalanced problems- Initial Basic feasible solution by North-West Corner rule, Least cost and Vogel's approximation methods- Check for optimality: Solution by Modified Distribution method — Assignment models (Minimizing and Maximizing Problems)- Balanced and Unbalanced Problems- Solution by Hungarian and Branch and Bound Algorithms -
Travelling salesman problem.

Total (L+T)= 60 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	:	Obtain the knowledge about interpolation , numerical differentiation and integration.
CO2	:	Solve the initial value problems by using single-step and multi-step methods.
CO3	:	Find the numerical solution of partial differential equation by using Finite difference methods.
CO4	:	Solve LPP by using Graphical and Simplex methods
CO5	:	Obtain the solution of Transportation and Assignment models.

Text Books:

1.	Veerarajan. T and Ramachandran, "Numerical methods with Programs in C and C^{++} ",Tata McGraw Hill,New Delhi,2006
2.	Taha, H.A., "Operations research – An Introduction", 9^{th} Edition, Pearson Education Edition, Asia, NewDelhi (2014).

Reference Books:

1.	Kandasamy.P, Thilagavathy.K, Gunavathi.K, "Numerical Methods" S.Chand & Co., New Delhi, 2005
2.	Sankara Rao. K., "Numerical methods for Scientists and Engineers", Prientice Hall of India (P) Ltd, 3^{rd}Edition, New Delhi, 2008.
3.	Paneer Selvam, „Operations Research", Prentice Hall of India, 2002
4.	A.M.Natarajan, P.Balasubramani, A.Tamilarasi, "Operations Research", Pearson Education, Asia, 2005.
5.	Prem Kumar Gupta, D.S. Hira, "Operations Research", S.Chand& Company Ltd, New Delhi, 3rd Edition ,2003

18CS401	COMPUTER NETWORKS	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To study the concepts of data communications and functions of different ISO/OSI reference architecture
2.	To understand the error detection and correction methods and also the types of LAN
3.	To study the concepts of subnetting and routing mechanisms
4.	To understand the different types of protocols and congestion control
5.	To study the application protocols and network security

UNIT I	DATA COMMUNICATIONS AND PHYSICAL LAYER	9	+	0

Data Communication;Networks- Physical Structures(Types of Connections,Physical Topology),Categories of Networks,Interconnection of Networks: Internetwork;Protocols and Standards; Network Models-The OSI Model,Layers in the OSI Model,Addressing;Transmission media-Guided Media,Unguided Media.

UNIT II	DATA LINK LAYER	9	+	0

Introduction-Types of errors,Redundancy,Detection versus Correction,Modular Arithmetic;Block Coding-Error Detection and Correction (VRC,LRC,CRC,Checksum,Hamming Code);Data link Control- Flow Control (Stop- and-Wait,Sliding Window),Error Control (Automatic Repeat Request, Stop-and-wait ARQ,Sliding Window ARQ), HDLC; Local Area Networks- Ethernet, Token Bus, Token Ring, FDDI.

UNIT III	NETWORK LAYER	9	+	0

Network Layer services-Packet Switching-Network Layer Performance-IPv4 addresses-IPv6 addressing-Subnetting-Bridges-Gateways- Routers-Routing Algorithm-Distance Vector Routing, Link State Routing.

UNIT IV	TRANSPORT LAYER	9	+	0

Duties of the Transport layer-User Datagram Protocol-Transmission Control Protocol- Congestion Control and Quality of Service-Congestion,Congestion Control, Quality of Service, Techniques to improve QoS, Integrated Services.

UNIT V	PRESENTATION LAYER AND APPLICATION LAYER	9	+	0

Translation, Encryption/Decryption, Authentication, Data Compression; Domain Name System – FTP-SMTP-HTTP-World Wide Web.

Total (L+T)= 45 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	:	Classify the fundamentals of data communications and functions of layered architecture
CO2	:	Apply the error detection and correction methods and also identify the different networktechnologies
CO3	:	Analyze the requirements for a given organizational structure and select the most appropriate networking architecture and routing technologies
CO4	:	Illustrate the transport layer principles and reliable data transfer using protocols
CO5	:	Analyze the application layer protocols and also the use of network security

Text Books:

1.	Behrouz A.Ferouzan, "Data Communications and Networking", 4th Edition, Tata McGraw-Hill, 2007.

Reference Books:

1.	Andrew S. Tanenbaum, "Computer networks "PHI, 4th edition 2008
2.	William Stallings," Data and computer communications", 10th edition,PHI, 2012
3.	Douglas E. comer," Internetworking with TCP/IP-Volume-I", 6th edition,PHI, 2008

18CS402	DESIGN AND ANALYSIS OFALGORITHMS	L	T	P	C
		3	0	0	3

Course Objectives:

1.	Learn the algorithm analysis techniques.
2.	Become familiar with the divide-and-conquer and greedy algorithm design techniques.
3.	Become familiar with the dynamic programming design techniques.
4.	Become familiar with the backtracking design techniques for a problem.
5.	Understand the limitations of Algorithmic power.

UNIT I	INTRODUCTION	9	+	0

The Role of Algorithms in Computing – Getting Started : Insertion Sort - Analyzing Algorithms - Designing Algorithms – Growth of Functions : Asymptotic Notations – Standard notations and common functions – Recurrences :The Substitution Method – The Recursion-tree Method – The Master Method.

UNIT II	DIVIDE-AND-CONQUER AND GREEDY ALGORITHMS	9	+	0

Divide and Conquer: General Method — Binary Search — Finding Maximum and Minimum – Merge Sort - Quick Sort – Greedy Algorithms: General Method – Container Loading – Knapsack Problem – Tree Vertex Splitting - Job Sequencing with Deadlines.

UNIT III	DYNAMIC PROGRAMMING	9	+	0

Dynamic Programming: General Method — Multistage Graphs — All-Pair Shortest Paths — Single- Source Shortest Paths: General Weights - Optimal Binary Search Trees – 0/1 Knapsack – Travelling Salesperson Problem- Flow Shop Scheduling .

UNIT IV	BACKTRACKING	9	+	0

Backtracking: General Method — 8 Queens problem — sum of subsets – graph coloring – Hamiltonian problem — knapsack problem.

UNIT V	GRAPH TRAVERSALS AND BRANCH AND BOUND	9	+	0

Graph Traversals — Connected Components — Spanning Trees — Biconnected components — Branch and Bound: General Methods (FIFO & LC) — 0/1 Knapsack problem – Introduction to NP-Hard and NP-Complete Problems-Basic concepts, Traveling salesman problem.

Total(L+T) = 45 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	:	Analyze the time and space complexity of different algorithms.
CO2	:	Apply appropriate design technique for a problem.
CO3	:	Modify existing algorithms to improve efficiency.

Text Books:	
1.	Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, Computer Algorithms/C++, Second Edition, Universities Press, 2007. (Units II to V)
2.	T. H. Cormen, C. E. Leiserson, R.L.Rivest, and C. Stein, "Introduction to Algorithms", Second Edition,Prentice Hall of India Pvt. Ltd, 2003.(Unit I)
Reference Books:	
1.	Anany Levitin, “Introduction to the Design and Analysis of Algorithm”, Pearson Education Asia, Thirdedition, 2011.
2.	Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "The Design and Analysis of ComputerAlgorithms", Pearson Education, 1999.
E-References	
1	DAA lectures by Ravindrababu-video lecture

18CS403	OBJECT ORIENTED PROGRAMMINGUSING C++	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To understand and develop the object oriented programming concepts.
2.	To familiarize and design the template functions and classes
3.	To disseminate and apply exception handling mechanisms.
4.	To learn and exploit steam classes.

UNIT I	INTRODUCTION	9	+	0

Procedure Oriented Programming paradigm - Object Oriented Programming paradigm - Basic concepts of Object Oriented Programming, benefits of OOP, application of OOP - C++ fundamentals –structure of C++ program, tokens, data types - Operators and Expressions - Control structures - Functions.

UNIT II	CLASSES AND OBJECTS	9	+	0

Classes and Objects - friend functions- constructors and destructors- Operator overloading – binary and unaryoperator overloading using member function and friend function - Type conversions.

UNIT III	INHERITANCE AND VIRTUAL FUNCTIONS	9	+	0

Inheritance — defining derived classes, types, virtual base classes, abstract classes, constructor in derivedclasses - Pointers- pointers to objects, this pointer, pointer to derived classes - Virtual functions.

UNIT IV	TEMPLATES AND EXCEPTION HANDLING	9	+	0

Generic Classes – class template, class templates with multiple parameters - Generic Functions - functiontemplates, function templates with multiple parameters, member function templates - Exception handling –basics, exception handling mechanism, rethrowing an exception — Exception handling options — understanding terminate() and unexpected() – the uncaught_exception() function – bad_exception().

UNIT V	CONSOLE I/O AND FILE HANDLING	9	+	0

C++ Stream Classes — unformatted I/O operations, formatted console I/O operations, manipulators - Files- classes for file operation, opening and closing a file, detecting end of file, files modes, sequential file operations, random file operations.

Total (L+T)= 45 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	:	Construct the object oriented programming concepts.
CO2	:	Familiarize and build the template functions and classes
CO3	:	Disseminate and apply exception handling mechanisms.
CO4	:	Depict and exploit steam classes.
Text Books:		
1.	E. Balagurusamy “Object –Oriented Programming with C++” Sixth Edition Tata McGraw-Hill	
Reference Books:		
1.	Herbert Schildt, "The Complete Reference C++", Fifth Edition, Tata McGraw Hill	
2.	Bjarne Stroustrup, “The C++ programming language”, Fourth Edition Addison Wesley	
3.	K.R. Venugopal, Rajkumar Buyya “Mastering in C++” Second Edition, Tata McGraw Hill	

18CS404	SOFTWARE ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To understand the different life cycle models and requirements collection process
2.	To understand design and development principles in the construction of software systems
3.	To learn the various software testing techniques and methods used for project management

UNIT I	SOFTWARE PROCESS	9	+	0

Introduction-The software process-software Engineering Practice-A generic process model-prescriptive process models-specialized process models-unified process-Personal and Team Process Models –processtechnology-product and process.

UNIT II	UNDERSTANDING REQUIREMENTS	9	+	0

Requirements Engineering -Establishing the Groundwork -Eliciting Requirements -Developing Use Cases - Building the Requirements Model -Negotiating Requirements - Validating Requirements-Requirements Analysis - Scenario-Based Modeling - UML Models That Supplement the Use Case -Data Modeling Concepts
- Class-Based Modeling.

UNIT III	DESIGN CONCEPTS AND PRINCIPLES	9	+	0

Design within the Context of Software Engineering - The Design Process - Design -The Design Model - Software Architecture - Architectural Genres - Architectural Styles -Architectural Design -Assessing AlternativeArchitectural Designs -Architectural Mapping Using Data Flow.

UNIT IV	TESTING	9	+	0

A Strategic Approach to Software Testing - Strategic Issues -Test Strategies for Conventional Software - Test Strategies for Object-Oriented Software - Test Strategies for WebApps - Validation Testing –System- -The Art of Debugging.

UNIT V	SOFTWARE PROJECT MANAGEMENT	9	+	0

The Management Spectrum - The People - The Product - The Process -The WHH Principle - Metrics in the Process and Project Domains - Software Measurement - Metrics for Software Quality - Integrating Metrics within the Software - Metrics for Small Organizations - Establishing a Software Metrics Program - Decomposition - Empirical Estimation Models -Specialized Estimation Techniques -The Make/Buy Decision .

Total (L+T)= 45 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	:	Familiar with the different life cycle models and requirement collection process.
CO2	:	Describe design and development principles in the construction of software systems.
CO3	:	Explain the various software testing techniques and methods used for project management.

Text Books:	
1.	Roger S.Pressman, "Software engineering- A practitioner's Approach", McGraw- Hill International Edition, 7th edition, 2010.
Reference Books:	
1.	PankajJalote- "An Integrated Approach to Software Engineering, Narosa Publications", Third Edition,2008.
2.	James F Peters and WitoldPedryez, "Software Engineering – An Engineering Approach", John Wiley andSons, New Delhi, 2000.
3.	Ian Sommerville, "Software engineering", Pearson education Asia, 6th edition, 2006.
E-References:	
1.	Software Engineering NPTEL video lectures by Prof.N.L. Sarda, Prof. Umesh Bellur,Prof.R.K.Joshi andProf.Shashi Kelkar, Department of Computer Science & Engineering ,IIT Bombay.

18CS405	MICROPROCESSORS ANDMICROCONTROLLERS	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To understand the Architecture of 8086 microprocessor
2.	To learn the design aspects of I/O and Memory Interfacing circuits
3.	To interface microprocessors with supporting chips
4.	To study the Architecture of 8051 microcontroller and design a microcontroller based system

UNIT I	THE 8086 MICROPROCESSOR	9	+	0

Introduction to 8086 – Microprocessor architecture – Addressing modes – Instruction set and assembler directives – Assembly language programming – Modular Programming – Linking and Relocation – Stacks – Procedures – Macros – Interrupts and interrupt service routines – Byte and String Manipulation.

UNIT II	8086 SYSTEM BUS STRUCTURE	9	+	0

8086 signals – Basic configurations – System bus timing –System design using 8086 – I/O programming – Introduction to Multiprogramming – System Bus Structure – Multiprocessor configurations – Coprocessor, Closely coupled and loosely Coupled configurations – Introduction to advanced processors.

UNIT III	I/O INTERFACING	9	+	0

Memory Interfacing and I/O interfacing – Parallel communication interface – Serial communication interface –D/A and A/D Interface — Timer — Keyboard /display controller — Interrupt controller — DMA controller — Programming and applications Case studies: Traffic Light control, LED display , LCD display, Keyboard display interface and Alarm Controller.

UNIT IV	MICROCONTROLLER	9	+	0

Architecture of 8051 – Special Function Registers(SFRs) – I/O Pins Ports and Circuits – Instruction set – Addressing modes – Assembly language programming.

UNIT V	INTERFACING MICROCONTROLLER	9	+	0

Programming 8051 Timers – Serial Port Programming – Interrupts Programming – LCD & Keyboard Interfacing – ADC, DAC & Sensor Interfacing – External Memory Interface- Stepper Motor and Waveform generation – Comparison of Microprocessor, Microcontroller, PIC and ARM processors.

Total (L+T)= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Understand and execute programs based on 8086 microprocessor.
CO2	:	Design Memory Interfacing circuits.
CO3	:	Design and interface I/O circuits.
CO4	:	Design and implement 8051 microcontroller based systems.

Text Books:

1.	Yu-Cheng Liu, Glenn A.Gibson, ―Microcomputer Systems: The 8086 / 8088 Family – Architecture,Programming and Design, Second Edition, Prentice Hall of India, 2007. (UNIT I- III)
2.	Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, ―The 8051 Microcontroller and EmbeddedSystems: Using Assembly and C, Second Edition, Pearson education, 2011. (UNIT IV-V)

Reference Books:

1.	A.K.Ray,K.M.Bhurchandi,ǁAdvanced Microprocessors and Peripherals ―3rd edition, Tata McGrawHill,2012
2.	Doughlas V.Hall, ―Microprocessors and Interfacing, Programming and Hardware,TMH,2012
3.	Douglas V.Hall, "Microprocessors And Interfacing Programming and Hardware", Tata McGraw Hill, 2003
4.	"Microcontrollers: Architecture, Programming, Interfacing and System Design", Raj Kamal, PearsonEducation, 2005.

E-References:

1.	https://onlinecourses.nptel.ac.in/noc18_ec03/preview, (Prof. Santanu Chattopadhyay,IIT KHARAGPUR)

18CS406	OBJECT ORIENTED PROGRAMMING USING C++ LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives:

1.	To write programs using control structures and functions
2.	To apply Object Oriented Programming concepts
3.	To implement Template functions and classes
4.	To develop program with Exceptions
5.	To implement program using File

EXPERIMENTS

1.	Programs using control structures.
2.	Programs Using Functions ● Implementation of Functions with default arguments ● Implementation of Call by Value, Call by Address and Call by Reference ● Implementation of Function Overloading
3.	Programs using Class ● Class with primitive data members ● Class with pointers as data members ● Class with static member functions ● Class with friend function
4.	To implement Compile time Polymorphism ● Constructors and Destructors ● Operator Overloading - Unary and Binary Operators. ● Type conversions
5.	To implement Inheritances ● Single inheritance ● Multiple inheritance ● Hierarchical inheritance ● Virtual Base Classes
6.	To implement Runtime Polymorphism
7.	To implement Templates ● Function templates ● Class templates
8.	To implement Exception Handling Mechanism ● Handling pre-defined exceptions ● Handling user-defined exceptions
9.	File Handling ● Sequential Access ● Random Access

Total (P)= 60 Periods

Course Outcomes:		
After the successful completion of the practical session, the students will be able to		
CO1	:	Write programs using control structures and functions
CO2	:	Construct programs using Object Oriented Programming concepts
CO3	:	Build Template functions and classes
CO4	:	Develop program with Exceptions
CO5	:	Implement program using File

Reference Books:

1.	E. Balagurusamy “Object –Oriented Programming with C++” Sixth Edition Tata McGraw-Hill
2.	Herbert Schildt, "The Complete Reference C++", Fifth Edition, Tata McGraw Hill
3.	K.R. Venugopal, Rajkumar Buyya “Mastering in C++” Second Edition, Tata McGraw Hill

18CS407	MICROPROCESSOR AND MICROCONTROLLER LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives:

1.	Introduce ALP concepts and features
2.	Write ALP for arithmetic and logical operations in 8086 and 8051
3.	Differentiate Serial and Parallel Interface
4.	Interface different I/Os with Microprocessors
5.	Be familiar with MASM

EXPERIMENTS

1.	Basic arithmetic and Logical operations
2.	Move a data block without overlap
3.	Code conversion, decimal arithmetic and Matrix operations.
4.	Floating point operations, string manipulations, sorting and searching
5.	Password checking, Print RAM size and system date
6.	Counters and Time Delay Peripherals and Interfacing Experiments
7.	Traffic light control
8.	Stepper motor control
9.	Digital clock
10.	Key board and Display
11.	Printer status
12.	Serial interface and Parallel interface
13.	A/D and D/A interface and Waveform Generation 8051 Experiments using kits and MASM
14.	Basic arithmetic and Logical operations
15.	Square and Cube program, Find 2's complement of a number
16.	Unpacked BCD to ASCII

Total (P)= 60 Periods

Course Outcomes:		
After the successful completion of the practical session, the students will be able to		
CO1	:	Write ALP Programmes for fixed and Floating Point and Arithmetic
CO2	:	Interface different I/Os with processor
CO3	:	Generate waveforms using Microprocessors
CO4	:	Execute Programs in 8051
CO5	:	Explain the difference between simulator and Emulator

LAB EQUIPMENT FOR HARDWARE (A BATCH OF 30 STUDENTS):	
1.	8086 development kits – 30 nos
2.	Interfacing Units – Each 10 nos
3.	Microcontroller – 30 nos
LAB EQUIPMENT FOR SOFTWARE (A BATCH OF 30 STUDENTS):	
1.	Intel Desktop Systems with MASM – 30 nos
2.	8086 Assembler 8051 Cross Assembler

18CYMC01	ENVIRONMENTAL SCIENCE	L	T	P	C
		0	0	1	0

Course Objectives:

1.	They are part of the environment
2.	To have an ancient wisdom drawn from Vedas
3.	Activities based knowledge to preserve environment
4.	Conservation of water and its optimization.

ENVIRONMENTAL AWARENESS	**6**	**+**	**0**

1. Group activity on water management
2. Group discussion on recycle of waste (4R's)
3. Slogan making contest.
4. Poster making event.
5. Expert lecture on environmental awareness.
6. Imparting knowledge on reduction of electricity usage

ENVIRONMENTAL ACTIVITIES	**8**	**+**	**0**

1. Identification and segregation of biodegradable and non biodegradable waste
2. Campus cleaning activity
3. Plantation of trees in the college campus and local waste lands.
4. Identification of varieties of plants and their usage
5. Shutting down the fans and ACs of the campus for an hour
6. Field work on growing of kitchen garden for mess.

Total(L+T)= 14 Hours

SEMESTER-V

18CS501	DATABASE MANAGEMENT SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To understand the fundamentals of data models ,SQL queries and relational databases.
2.	To make a study of database design using ER Diagram and normalize.
3.	To impart knowledge in transaction processing.
4.	To make the students to understand the file operations and indexing.
5.	To familiarize the students with advanced databases

UNIT I	RELATIONAL DATABASES	9	+	0

Purpose of Database System – Views of data – Data Models – Database System Architecture – Introductionto relational databases – Relational Model – Keys – Relational Algebra – SQL fundamentals – Advanced SQL features – Embedded SQL– Dynamic SQL.

UNIT II	DATABASE DESIGN	9	+	0

Entity-Relationship model – E-R Diagrams – Enhanced-ER Model – ER-to-Relational Mapping – Functional Dependencies – Non-loss Decomposition – First, Second, Third Normal Forms, Dependency Preservation – Boyce/Codd Normal Form – Multi-valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form.

UNIT III	TRANSACTIONS	9	+	0

Transaction Concepts – ACID Properties – Schedules – Serializability – Concurrency Control – Need for Concurrency – Locking Protocols – Two Phase Locking – Deadlock – Transaction Recovery – Save Points – Isolation Levels – SQL Facilities for Concurrency and Recovery.

UNIT IV	IMPLEMENTATION TECHNIQUES	9	+	0

RAID – File Organization – Organization of Records in Files – Indexing and Hashing –Ordered Indices – B+ tree Index Files – B tree Index Files – Static Hashing – Dynamic Hashing – Query Processing Overview – Algorithms for SELECT and JOIN operations – Query optimization using Heuristics and Cost Estimation.

UNIT V	ADVANCED TOPICS	9	+	0

Distributed Databases: Architecture, Data Storage, Transaction Processing – Object-based Databases: ObjectDatabase Concepts, Object-Relational features, ODMG Object Model, ODL, OQL – XML Databases: XML Hierarchical Model, DTD, XML Schema, XQuery – Data Warehousing and Data Mining - information Retrieval:
IR Concepts, Retrieval Models, Queries in IR systems.

Total (L+T)= 45 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	:	Understand the basic concepts of the database and data models.
CO2	:	Design a database using ER diagrams and map ER into Relations and normalize the relations.
CO3	:	Develop a simple database for applications

Text Books:	
1.	Abraham Silberschatz, Henry F.Korth and S.Sundarshan "Database System Concepts", Sixth Edition,Tata McGraw Hill, 2011.

Reference Books:	
1.	Ramez Elamassri and Shankant B-Navathe, "Fundamentals of Database Systems", Sixth Edition,Pearson Education, 2011.
2.	C.J. Date, "An Introduction to Database Systems", Eighth Edition, Pearson Education Delhi, 2008.
3.	Raghu Ramakrishnan, ―Database Management Systems, Fourth Edition, McGraw-Hill CollegePublications, 2015.
4.	G.K.Gupta,"Database Management Systems", Tata McGraw Hill, 2011.

E-References:	
1.	Lecture Series on Database Management System by Dr.S.Srinath,IIIT Bangalore,nptl

18CS502	THEORY OF COMPUTATION	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To understand different computational models
2.	To comprehend the properties of computational models

UNIT I	AUTOMATA	9	+	0

Introduction to Formal Proof - Additional Forms of Proof - Inductive Proof - Finite Automata (FA) — Deterministic Finite Automata (DFA) — Non-deterministic Finite Automata (NFA) — Finite Automata with Epsilon transitions (ε - NFA) — Proof of Equivalence: DFA and NFA — DFA and ε - NFA — NFA and ε - NFA

UNIT II	REGULAR EXPRESSIONS AND LANGUAGES	9	+	0

Regular Expression (RE) – FA and Regular Expressions – Application of RE – Algebraic Laws - Proving languages not to be regular – Closure properties of regular languages – Decision properties of regular languages – Equivalence and minimization of Automata

UNIT III	CONTEXT-FREE GRAMMAR AND LANGUAGES	9	+	0

Context-Free Grammar (CFG) – Parse Trees – Ambiguity in grammars and languages – Definition of the Pushdown automata – Languages of a Pushdown Automata – Equivalence of Pushdown automata and CFG, Deterministic Pushdown Automata – Normal Forms for Context-Free Grammars – Pumping Lemma for Context-Free Languages – Closure Properties of Context-Free Languages – Decision Properties of Context-Free Languages

UNIT IV	TURING MACHINES	9	+	0

Turing machines – Turing machines as acceptor – Turing machines as a Computing Device – Programming Techniques for Turing Machines – Extensions to the Basic Turing Machine – Restricted Turing Machines

UNIT V	UNDECIDABILITY AND INTRACTABLE PROBLEMS	9	+	0

Language That Is Not Recursively Enumerable–Undecidable Problem That Is Recursively Enumerable – Undecidable Problems About Turing Machines – The Classes P and NP – An NP-Complete Problem – A Restricted Satisfiability Problem

Total (L+T)= 45 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	:	Develop a computational model to recognize regular language or context free language
CO2	:	Establish equivalence among computational models of equivalent capacities.
CO3	:	Recall the procedures involved in the construction of computational models.

Text Books:	
1.	J.E.Hopcroft, R.Motwani, J.D.Ullman, "Introduction to Automata Theory, Languages and Computations",3rd Edition, Pearson Education,2008.
Reference Books:	
1.	Dexter C. Kozen, "Automata and Computability", Springer Publishers, 2007.
2.	John. C. Martin, "Introduction to languages and the theory of computation", Tata McGrawHill, 2003.
3.	Peter Linz, "An introduction to formal language and automata", Narosa publishers, 2002.
4.	Kamala Kritivasan and R.Rama,"Introduction to Formal Languages, Automata Theory and Computation",Pearson Publishers, 2009.
E-References:	
1.	https://nptel.ac.in/courses/106104028/
2.	http://www.nptelvideos.in/2012/11/theory-of-computation.html
3.	http://infolab.stanford.edu/~ullman/ialc.html

18CS503	JAVA PROGRAMMING	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To familiarize and apply the Object Oriented concepts and java features
2.	To write the standalone applications and applet applications
3.	To build simple chart application and Database Connectivity

UNIT I	INTRODUCTION TO JAVA	9	+	0

Fundamentals of object oriented programming- Java features, comparing Java with C and C++,Java environment; Overview of java language - Java program structure, Java tokens, Java statements, implementing Java program, Java Virtual Machine, command line arguments; constants, variables and data types - Operators and expressions - Decision making — branching and looping - Arrays and Strings.

UNIT II	JAVA FEATURES	9	+	0

Classes, Objects, methods — Inheritances — Interface — Packages - Exception handling - Multithreaded programming - Exploring java.lang– primitive types, wrapper classes ; Exploring java.io - java I/O classes and interfaces, files, stream classes, byte streams, character stream.

UNIT III	APPLET AND EVENT HANDLING	9	+	0

Applet class- two types of applets, Applet basics, Applet architecture, Applet skeleton, simple Applet display method — Passing parameters to Applet; Event handling — two event handling Mechanisms, delegation event model, event classes, sources of events, event listener interfaces; Introduction to AWT - AWT classes, windows fundamentals, working with frame Windows, creating a frame window in an Applet, creating a windowed program, working with graphics, working with color, working with fonts.

UNIT IV	AWT AND SWING CONTROLS	9	+	0

AWT - AWT controls, Layout Managers, Menu Bars and Menus, Dialog Boxes, FileDialogs; Swings-JApplet,JLabel and ImageIcon, JTextField, Swing Buttons, JTabbedPane, JScrollPane, JList, JComboBox, Trees, JTables.

UNIT V	NETWORKING AND JDBC	9	+	0

Networking - Networking Basics, InetAddress, TCP/IP Client Sockets, URL, URL Connection, TCP/IP ServerSockets, Datagrams; Design of JDBC - JDBC drivers; JDBC programming concepts - Database concepts, making connection, executing SQL commands, managing connections, statements, and result sets;
Query execution - Prepared Statements.

Total (L+T)= 45 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	:	Familiarize and apply the Object Oriented concepts and java features
CO2	:	Build the standalone applications and applet applications
CO3	:	Develop simple chart application and Database Connectivity

Text Books:	
1.	PatricNaughton , Herbert Schildt, "The Complete Reference Java 2" , Eighth edition Tata McGraw Hills.(Unit II - V)
2.	E. Balaguruswamy, "Programming with Java", Fifth Edition, TMH.(Unit- I)

Reference Books:	
1.	Cay S. Horstmann, Gary Cornell " Core Java 2" Eighth Edition, Pearson Education
2.	Graham Hamilton , Rick Cattell, Maydene Fisher ,"JDBC Database access with java".
3.	PaulDeitel and Harvey Deitel, "Java How to Program", Tenth Edition, Pearson Prentice Hall.

18MG501	PRINCIPLES OF MANAGEMENT	L	T	P	C
		3	0	0	3

Course Objectives:

1	To familiarize the students about the overall management functions like planning, organizing, staffing, leading, and controlling and also the systems model integrates these functions into a system and links the organization with its environment.

UNIT I	INTRODUCTION	9	+	0

Definitions of management – features of management – Management thoughts – different schools of management – Scientific management – Arts or Science, Management Vs administration – Principles of Management

UNIT II	FUNCTIONS OF MANAGEMENT	9	+	0

Role of managers. Functions approach to management, Management functions Vs Management levels — management skills Vs Management levels – the role approach to management, reconciling functions and role, responsibility of managers — towards subordinates, peers, supervisors, customers, government, company, creditors, shareholders, competitors

UNIT III	MANAGERIAL PLANNING AND DECISION MAKING	9	+	0

Planning fundamentals, objectives. Management by objectives – Changes in objectives – goal distortions – major types of plans, policies and objectives, procedures – methods, rules, programmes and schedule, projects, budgets – importance of decision making, types of decisions, decision making process – decision theory – quantitative techniques – decision making conditions – Operation Research (OR), Definition, successful areas of operation research - Decision tree

UNIT IV	ORGANIZATION	9	+	0

Organization: Basic concepts – organization as a structure – as a process – as a group properties of modern organization – typology, importance of organization – business /industrial organization – sole trading, partnership company, co – operative , public enterprise line (military), line and staff, functional , matrix committee based organization - departmentation – need, bases of departmentation – by function product, territory, customer, process, marketing channels

UNIT V	STAFFING, CONTROLLING AND COMMUNICATION	9	+	0

Nature and purpose of staffing – man power planning, aims and objectives of HRP recruitment, selection and training sources of recruitment, process of recruitment training methods – performance appraisal methods –communication – importance – methods process – barriers to communications. Hoe to remove obstacles of effective communication – controlling – definition – Characteristics of control – types of control – requirements of effective control – control techniques – Break even analysis, budgeting, PERT/ CPM, MIS, ZBB, ratio analysis.

Total (L+T)= 45 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	:	Identify the concepts of management, administration and the evolution of management thoughts
CO2	:	Apply the planning concepts in different applications
CO3	:	Analyze the different organizational structures
CO4	:	Analyze the various staffing, controlling and communication processes

Text Books:	
1.	Herald knootz and Heinz weihrich, ―Essentials of Management‖, McGraw-Hill Publishing Company, Singapore International Edition, 2007
2.	Joseph L, Massie, ―Essentials of Management‖, Prentice Hall of India Pvt., Ltd (Pearson) Fourth Edition, 2003.

Reference Books:	
1.	Stephen A. Robbins & David A. Decenzo& Mary Coulter, "Fundamentals of Management"7th Edition, Pearson Education, 2011
2.	Robert Kreitner&MamataMohapatra, "Management", Biztantra, 2008.
3.	Tripathy PC & Reddy PN, "Principles of Management", Tata McGraw Hill, 1999.

18CS504	DATABASE MANAGEMENT SYSTEMSLABORATORY	L	T	P	C
		0	0	4	2

Course Objectives:

1.	Learn to create and use a database.
2.	Be familiar with a query language.
3.	Have hands-on experience on DDL, DML and DCL commands.
4.	Familiarize advanced SQL queries.
5.	Be Exposed to different applications.

EXPERIMENTS

1.	Create a relational database system using DDL commands with constraints.
2.	Update the database system using DML commands.
3.	Query the database using simple and complex queries.
4.	Create and update views.
5.	High level programming language extensions (Control structures, Procedures and Functions).
6.	Create triggers.
7.	Create assertions and indexes.
8.	Use of front end tools to manipulate the database.
9.	Generate reports using a reporting tool.
10.	Database Design and implementation of an application system. (Suggested Mini Project)

Total (P)= 60 Periods

Course Outcomes:

After the successful completion of the practical session, the students will be able to

CO1	:	Build tables, construct relationships among them and retrieve data with simple and complex queries.
CO2	:	Build various constraints, triggers and indexes on the tables.
CO3	:	Design and implement a database and to integrate into a simple application.

18CS505	JAVA PROGRAMMING LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives:

1.	To implement object oriented programming concepts and java features
2.	To build Java standalone applications and applet applications
3.	To develop simple chat applications and database connectivity applications

EXPERIMENTS

1.	Program using Control structures
2.	Program using arrays and strings
3.	Program using Java Classes and Objects
4.	Program to implement inheritance
5.	Program to implement interface
6.	Program to create packages and import the package
7.	Program to create own Exceptions and catch the exceptions
8.	Program to implement the Multiple threads
9.	Program to implement File operations
10.	Program to create a simple applet application
11.	Program to create application the AWT controls with events
12.	Program to create application with Layouts
13.	Program to create application the Swings controls with events
14.	Program to implement a simple chat using Sockets programming
15.	Program to implement a simple chat using Datagrams.
16.	Program to implement JDBC connectivity

Total (P)= 60 Periods

Course Outcomes:

After the successful completion of the practical session, the students will be able to

CO1	:	Implement object oriented programming concepts and java features
CO2	:	Develop Java standalone applications and applet applications
CO3	:	Build simple chat applications and database connectivity applications

Reference Books:	
1.	PatricNaughton , Herbert Schildt, “The Complete Reference Java 2” , Eighth edition Tata McGraw Hills ,2011.
2.	E. Balaguruswamy, “Programming with java”, Second Edition, TMH, 1999.
3.	Cay S. Horstmann, Gary Cornell “ Core Java 2” Eighth Edition, Pearson Education

18EN501	COMMUNICATION SKILLS ANDLANGUAGE LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives:

1.	Communicate effectively with interviewers
2.	Express opinions, illustrate with examples, elucidate and conclude in group discussions
3.	Write error free letters and prepare reports
4.	Speak fluently and avoid pitfalls in pronunciation and grammatical errors

EXPERIMENTS

WRITING SKILLS (15 hours)

- Letter seeking permission to go on industrial visit
- Letter of invitation
- Resume and Cover Letter
- Report Writing – Progress in project work

SPEAKING SKILLS (15 hours)

- Welcome Address and Vote of Thanks
- Analysing and presenting business articles
- Power Point Presentation
- Group Discussion

SOFT SKILLS (15 hours)

- Psychometric profile
- Self-Introduction
- Interview skills
- Conducting a board meeting

VERBAL ABILITIES (15 hours)

- Error Spotting
- Listening Comprehension
- Rearranging Jumbled sentences
- Vocabulary

Lab Record

1. Group Discussion - Literature survey
2. Group Discussion - Transcripts
3. Group Discussion - Assessment forms
4. Interview Skills – Psychometric profile
5. Interview Skills - Self-introduction
6. Interview Skills – Resume and Cover Letter
7. Interview Skills - Transcription of interview
8. Interview Skills - Assessment sheet signed by interview panel
9. Power Point Presentation
10. Error spotting worksheet

	11. Jumbled sentences worksheet 12. Welcome Address 13. Vote of Thanks 14. Letter seeking permission to go on industrial visit 15. Report Writing – Progress in project work 16. Presentation of business articles - Transcription

Total (P)= 60 Periods

Course Outcomes:

After the successful completion of the practical session, the students will be able to

CO1	:	Write error free letters and prepare reports
CO2	:	Deliver welcome address and vote of thanks
CO3	:	Speak coherently with proper pronunciation and accent
CO4	:	Avoid common Indianisms and grammatical errors
CO5	:	Improve repertoire of passive vocabulary
CO6	:	Answer questions posed by interviewers confidently
CO7	:	Participate in group discussion effectively
CO8	:	Undertake online psychometric and IQ test to understand their strengths and weaknesses

Suggested References:

1.	Anderson, P.V, Technical Communication, Thomason Wadsworth, Sixth Edition, New Delhi,2007
2.	Prakash, P, Verbal and Non-Verbal Reasoning, Macmillan India Ltd., Second Edition, NewDelhi, 2004
3.	John Seely, The Oxford Guide to Writing and Speaking, Oxford University Press, New Delhi,2004
4.	Evans, D, Decision maker, Cambridge University Press, 1997
5.	Thorpe, E, and Thorpe, S, Objective English, Pearson Education, Second Edition, New Delhi,2007
6.	Turton, N.D and Heaton, J.B, Dictionary of Common Errors, Addision Wesley Longman Ltd.,Indian reprint 1998
7.	Ready,Steady, Go. Deepak Mehra, Jaico Publishing House, Delhi,2015
8.	Business English Certificate Materials, Cambridge University Press
9.	http://www.seemypersonality.com (Personality Test and IQ Test).
10	http://www.humanmetrics.com/cgi-win/jtypes2.asp

18MC301	INDIAN CONSTITUTION	L	T	P	C
	(Common to all branches)	**2**	**0**	**0**	**0**

Course Objectives:

1.	learn the salient features of the Indian Constitution
2.	list the Fundamental Rights and Fundamental Duties
3.	present a systematic analysis of all dimensions of Indian Political System
4.	understand the power and functions of the Parliament, the Legislature and the Judiciary

UNIT I		**6**	**+**	**0**

Union and its Territory – Citizenship–Fundamental Rights–Directive Principles of State Policy–Fundamental Duties

UNIT II		**6**	**+**	**0**

The Union–The States–The Union Territories–The Panchayats–The Municipalities

UNIT III		**6**	**+**	**0**

The Co-operative Societies–The scheduled and Tribal Areas–Relations between the Union and the States–Finance, Property, Contracts and Suits–Trade and Commerce within the territory of India

UNIT IV		**6**	**+**	**0**

Services under the Union, the States – Tribunals – Elections– Special Provisions –Relating to certain Classes

UNIT V		**6**	**+**	**0**

Languages–Emergency Provisions – Miscellaneous–Amendment of the Constitution

Total (L+T)= 30 Periods

Course Outcomes:

On completion of the course, students will:

CO1	:	understand the emergence and evolution of the Indian Constitution
CO2	:	explain the key concepts of Indian Political System
CO3	:	describe the role of constitution in a democratic society.
CO4	:	present the structure and functions of the Central and State Governments, the Legislature and theJudiciary

Text Books:

1.	SubhashC.Kashyap, Our Constitution, National Book Trust, 2017
2.	Durga Das Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.
3.	M.V.Pylee, Constitutional History of India, S.Chand publishing, 2010
4.	Granville Austin, The Indian Constitution: Cornerstone of a Nation, Oxford University Press, 1999

SEMESTER-VI

18CS601	PRINCIPLES OF COMPILER DESIGN	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To explore the principles involved in the design and construction of compilers.
2.	To understand the algorithms used in the development of compilers.

UNIT I	INTRODUCTION TO COMPILER & LEXICAL ANALYSIS	9	+	0

Compilers – Phases of a compiler – Grouping of Phases – Lexical Analysis – Role of Lexical Analyzer – Input Buffering – Specification of Tokens – Recognition of tokens – Finite Automata (FA) – Regular Expression (RE) – RE to Non deterministic Finite Automata (NFA) – NFA to Deterministic Finite Automata (DFA) – Minimizingstates of FA — RE to DFA

UNIT II	SYNTAX ANALYSIS	9	+	0

Role of the parser – Context-Free Grammars – Top Down parsing – Recursive Descent Parsing – PredictiveParsing – Bottom-up parsing – Operator Precedence Parsing – LR Parsers – SLR Parser – Canonical LRParser — LALR Parser.

UNIT III	SYNTAX DIRECTED TRANSLATION & INTERMEDIATE CODE GENERATION	9	+	0

Syntax Directed definitions – Construction of Syntax Trees – Bottom up evaluation of S-attributed definitions – L-attributed definitions – Top-down translation – Bottom up evaluation of inherited attributes – Intermediate languages – Declarations – Assignment Statements – Boolean Expressions – Case Statements – Back patching — Procedure calls.

UNIT IV	CODE GENERATION	9	+	0

Issues in the design of a code generator – The target machine – Run-time storage management – Basic Blocks and Flow Graphs — Transformations on Basic Blocks — Next-use Information — A simple Code generator — Register allocation and assignment — DAG representation of Basic Blocks — Peephole Optimization.

UNIT V	CODE OPTIMIZATION AND RUN TIME ENVIRONMENTS	9	+	0

Introduction – Principal Sources of Optimization – Optimization of basic Blocks – Loops in Flow graphs – Reducible Flow graphs – Introduction to Global Data Flow Analysis – Reaching Definitions – Data flow analysis of structured programs

Total (L+T)= 45 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	:	Illustrate the operation of any phase of a compiler.
CO2	:	Compute the information to perform the task of a compiler phase.
CO3	:	Recall the principles and algorithms involved in compiler construction.

Text Books:

1.	Alfred Aho, Monica S Lam, Ravi Sethi and Jeffrey D Ullman, “Compilers Principles, Techniques andTools”, Pearson Education Asia, Second Edition, 2014.

Reference Books:

1.	Keith D Cooper and Linda Torczon, “Engineering a Compiler”, Elsevier Publication, 2012.
2.	J.P. Bennet, “Introduction to Compiler Techniques”, Second Edition, Tata McGraw-Hill, 2003.

E-References:

1.	https://nptel.ac.in/courses/106108113/
2.	https://doc.lagout.org/programmation/C/Modern%20Compiler%20Implementation%20in%20C%20%5BAppel%201997-12-13%5D.pdf
3.	https://nptel.ac.in/courses/106104072/

18CS602	WEB TECHNOLOGY	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To express the fundamental concepts of Clients, Servers and communication between them
2.	To create Web pages with static and dynamic information and Client side program (Java scripts)
3.	To learn the features of Document Object Model (DOM)
4.	To practice the Servlet and Server side programs(JSP)
5.	To defined the web data representations
6.	To demonstrates how the various web service technologies interact

UNIT I	WEB ESSENTIALS AND MARKUP LANGUAGES	9	+	0

Web Essentials: Clients, Servers, and Communication. The Internet-Basic Internet Protocols -The World Wide Web-HTTP request message-response message-Web Clients Web Servers-Case Study. Markup Languages: XHTML. An Introduction to HTML History-Versions-Basic XHTML Syntax and Semantics-Some Fundamental HTML Elements-Relative URLs-Lists-tables-Frames-Forms-XML Creating HTML Documents-Case Study.

UNIT II	STYLE SHEETS AND CLIENT SIDE PROGRAMMING	9	+	0

Style Sheets: CSS-Introduction to Cascading Style Sheets-Features-Core Syntax-Style Sheets and HTML Style Rule Cascading and Inheritance-Text Properties-Box Model-Normal Flow Box Layout- Beyond the Normal Flow-Other Properties-Case Study. Client-Side Programming: The JavaScript Language-History and Versions Introduction to JavaScript in Perspective-Syntax-Variables and Data Types-Statements-Operators- Literals-Functions-Objects-Arrays-Built-in Objects - JavaScript Debuggers.

UNIT III	HOST OBJECTS AND SERVER SIDE PROGRAMMING	9	+	0

Host Objects: Browsers and the DOM-Introduction to the Document Object Model DOM History and Levels- Intrinsic Event Handling-Modifying Element Style-The Document Tree-DOM Event Handling-Accommodating Noncompliant Browsers Properties of window-Case Study. Server-Side Programming: Java Servlets- Architecture -Overview-A Servlet-Generating Dynamic Content-Life Cycle- Parameter Data-Sessions- Cookies- URL Rewriting-Other Capabilities-Data Storage Servlets and Concurrency-Case Study- Related Technologies.

UNIT IV	DATA REPRESENTATION AND PRESENTATION	9	+	0

Representing Web Data: XML-Documents and Vocabularies-Versions and Declaration- Namespaces JavaScript and XML: Ajax-DOM based XML processing Event-oriented Parsing: SAX-Transforming XML Documents-Selecting XML Data: XPATH-Template based Transformations: XSLT-Displaying XML
Documents in Browsers-Case Study-Related Technologies. Separating Programming and Presentation: JSP

Technology-Introduction-JSP and Servlets-Running JSP Applications Basic JSP-JavaBeans Classes and JSP-Tag Libraries and Files-Support for the Model-View-Controller Paradigm-Case Study-Related Technologies					
UNIT V	**WEB SERVICES**		**9**	**+**	**0**
Web Services: JAX-RPC-Concepts-Writing a Java Web Service-Writing a Java Web Service Client-DescribingWeb Services: WSDL- Representing Data Types: XML Schema-communicating Object Data: SOAP Related Technologies-Software Installation-Storing Java Objects as Files-Databases and Java Servlets.					
					Total (L+T)= 45 Periods
Course Outcomes:					
Upon completion of this course, the students will be able to:					
CO1	:	Express the fundamental concepts of Clients, Servers and communication between them			
CO2	:	Design of Web pages with static and dynamic information and Client side program(Java scripts)			
CO3	:	Articulate the features of Document Object Model (DOM)			
CO4	:	Implement the Servlet and Server side programs(JSP)			
CO5	:	Persuasive the web data representations			
CO6	:	Illustrates how the various web service technologies interact			
Text Books:					
1.	Jeffrey C. Jackson, "Web Technologies--A Computer Science Perspective", Pearson Education, 2006.				
Reference Books:					
1.	Robert. W. Sebesta, "Programming the World Wide Web", Fourth Edition, Pearson Education, 2007.				
2.	Deitel, Deitel, Goldberg, "Internet & World Wide Web How To Program", Third Edition, PearsonEducation, 2006.				
3.	Marty Hall and Larry Brown,"Core Web Programming" Second Edition, Volume I and II, PearsonEducation, 2001				

18CS603	COMPILER DESIGN LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives:

1.	To develop Finite state machines
2.	To implement Parsers

EXPERIMENTS

1.	Regular Expression (RE) to Non deterministic Finite Automata with Epsilon (ε - NFA).
2.	ε - NFA to Deterministic Finite Automata (DFA).
3.	Recognizing token using DFA.
4.	Top down Parsing of strings.
5.	Operator precedence parsing of strings.
6.	Bottom up parsing of strings.
7.	Generating intermediate code for arithmetic expressions.

Total (P)= 60 Periods

Course Outcomes:

After the successful completion of the practical session, the students will be able to

CO1	:	Implement the representation for RE, ε - NFA and DFA and perform conversions among them.
CO2	:	Implement Top-down and Bottom-up parsing.

Reference Books:

1.	Allen I. Holub “Compiler Design in C”, Prentice Hall of India, 2003.

E-References:

1.	https://nptel.ac.in/courses/106108113/
2.	https://doc.lagout.org/programmation/C/Modern%20Compiler%20Implementation%20in%20C%20%5BAppel%201997-12-13%5D.pdf
3.	https://nptel.ac.in/courses/106104072/

18CS604	WEB TECHNOLOGY LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives:

1.	To expressive and build Web applications using various technologies HTML, DHTML, XML, Javascripts, Servlets and JSP

LIST OF EXPERIMENTS

1. Creation of HTML pages with frames, links, tables and other tags.
2. Create a web page with the following using HTML
   i. To embed an image map in a web page
   ii. To fix the hot spots
   iii. Show all the related information when the hot spots are clicked.
3. Usage of internal and external CSS along with HTML pages.
4. Client Side Programming.(Form validation including textfield, radio buttons, checkboxes,listbox and other controls)
5. Usage of JSP objects Request, Response, Application, Session, Server, ADO etc. (Writingonline applications such as Shopping, railway/air/bus ticket reservation system)
6. Writing Servlet Program using HTTP Servlet.
7. Any online application with database access. (Write a JSP application for Telephone Directory using MS-ACCESS)
8. Creation of XML document for a specific domain.
9. Writing DTD or XML schema for the domain specific XML document.
10. Parsing an XML document using DOM and SAX Parsers.

Software Required:

1.	JDK

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Articulate and build Web applications using various technologies HTML, DHTML, XML, Javascripts, Servlets and JSP

18CS605	MINI PROJECT	L	T	P	C
		0	0	6	3

The objective of project work is to enable the students to work in convenient groups of not more than four members in a group on a project involving some design and fabrication work or theoretical and experimental studies related to the respective engineering discipline.

Every project work shall have a Guide who is a member of the faculty of the University. Six periods per weeks shall be allotted in the Time Table for this important activity and this time shall be utilized by the student to receive directions from the Guide, on library reading, laboratory work, computer analysis, or field work as assigned by the Guide and also to present periodical seminars of viva to review the progress made in the project.

Each student shall finally produce a comprehensive report covering background information, literature- survey, problem statement, project work details, estimation of cost and conclusions. This final report shall be in typewritten form as specified in the guidelines.

The continuous assessment and semester evaluation may be carried out as specified in the guidelines to be issued time to time.

SEMESTER-VII

18CS701	CRYPTOGRAPHY AND NETWORKSECURITY	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To know about various encryption techniques and number theory
2.	To understand the concepts of block cipher and public key encryption
3.	To study about authentication and Hash functions and digital signatures
4.	To learn about the network security tools and system level security
5.	To understand the IP security and Web security.

UNIT I	INTRODUCTION AND NUMBER THEORY	9	+	0

Security Attacks - Services and Mechanisms - OSI Security Architecture - Classical Encryption techniques (Symmetric Cipher Model, Substitution Techniques - Transposition Techniques and Steganography).
Finite Fields and Number Theory: Groups - Rings and Fields - Modular Arithmetic - Euclidean Algorithm - Finite fields - Polynomial Arithmetic - Prime Number - Fermat's and Euler's theorem - Testing of Primality - The Chinese remainder Theorem and Discrete logarithms.

UNIT II	BLOCK CIPHERS AND PUBLIC KEY CRYPTOGRAPHY	9	+	0

Data Encryption Standard - Block Cipher Design Principles and Modes of Operation - Advanced EncryptionStandard. Principles of Public Key Cryptosystems - The RSA Algorithm - Key Management - Diffie-Hellman key Exchange- Elliptic Curve Arithmetic and Cryptography.

UNIT III	AUTHENTICATION, HASH FUNCTION AND DIGITAL SIGNATURES	9	+	0

Authentication requirements - Authentication functions - Message Authentication Codes - Hash Functions - Security of Hash Functions and MACs — HMAC - MD5 message Digest algorithm - Secure Hash Algorithm - Digital Signatures - Authentication Protocols - Digital Signature Standard.

UNIT IV	NETWORK SECURITY AND SYSTEM SECURITY	9	+	0

Authentication Applications: Kerberos - X.509 Authentication Service - Firewall Design Principles - TrustedSystems — Intruders - Intrusion Detection - Password management - Viruses and related Threats, virus Countermeasures.

UNIT V	EMAIL, IP AND WEB SECURITY	9	+	0

Pretty Good Privacy - S/MIME - IP Security Overview - IP Security Architecture - Authentication Header - Encapsulating Security Payload - Web Security Considerations - Secure Socket Layer and Transport Layer Security - Secure Electronic Transaction(SET).

Total (L+T)= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Gain knowledge of various encryption techniques and number theory
CO2	:	Understand the concepts of block cipher and public key encryption
CO3	:	Learn basics of authentication and Hash functions and digital signatures
CO4	:	Understand the concept of network security tools and system level security
CO5	:	Gain knowledge of the IP security and Web security.

Text Books:

1.	William Stallings, “Cryptography and Network Security – Principles and Practices”, Fourth Edition, 2006.

Reference Books:

1.	AtulKahate, “Cryptography and Network Security”, Tata McGraw-Hill, 2003.
2.	Bruce Schneier, “Applied Cryptography”, John Wiley & Sons Inc, 2001.
3.	Charles P. Pfleeger, Shari Lawrence Pfleeger, “Security in Computing”, Third Edition, Prentice Hall ofIndia, 2006.

18CS702	NETWORK SECURITY LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives:

1.	To understand how AES algorithm is implemented
2.	To implement DES algorithm
3.	To be familiar with how RSA and Secure hash algorithm are implemented
4.	To understand how Diffie-Hellman Algorithm is implemented and stimulated
5.	To be familiar with simulation of firewall concepts and virus attacks

EXPERIMENTS

1.	Implementation of Caesar Cipher Algorithm.
2.	Implementation of Playfair Cipher Algorithm.
3.	Implementation of Hill Cipher Algorithm.
4.	Implementation of DES Algorithm.
5.	Implementation of AES Algorithm.
6.	Implementation of RSA Algorithm.
7.	Implement and simulate Diffie –Hellman Algorithm.
8.	Implementation of Secure Hash Algorithm.
9.	Create a model to simulate Digital Signature concept.
10.	Create a model to simulate firewall concept.
11.	Create a model to simulate the concept of virus attack.
	Software Required: Borland C++ / Java

Total (P)= 60 Periods

Course Outcomes:

After the successful completion of the practical session, the students will be able to

CO1	:	Understand how AES algorithm is implemented.
CO2	:	Implement DES algorithm.
CO3	:	Familiar with how RSA and Secure hash algorithm are implemented.
CO4	:	Understand how Diffie-Hellman Algorithm is implemented and stimulated.
CO5	:	Familiar with simulation of firewall concepts and virus attacks.

Reference Books:	
1.	William Stallings, “Cryptography and Network Security – Principles and Practices”, Fourth Edition, 2006.
2.	PatricNaughton , Herbert Schildt, “The Complete Reference Java 2” , Eighth edition Tata McGraw Hills,2011.
3.	Herbert Schildt, "The Complete Reference C++", Fourth edition, TMH, 2003

18CS703	PROJECT PHASE I	L	T	P	C
		0	0	12	6

The objective of project work is to enable the students, to work in convenient groups of not more than four members in a group, on a project involving some design and fabrication work or theoretical and experimental studies related to the respective engineering discipline.

Every project work shall have a Guide who is a member of the faculty of the University. Twelve periods per weeks shall be allotted in the Time Table for this important activity and this time shall be utilized by the student to receive directions from the Guide, on library reading, laboratory work, computer analysis, or field work as assigned by the Guide and also to present periodical seminars of viva to review the progress made in the project.

Each student shall finally produce a comprehensive report covering background information, literature-survey, problem statement, project work details, estimation of cost and conclusions. This final report shall be in typewritten form as specified in the guidelines.
The continuous assessment and semester evaluation may be carried out as specified in the guidelines to be issued time to time.

SEMESTER-VIII

18CS801	PROJECT PHASE II	L	T	P	C
		0	0	12	6

The objective of project work is to enable the students, to work in convenient groups of not more than four members in a group, on a project involving some design and fabrication work or theoretical and experimental studies related to the respective engineering discipline.

Every project work shall have a Guide who is a member of the faculty of the University. Twelve periods per weeks shall be allotted in the Time Table for this important activity and this time shall be utilized by the student to receive directions from the Guide, on library reading, laboratory work, computer analysis, or field work as assigned by the Guide and also to present periodical seminars of viva to review the progress made in the project.

Each student shall finally produce a comprehensive report covering background information, literature-survey, problem statement, project work details, estimation of cost and conclusions. This final report shall be in typewritten form as specified in the guidelines.

The continuous assessment and semester evaluation may be carried out as specified in the guidelines to be issued time to time.

LIST OF PROFESSIONAL ELECTIVES

(VI SEMESTER)

18CSPE601	SOFTWARE PROJECT MANAGEMENT	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To explain the main tasks undertaken by project managers
2.	To introduce software project management and to describe its distinctive characteristics
3.	To discuss project planning and the planning process
4.	To show how graphical schedule representations are used by project management
5.	To discuss the notion of risks and the risk management process

UNIT I	INTRODUCTION TO SOFTWARE PROJECT MANAGEMENT	9	+	0

Project Definition – Contract Management – Activities Covered By Software Project Management – Overviewof Project Planning — Stepwise Project Planning.

UNIT II	PROJECT EVALUATION	9	+	0

Strategic Assessment – Technical Assessment – Cost Benefit Analysis –Cash Flow Forecasting – CostBenefit Evaluation Techniques — Risk Evaluation.

UNIT III	ACTIVITY PLANNING	9	+	0

Objectives – Project Schedule – Sequencing and Scheduling Activities –Network Planning Models – ForwardPass – Backward Pass – Activity Float – Shortening Project Duration – Activity on Arrow Networks – Risk Management – Nature of Risk – Types of Risk – Managing Risk – Hazard Identification – Hazard analysis – Risk Planning and Control.

UNIT IV	MONITORING AND CONTROL	9	+	0

Creating Framework — Collecting The Data — Visualizing Progress — Cost Monitoring — Earned Value — Prioritizing Monitoring — Getting Project Back To Target — Change Control — Managing Contracts — Introduction – Types Of Contract – Stages In Contract Placement – Typical Terms Of A Contract – Contract Management — Acceptance.

UNIT V	MANAGING PEOPLE AND ORGANIZING TEAMS	9	+	0

Introduction – Understanding Behavior – Organizational Behaviors A Background – Selecting The Right Person For The Job — Instruction In The Best Methods — Motivation — The Oldham — Hackman Job Characteristics Model — Working In Groups — Becoming A Team –Decision Making — Leadership — Organizational Structures – Stress –Health And Safety – Case Studies.

Total (L+T)= 45 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	:	Apply project management practices and techniques and gain hands-on experience in planning,organizing, and managing software projects
CO2	:	Apply time, risk, and cost management techniques in real time software projects.
CO3	:	Apply quality management concepts and models.
CO4	:	Appreciate the importance of software project management processes and understand the softwareproject lifecycle
Text Book:		
1.	Bob Hughes, Mikecotterell, “Software Project Management”, Third Edition, Tata McGraw Hill, 2004.	
Reference Books:		
1.	Ramesh, Gopalaswamy, "Managing Global Projects", Tata McGraw Hill, 2001.	

18CSPE602	ARTIFICIAL INTELLIGENCE	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To learn the various characteristics of Intelligent agents, different search strategies and representknowledge in solving AI problems
2.	To understand the different ways of designing software agents
3.	To know about the various applications of AI

UNIT I	INTRODUCTION	9	+	0

Introduction–Definition – Future of Artificial Intelligence – Characteristics of Intelligent Agents–TypicalIntelligent Agents – Problem Solving Approach to Typical AI problems.

UNIT II	PROBLEM SOLVING METHODS	9	+	0

Problem solving Methods – Search Strategies- Uninformed – Informed – Heuristics – Local Search Algorithms and Optimization Problems – Searching with Partial Observations – Constraint Satisfaction Problems – Constraint Propagation – Backtracking Search – Game Playing – Optimal Decisions in Games – Alpha – BetaPruning.

UNIT III	KNOWLEDGE REPRESENTATION	9	+	0

First Order Predicate Logic — Forward Chaining-Backward Chaining — Resolution — Knowledge Representation – Ontological Engineering-Categories and Objects – Events – Mental Events and Mental Objects – Reasoning Systems for Categories – Reasoning with Default Information.

UNIT IV	SOFTWARE AGENTS	9	+	0

Architecture for Intelligent Agents – Agent communication – Negotiation and Bargaining – Argumentationamong Agents – Trust and Reputation in Multi-agent systems.

UNIT V	APPLICATIONS	9	+	0

AI applications – Language Models – Information Retrieval- Information Extraction – Natural Language Processing — Machine Translation — Speech Recognition — Robot — Hardware — Perception — Planning — Moving.

Total (L+T)= 45 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	:	Use appropriate search algorithms for any AI problem
CO2	:	Represent a problem using first order and predicate logic
CO3	:	Provide the apt agent strategy to solve a given problem
CO4	:	Design software agents to solve a problem and Design applications for NLP that use ArtificialIntelligence

Text Books:	
1.	S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach‖, Prentice Hall, Third Edition, 2009
2.	I. Bratko, ―Prolog: Programming for Artificial Intelligence‖, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011

Reference Books:	
1.	M. Tim Jones, ―Artificial Intelligence: A Systems Approach(Computer Science)‖, Jones and Bartlett Publishers, Inc.; First Edition, 2008
2.	Nils J. Nilsson, ―The Quest for Artificial Intelligence‖, Cambridge University Press, 2009
3.	William F. Clocksin and Christopher S. Mellish,‖ Programming in Prolog: Using the ISO Standard‖, Fifth Edition, Springer, 2003
4.	Gerhard Weiss, ―Multi Agent Systems‖, Second Edition, MIT Press, 2013
5.	David L. Poole and Alan K. Mackworth, ―Artificial Intelligence: Foundations of Computational Agents‖, Cambridge University Press, 2010

E-References:	
1.	https://builtin.com/artificial-intelligence
2.	https://science.howstuffworks.com/robot6.htm
3.	https://www.thestreet.com/technology

18CSPE603	DISTRIBUTED AND PARALLELCOMPUTING	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To Familiarize with the system models and the basic client server communication.
2.	To learn the architecture of Remote Procedure Call.
3.	To Illustrate the Design principles of Parallel Processing.
4.	To explain the concept of Interconnection Networks and parallel programming models.

UNIT I	CHARACTERIZATION OF DISTRIBUTED SYSTEMS	9	+	0

Resource sharing and the Web-System models:-Architectural models-Fundamental Models, Interposes Communication:-The API for the Internet protocols, External data representation and marshalling, Client Server communication, Group communication

UNIT II	DISTRIBUTED OBJECTS AND REMOTE INVOCATION	9	+	0

Communication between distributed objects, Remote Procedure call, Events and notifications. Operating System Support. The operating system layer- Protection-Processes and threads-Communication and invocation-Operating system architecture**.**

UNIT III	SCALABILITY AND CLUSTERING	9	+	0

Evolution of Computer Architecture – Dimensions of Scalability – Parallel Computer Models – Basic ConceptsOf Clustering – Scalable Design Principles – Parallel Programming Overview – Processes, Tasks and Threads – Parallelism Issues – Interaction / Communication Issues – Semantic Issues In Parallel Programs

UNIT IV	SYSTEM INTERCONNECTS	9	+	0

Basics of Interconnection Networks – Network Topologies and Properties – Buses, Crossbar and MultistageSwitches, Software Multithreading – Synchronization Mechanisms.

UNIT V	PARALLEL PROGRAMMING	9	+	0

Paradigms And Programmability – Parallel Programming Models – Shared Memory Programming

Total (L+T)= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Familiarize with the system models and the basic client server communication.
CO2	:	Explain the architecture of Remote Procedure Call.
CO3	:	Illustrate the Design principles of Parallel Processing
CO4	:	Explain the components of Interconnection Networks and parallel programming models

Text Book:

1.	George Coulouris, Jean Dollimore, Tim Kindberg- Distributed Systems Concepts and Design- AWL, Fifth Edition- 2012.(Unit I,II)
2.	Kai Hwang and Zhi.Wei Xu, "Scalable Parallel Computing", Tata McGraw-Hill, New Delhi, 2003. (Unit III - V).

Reference Books:

1.	Maarten Van Steen,Andrew & Tanenbaum-Distributed Systems: Principles and Paradigms-PrenticeHall-second edition -2007.
2.	Ross J.Anderson-Security Engineering: A Guide to building dependable distributed systems-John Wiley & Sons- second edition -2008.

18CSPE604	PYTHON PROGRAMMING	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To learn Python data structures, conditional and control structures and files.
2.	To study Python Modules, packages, Functions and Exceptions.
3.	To describe Object oriented programming features and Regular Expressions.
4.	To learn about Web programming, GUI Programming and Database programming

UNIT I	INTRODUCTION	9	+	0

Python: Features - The Basics-Python Objects-Numbers-Sequences-Mapping and set types- Conditionals andloops-if statement-else statement-elif-Conditional Expressions-while statement-for statement-break-continue.

UNIT II	FUNCTIONS, MODULES AND PACKAGES	9	+	0

Functions-Calling functions-Creating functions-Passing Functions-Formal Arguments-Variable length arguments-variable scope-Recursion, Modules-Packages.

UNIT III	FILES AND EXCEPTIONS	9	+	0

Files and Input/ Output –Errors and Exceptions-Introduction-Detecting and handling Exceptions-Context Management-Raising Exceptions-Assertions-Standard Exceptions.

UNIT IV	OBJECT ORIENTED PROGRAMMING AND REGULAR EXPRESSIONS	9	+	0

Object Oriented Programming Introduction-Classes-class Attributes-Instances-Instances attributes-Buildingand Method Invocation-Static methods and class Methods-Inheritance-Operator overloading -
- Regular Expressions-Network Programming –Multithreaded Programming

UNIT V	ADVANCED TOPICS	9	+	0

GUI Programming- Web Programming-Database Programming

Total (L+T)= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Develop programs using control structures and files.
CO2	:	Create own Python Modules, packages, functions and Exceptions.
CO3	:	Illustrate Object oriented Programming features and Regular Expressions.
CO4	:	Create own Web programs, GUI and database programs.

Text Books:	
1.	Wesley J.Chun-“Core Python Programming” –Prentice Hall, Second Edition, 2006.
Reference Books:	
1.	Swaroop C N, “ A Byte of Python “, ebshelf Inc., 1st Edition, 2013
2.	“A Practical Introduction to python programming”, Brian Heinold,Mount St.Mary’s University,2012
3.	Learning to Program with Python,” Richard L. Halterman”., Southern Adventist University
E-References:	
1.	Introduction to Python Programming NPTEL video lectures by Dr. Sudip Misra, IIT Kharagpur 2017.

18CSPE605	AGILE TECHNOLOGIES	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To understand the internals of the Agile Project Development
2.	To know how Agile Project Development is actually implemented
3.	To understand the concepts of Scrum and Extreme Programming
4.	To understand the concepts of Unified Process and EVE

UNIT I	INTRODUCTION	9	+	0

Iterative and Evolutionary: Definition – Comparison - Major activities.
Agile: Basic concepts - Major activities - Available agile methods.
Story: Overview-Estimated hours remaining**.**

UNIT II	MOTIVATION AND EVIDENCE	9	+	0

Motivation: Change on software projects – Key motivation-Requirement challenge –Problems of water fall.
Evidence: Research and early historical – Standard and though leader-Business case -Water fall validity.

UNIT III	SCRUM AND EXTREME PROGRAMMING	9	+	0

Scrum: Concepts, Method overview, Lifecycle, Work products, Roles and Practices, Values, Common mistakes and misunderstandings, Process Mixtures, Adaption Strategies, Fact versus Fantasy, Strength Versus Other, Sample Projects
Extreme Programming: Concepts, Method overview, Lifecycle, Work products, Roles and Practices, Values, Common Mistakes and Misunderstandings, Sample Projects.

UNIT IV	UNIFIED PROCESS AND EVE	9	+	0

Unified Process: Concepts, Method overview, Lifecycle, Work products, Roles and Practices, Values, Common mistakes and misunderstandings, Process Mixtures, Adaption Strategies, Fact versus Fantasy, Strength Versus Other, and Sample Projects.
EVE: Concepts, Method overview, Lifecycle, Work products, Roles and Practices, Values, Common mistakes and misunderstandings ,Process Mixtures, Adaption Strategies, Fact versus Fantasy, Strength Versus Other.

UNIT V	PROJECT MANAGEMENT	9	+	0

Practice Tips: Project – Management – Environment – Requirements — Tests - Frequently raised questions and answers.

Total (L+T)= 45 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	:	Understand the internals of the Agile Project Development
CO2	:	Understand how Agile Project Development is actually implemented
CO3	:	Understand the concepts of Scrum and Extreme Programming
CO4	:	Understand the concepts of Unified Process and EVE

Text Books:	
1.	Craig Larman, "Agile and Iterative Development A Manger's Guide" Pearson Education, First Edition,India, 2004.

Reference Books:	
1.	Shore, "Art of Agile Development", Shroff Publishers & Distributors, 2007

18CSPE606	OBJECT ORIENTED ANALYSIS AND DESIGN	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To understand the fundamentals of object modelling.
2.	To understand and differentiate Unified Process from other approaches.
3.	To design with static UML diagrams.
4.	To design with the UML dynamic and implementation diagrams.
5.	To map the design properly to code

UNIT I	INTRODUCTION	9	+	0

The system life cycle - Traditional life cycle models - The object-oriented approach - The Rational Unified Process (RUP) - The Unified Modeling Language (UML) - UML models - Introduction to the case study - Requirements for the Wheels case study system - Requirements engineering - Requirements elicitation - List of requirements for the Wheels system - Use cases - Use case diagram - Use case descriptions- Actors and actor descriptions - Use case relationships: communication association, include and extend - Boundary - Using the use case model in system development.

UNIT II	OBJECTS AND CLASSES	9	+	0

Basics — Object — classes - Relationships between classes - The class diagram - Stages in building a classdiagram - Packages - Using the class diagram in system development.

UNIT III	IDENTIFYING FUNCTIONALITIES	9	+	0

Introduction - CRC cards and interaction diagrams - Identifying operations using the CRC card technique - Interaction diagrams - Specifying operations - Using the CRC cards and interaction diagrams in system development - State Diagrams - States and events - Constructing a state diagram - Using state diagrams in system development.

UNIT IV	ACTIVITY DIAGRAMS	9	+	0

Introduction - Modeling a sequence of activities - Modeling alternative courses of action - Modeling iteration of activities - Modeling activities that are carried out in parallel — Swimlanes - Design - Architecture - Implementation diagrams The user interface Dealing with persistent data.

UNIT V	DESIGNING OBJECTS AND CLASSES	9	+	0

Introduction - class diagram - Interaction diagrams. Implementation of class diagram - The code - Sequencediagram.

Total (L+T)= 45 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	:	Identify various scenarios based on software requirements
CO2	:	Express software design with UML diagrams
CO3	:	Understand the various testing methodologies for OO software
Text Books:		
1.	Carol Britton and Jill Doake, "A Student Guide to Object - Oriented Development", Elsevier, Butterworth – Heinemann, Eighth edition, 2007.	
Reference Books:		
1.	Brett McLaughlin, Gary Pollice and David West, "Head First Object-Oriented Analysis and Design: A Brain Friendly Guide to OOA&D", O'Reilly, Shroff Publishers & Distributors Pvt. Ltd., 2008.	
2.	Mahesh P. Matha, "Object Oriented Analysis and Design using UML", Prentice-Hall of India, 2008.	

18CSPE607	DATA MINING AND WAREHOUSING	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To know the fundamentals of data mining
2.	Be familiar with the concepts of data warehouse
3.	To understand the importance of association rule mining
4.	To understand the techniques of classification and clustering .
5.	Be aware about the recent trends of data mining

UNIT I	DATA MINING	9	+	0

Introduction — Data — Types of Data — Data Mining Functionalities — Interestingness of Patterns — Classification of Data Mining Systems – Data Mining Task Primitives – Integration of a Data Mining System with a Data Warehouse – Issues –Data Preprocessing.

UNIT II	DATA WAREHOUSING	9	+	0

Basic concepts – Data Cube – Multidimensional Data Model – Data Warehouse Architecture -–– Data warehouse implementation – From Data Warehousing to Data Mining.

UNIT III	ASSOCIATION RULE MINING AND CLASSIFICATION	9	+	0

Mining Frequent Patterns, Associations and Correlations – Mining Methods – Mining various Kinds of Association Rules – Correlation Analysis – Constraint Based Association Mining. Classification and Prediction, Issues, Decision Tree Induction, Bayesian Classification, Rule Based Classification, Classification by Backpropagation – Support Vector Machines - Other Classification Methods.

UNIT IV	CLUSTERING AND OUTLIER ANALYSIS	9	+	0

Cluster Analysis - Types of Data – Categorization of Major Clustering Methods – K-means– Partitioning Methods – Hierarchical Methods - Density-Based Methods – Grid Based Methods – Model-Based Clustering Methods – Clustering High Dimensional Data – Constraint-Based Cluster Analysis – Outlier Analysis.

UNIT V	DATA MINING TRENDS	9	+	0

Multidimensional Analysis and Descriptive Mining of Complex Data Objects, Spatial Databases, Multimedia Databases, Time Series and Sequence Data, Text Databases, World Wide Web, Applications and Trends in Data Mining.Case studies involving classification and clustering.

Total (L+T)= 45 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	:	Discuss the fundamentals of data mining and preprocessing.
CO2	:	Explain the basic concept of data warehousing and multidimensional model.
CO3	:	Develop association rule mining and classification algorithms.
CO4	:	Apply different clustering and outlier detection techniques.
CO5	:	Have an overview about the applications and recent trends in Data Mining.

Text Books:	
1.	Jiawei Han, Micheline Kamber, "Data Mining: Concepts and Techniques", Morgan Kaufmann, Third Edition, 2011.

Reference Books:	
1.	G. K. Gupta, "Introduction to Data Mining with Case Studies", Easter Economy Edition, Prentice Hall of India, Third Edition, 2014.
2	David Hand, Heikki Manila, Padhraic Symth, "Principles of Data Mining", PHI 2012.
3.	W.H.Inmon, "Building the Data Warehouse", Third Edition, Wiley, 2011.

18CSPE608	COMPONENT BASED TECHNOLOGY	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To be familiar with component based technology.
2.	To understand the support to component based technology in different languages

UNIT I	INTRODUCTION	9	+	0

Software Components – objects – fundamental properties of Component technology – modules – interfaces –callbacks – directory services – component architecture – components and middleware

UNIT II	JAVA BASED COMPONENT TECHNOLOGIES	9	+	0

Threads – Java Beans – Events and connections – JAR files – reflection – object serialization – EnterpriseJava Beans – Distributed Object models – RMI and RMI-IIOP

UNIT III	CORBA COMPONENT TECHNOLOGIES	9	+	0

CORBA – Interface Definition language – Object Request Broker – system object model – portable object adapter – CORBA services – CORBA component model – containers – application server – model drivenarchitecture

UNIT IV	.NET BASED COMPONENT TECHNOLOGIES	9	+	0

COM – Distributed COM – object reuse – interfaces and versioning – dispatch interfaces – connectableobjects – OLE containers and servers – Active X controls – .NET components - assemblies – appdomains – contexts — reflection — remoting

UNIT V	COMPONENT FRAMEWORKS AND DEVELOPMENT	9	+	0

Connectors – contexts – EJB containers – CLR contexts and channels – Black Box component framework – directory objects – cross-development environment – component-oriented programming – Component design and implementation tools — testing tools - assembly tools

Total (L+T)= 45 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	:	Recall the fundamentals of component based technology.
CO2	:	Describe the support to component based technology in different languages.
CO3	:	Design simple applications based on component based technology

Text Books:

1.	Clemens Szyperski, "Component Software: Beyond Object-Oriented Programming", Second Edition,Pearson Education publishers, 2003.

Reference Books:

1.	Thomas J. Mowbray and William A. Ruh, "Inside CORBA: Distributed Object Standards AndApplications", Pearson Education, 2016.
2.	Wayne S Freeze, "Visual Basic Development Guide for COM & COM+", BPB Publication, 2000.
3.	Cay S Hortsmann and Gray Cornell, "CORE JAVA Vol-II Advanced Features" Eleventh Edition, PrenticeHall, 2018

E-References:

1.	http://rmi.yaht.net/bookz/core.java/9780134177908-Vol-2.pdf

18CSPE609	COMPUTER HARDWARE ANDTROUBLESHOOTING	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To understand the fundamentals of computer
2.	To learn the different types of memory
3.	Be familiar with Nomenclature, technology, standards of computer
4.	Be expose to the issues in troubleshooting
5.	To learn the printers and its types

UNIT I	FUNDAMENTALS OF COMPUTER	9	+	0

Block diagram and brief introduction of each block, Types of computers, PC, Main Parts: CPU Box, Monitor, & Peripherals [Keyboard, Mouse, Speaker]. Inside CPU Box: Motherboard, I/O Cards, Cables, Floppy Drive, HDD, CD-Drive

UNIT II	MOTHER BOARD IN DETAIL	9	+	0

Nomenclature, technology, standards AMD CPUs, Cyrix CPUs. CPUs: CPU over clocking, troubleshooting, CPU problems. Chip Sets: AMD chip sets, Intel chip sets, VIA chip sets SIS. chip sets, OPTI chipsets, Legacy and support ICS

UNIT III	BASIC CONCEPTS OF MEMORY AND ITS TYPES	9	+	0

Memory Chips: RAM and ROM, EPROM. Memory Modules and packaging, Logical and Physical organizationof memory in computer. Cache Memory - LX and LZ, EDO. Various terms used in computer memory

UNIT IV	PC- ASSEMBLY AND CMOS SETUP AND TROUBLESHOOTING	9	+	0

Observation of all parts of Floppy drives, HDD, CD, and SMPS. Identification of cables and computers. Mounting Motherboard in cabinet Installation of cards, devices and then connecting cables. Fitting of cabinet. CMOS — Setup Troubleshooting

UNIT V	BASICS OF PRINTERS	9	+	0

Types of printers and printing mechanism, How printer works**.** Inject printer, working of laser printer,Fonts/Type faces, Trouble shooting printers.

Total (L+T)= 45 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	:	Explain the concepts and block diagram of a computer
CO2	:	Familiar with the technology and standards used in computer
CO3	:	Identify and understand security issues related to troubleshooting
CO4	:	Familiar with the different memories used in computer
CO5	:	Explain the working mechanism of printers and its types

Text Books:	
1.	Hardware bible By : Winn L Rosch, 2nd Edition, B.P.B, Publication Ltd.,1996
2.	Trouble shooting, maintaining and repairing PCs, Stephon J Bigelow Tata McGraw Hill Publication
3.	Modern All about printers, Manohar Lotia, Pradeep Nair, Bijal Lotia BPB publications
Reference Books:	
1.	Mueller.S, Upgrading and repairing PCS, 4th Edition, Prentice Hall, 1995
2.	Govindarajulu.B, IBM PC and Clones Hardware trouble shooting and maintenance McGraw Hill, 1993
3.	D.V.Hall, Microprocessors and Interfacing Programming and Hardware, Mc Graw Hill,1986

18CSPE610	MIDDLEWARE TECHNOLOGIES	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To gain knowledge in various middleware technologies for distributed applications
2.	To create distributed application using EJB,CORBA and COM
3.	To familiarize and create the web services
4.	To disseminate web server architecture and standards

UNIT I	INTRODUCTION	9	+	0

General Middleware, Service Specific Middleware, Client/Server Building blocks — Peer–to– Peer Communications – RPC Middleware – Messaging - Java RMI - Computing Standards – OMG – Overview of CORBA - Overview of COM/DCOM - Overview of EJB - Middleware types - Middleware in Distributed Applications.

UNIT II	EJB AND CORBA	9	+	0

EJB Architecture - Overview of EJB Software Architecture, EJB Conversation, Building and Deploying EJBs, Roles, EJB Applications — Types of Enterprise Beans - Lifecycle of Beans - EJB clients - Developing an Application - Deployment. CORBA – Components - Architectural Features – Method Invocations - Static andDynamic CORBA – Structure of CORBA IDL - Self-Describing Data Type- Interface Repository - Building an Application Using CORBA - CORBA Services - Object Location Services, Messaging Services- CORBA Component Model.

UNIT III	COM AND .NET FRAMEWORK	9	+	0

Evolution of DCOM - Introduction to COM - COM Clients and Servers - COM IDL — COM Interfaces- COM Threading Models – Marshalling - Custom and Standard Marshalling -Comparison of RMI, COM and CORBA - Introduction to .NET - .NET Framework Architecture –Remoting

UNIT IV	SOA AND WEB SERVICES	9	+	0

Defining SOA - Business value of SOA - SOA characteristics - Concept of a Service - SOA Infrastructure- Enterprise Application Integration (EAI) - Enterprise Service Bus (ESB) - SOA — Conceptual Model — SOA Architecture – SOA Analysis & Design - WSDL – SOAP – UDDI - WS Standards -Web Services and Service Oriented Enterprise (SOE) – WSCoordination and Transaction - Business Process Execution Language for Web Services.

UNIT V	OTHER TYPES OF MIDDLEWARE	9	+	0

Other Types of Middleware, Real-Time Middleware, Embedded Systems Middleware, Mobile Middleware,Oracle Fusion Middleware.

Total (L+T)= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Gain knowledge of various middleware technologies for distributed applications
CO2	:	Build distributed application using EJB,CORBA and COM
CO3	:	Familiarize and create the web services
CO4	:	Express web server architecture and standards

Text Books:

1.	G. SudhaSadasivam, RadhaShankarmani, ―Middleware and Enterprise Integration Technologies,Wiley.

Reference Books:

1.	SasuTarkoma, ―Mobile Middleware: Supporting Applications and Services‖, First Edition, Wiley.
2.	Wei Zhao, ―Challenges in Design and Implementation of Middleware for Real-Time Systems, FirstEdition, Springer.
3.	Reza Shafii, Reza Shafii, Stephen Lee, and GangadharKonduri, ―Oracle Fusion Middleware 11gArchitecture and Management‖, First Edition,McGraw-Hill Osborne Media.
4.	Tammy Noergaard, ―Demystifying Embedded Systems Middleware: Understanding File Systems,Databases, Virtual Machines, Networking and More, Elsevier.
5.	Gustavo Alonso, Fabio Casati, Harumi Kuno, Vijay Machiraju, ―Web Services: Concepts, Architecturesand Applications, Springer.

LIST OF PROFESSIONAL ELECTIVES

(VII SEMESTER)

18CSPE701	UNIX ARCHITECTURE	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To provide knowledge about Unix operating system working principles, its file system and programmingfor interprocess communication.
2.	To be familiar with process control and process scheduling concepts.
3.	To understand the various system calls.
4.	To understand memory management policies concepts.
5.	To be ffamiliar with internal representation of files and structure of process.

UNIT I	OVERVIEW	9	+	0

General Overview of the system: History, system structure - User perspective - Operating system servicesand assumptions about hardware.
Introduction to the kernel: Architecture of the UNIX operating system - Introduction to system concepts kerneldata structures - System administration.
The buffer cache: Buffer headers - Structure of the buffer pool - Scenarios for retrieval of a buffer -Reading and writing disk blocks - Advantages and disadvantages of the buffer cache.

UNIT II	FILE SUBSYSTEM	9	+	0

Internal representation of files: Inodes - Structure of a regular file - Directories - Conversion of a path name toan Inode - Super block - Inode assignment to a new file

UNIT III	SYSTEM CALLS FOR THE FILE SYSTEM	9	+	0

Open - Read - Write - File and record locking - Adjusting the position of file I/O - Lseek - Close - File creation - Changing directory, root, owner, mode - stat and fstat - Pipes - Dup - Mounting and unmounting file systems -link - unlink

UNIT IV	PROCESSES	9	+	0

Process states and transitions - Layout of system memory - The context of a process. ProcessControl: Process creation - Signals - Process termination - user id of a process -The Shell - System boot and the INIT process - Process Scheduling-algorithm - scheduling parameters

UNIT V	MEMORY MANAGEMENT AND I/O	9	+	0

Memory Management Policies: Swapping-allocation swap space - swapping processes out - fork swap-expansion swap-swapping processes in. The I/O Subsystem: Driver Interface - Inter process communication-process tracing.

Total (L+T) = 45 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	:	Provide knowledge about Unix operating system working principles, its file system andprogramming for interprocess communication.
CO2	:	Be familiar with process control and process scheduling concepts.
CO3	:	Understand the various system calls.
CO4	:	Understand memory management policies concepts.
CO5	:	Familiar with internal representation of files and structure of process.

Text Books:	
1.	Maurice J. Bach, "The Design of the Unix Operating System", Prentice Hall of India, 2004.
Reference Books:	
1.	Vahalia, "Unix Internals: The New Frontiers", Pearson Education Inc, 2003.
2.	S. J. Leffler, M. K. Mckusick, M. J. .Karels and J. S. Quarterman. The Design and Implementation of the 4.4 BSD Operating System, Addison Wesley, 1996

18CSPE702	BIG DATA ANALYTICS	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To introduce basic concepts and challenges of big data (3 V's: volume, velocity, and variety) andmethodologies for analyzing structured and unstructured data.
2.	To impart basic concepts about Big Data Environment and Big Data Technology Landscape.
3.	To understand the importance of Hadoop Ecosystem.
4.	To know about Pig, Hive, MongoDB, NoSQL and Cassandra.
5.	To know about Jasper Report using Jasper Soft Studio.

UNIT I	DIGITAL DATA AND BIG DATA	9	+	0

Types of Digital Data- Structured, Semi-structured, Unstructured, Characteristics of data Definition of bigData- Challenges of big data-Why big data-Traditional BI vs. Big data-A typical BI environment- A Big data environment-What is changing in the realms of big data?

UNIT II	BIG DATA ANALYTICS AND TECHNOLOGY LANDSCAPE	9	+	0

Big Data Analytics - Classification of Analytics- Top challenges facing Big Data- Importance of Big Data Analytics- Greatest challenges that prevent businesses from capitalizing on Big Data - kind of technologies to help meet the challenges posed by Big Data- Data Science- Terminologies used in Big Data Environment- Big Data Technology Landscape- NoSQL- Types of NoSQL Databases- Why NoSQL- Advantages of NoSQL - SQL Vs. NoSQL - NewSQL - Comparison of SQL, NoSQL and NewSQL**.**

UNIT III	HADOOP	9	+	0

Hadoop Overview - Hadoop Components - High Level Architecture of Hadoop - Features of Hadoop- Key advantages of Hadoop- Versions of Hadoop- Hadoop 1.0, Hadoop 2.0- Overview of Hadoop Ecosystems- Interacting with Hadoop EcoSystem- Hive, Pig, HBASE, Sqoop - Hadoop Vs. SQL- High Level Architecture of Hadoop - Hadoop Distributed File System- HDFS Daemons- Special Features of Hadoop- Processing Data With Hadoop- MapReduce Daemons-How Map Reduce Works- Map Reduce Example- Limitation of Hadoop
1.0 - Hadoop 2: HDFS - Hadoop 2: YARN

UNIT IV	NoSQL – MongoDB, CASSANDRA, HIVE , PIG	9	+	0

Introduction to MongoDB- Why MongoDB? –Terms used in RDBMS and MongoDB-Data Types in MongoDB – MongoDB Query Language. Apache Cassandra- An Introduction- Features of Cassandra-CAL Data Types- CQLSH- Keyspaces- CRUD- Collections- Using a Counter- Time to Live(TTL)alter commands- Import and Export-Querying System Tables-Introduction to Hive- Hive Architecture- Hive Data Types- Hive File Format- Hive Query Language (HQL)Introduction to Pig- Key Features of Pig- Anatomy of Pig- Pig on Hadoop – PigPhilosophy-Use Case for Pig- ETL Processing — Pig Latin Overview — Data Types in Pig - Running Pig - Execution Modes of Pig — HDFS Commands- Relational Operators- Eval Functiuon- Complex Data Types -Pig Versus Hive.

UNIT V	JASPER REPORT USING JASPER SOFT STUDIO	9	+	0

Introduction to Jasper Report using Jasper Soft Studio - Reporting using MongoDB - Reporting using Cassandra. Introduction to MAPREDUCE Programming- Mapper - Reducer - Combiner - Partitioner - Searching — Sorting - Compression. Introduction to Machine Learning- Machine Learning Algorithms.

Total (L+T)= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Understand the types of digital data and challenges with big data.
CO2	:	Know about the Big data Landscape Technology.
CO3	:	Understand the common Hadoop ecosystem components, Hadoop Architecture, HDFS, HadoopMapReduce framework and the working of MapReduce on data stored in HDFS.
CO4	:	Learn the concepts of Pig, Hive, MongoDB, NoSQL and Cassandra
CO5	:	Produce Report using Jasper Soft studio.

Text Books:

1.	Seema Acharya, Subhashini Chellappan, “Big Data And Analytics”, Willey ,2015.

Reference Books:

1.	David Loshin,” Big Data Analytics: From Strategic Planning to Enterprise Integration withTools,Techniques, NoSQL, and Graph”, Morgan Kaufmann Publishers,2013.
2.	Wen-Chen Hu and Naima Kaabouch (eds) ,” Big Data Management, Technologies, and Applications “,IGI Global,2013.
3.	Tom White, “Hadoop: The Definitive Guide”, O`Reilly Publishers, USA, 2012.
4.	Michael Berthold, David J. Hand, “Intelligent Data Analysis”, Springer, 2007

18CSPE703	CYBER FORENSICS	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To acquire the knowledge computer forensics
2.	To familiarize the forensics tools
3.	To analyze and validate forensics data
4.	To gain the knowledge of ethical hacking techniques

UNIT I	INTRODUCTION TO COMPUTER FORENSICS	9	+	0

Introduction to Traditional Computer Crime, Traditional problems associated with Computer Crime. Introduction to Identity Theft & Identity Fraud. Types of CF techniques - Incident and incident response methodology - Forensic duplication and investigation. Preparation for IR: Creating response tool kit and IR team. - Forensics Technology and Systems - Understanding Computer Investigation – Data Acquisition.

UNIT II	EVIDENCE COLLECTION AND FORENSICS TOOLS	9	+	0

Processing Crime and Incident Scenes — Working with Windows and DOS Systems, Current Computer Forensics Tools - Software/ Hardware Tools.

UNIT III	ANALYSIS AND VALIDATION	9	+	0

Validating Forensics Data – Data Hiding Techniques – Performing Remote Acquisition – Network Forensics –Email Investigations – Cell Phone and Mobile Devices Forensics.

UNIT IV	ETHICAL HACKING	9	+	0

Introduction to Ethical Hacking - Foot-printing and Reconnaissance - Scanning Networks - Enumeration - System Hacking - Malware Threats – Sniffing.

UNIT V	ETHICAL HACKING IN WEB	9	+	0

Social Engineering - Denial of Service - Session Hijacking - Hacking Web servers - Hacking Web Applications – SQL Injection - Hacking Wireless Networks - Hacking Mobile Platforms.

Total (L)= 45 Periods

Course Outcomes:

At the end of the course students will be able to

CO1	:	Acquire the basics of computer forensics
CO2	:	Apply different computer forensic tools to a given scenario
CO3	:	Analyze and validate forensics data
CO4	:	Implement real-world hacking techniques to test system security

Text Books:

1.	Bill Nelson, Amelia Phillips, Frank Enfinger, Christopher Steuart, “Computer Forensics andInvestigations”, Cengage Learning, India Edition, 2016.
2.	CEH official Certified Ethical Hacking Review Guide, Wiley India Edition, 2015.

Reference Books:	
1.	John R.Vacca,"Computer Forensics", Cengage Learning, 2005
2.	Marjie T.Britz, "Computer Forensics and Cyber Crime": An Introduction",3 rd Edition,Prentice Hall,2013.
3.	AnkitFadia "Ethical Hacking" Second Edition, Macmillan India Ltd, 2006.
4.	Kenneth C.Brancik "Insider Computer Fraud "Auerbach Publications Taylor & amp; Francis Group-2008.

18CSPE704	USER INTERFACE DESIGN	L	T	P	C
		3	0	0	3

Course Objectives:

1.	Learn the characteristics of User Interface and design issues.
2.	Study the design principles, techniques and technologies to the development of User interface.
3.	Gain knowledge of various testing tools of interface designs.

UNIT I	INTRODUCTION	9	+	0

UID Importance-Human-Computer interface-characteristics of graphics interface-Direct manipulation graphical system - web user interface-popularity-characteristic & principles.

UNIT II	DESIGN ISSUES	9	+	0

User interface design process- obstacles-usability-human characteristics in design - Human interaction speed- business functions-requirement analysis-Direct-Indirect methods-basic business functions-Design standards- system timings - Human consideration in screen design - structures of menus - functions of menus-contents of menu-formatting -phrasing the menu - selecting menu choice-navigating menus-graphical menus.

UNIT III	WINDOWS CONTROLS(GUI)	9	+	0

Windows: Characteristics-components-presentation styles-types-managements-organizations-operations-web systems-device-based controls: characteristics-Screen -based controls: operate control - text boxes-selectioncontrol-combination control-custom control-presentation control.

UNIT IV	MULTIMEDIA	9	+	0

Text for web pages - effective feedback-guidance & assistance-Internationalization-accessibility-Icons-Image-multimedia -coloring.

UNIT V	LAYOUT AND TOOLS	9	+	0

Windows layout-test: prototypes - kinds of tests - retest - Information search - visualization - Hypermedia -www - Software tools.

Total (L+T)= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Outline the characteristics of User Interface and design issues
CO2	:	Be familiarizing with the design principles, techniques and technologies to the development of User interface.
CO3	:	Explain various testing tools of interface designs.

Text Books:

1.	Wilbent. O. Galitz ,"The Essential Guide to User Interface Design: An Introduction to GUI Design Principles", John Wiley& Sons, 2007.

Reference Books:

1.	Ben Sheiderman, "Design the User Interface", Pearson Education, 2nd Edition, 2008.
2.	Alan Cooper, "The Essential of User Interface Design", Wiley – Dream Tech Ltd., 2008.

18CSPE705	SOFTWARE QUALITY ASSURANCE	L	T	P	C
		3	0	0	3

Course Objectives:

1.	Understand the basic tenets of software quality and quality factors.
2.	Be exposed to the Software Quality Assurance (SQA) architecture and the details of SQA components.
3.	Understand of how the SQA components can be integrated into the project life cycle.
4.	Be familiar with the software quality infrastructure
5.	Be exposed to the management components of software quality.

UNIT I	INTRODUCTION TO SOFTWARE QUALITY & ARCHITECTURE	9	+	0

Need for Software quality – Quality challenges – Software quality assurance (SQA) – Definition and objectives — Software quality factors- McCall's quality model — SQA system and architecture — Software Project life cycle Components – Pre project quality components – Development and quality plans.

UNIT II	SQA COMPONENTS AND PROJECT LIFE CYCLE	9	+	0

Software Development methodologies – Quality assurance activities in the development process- Verification & Validation — Reviews — Software Testing — Software Testing implementations — Quality of software maintenance – Pre-Maintenance of software quality components – Quality assurance tools – CASE tools forsoftware quality – Software maintenance quality – Project Management.

UNIT III	SOFTWARE QUALITY INFRASTRUCTURE	9	+	0

Procedures and work instructions – Templates – Checklists – 3S developmenting – Staff training and certification Corrective and preventive actions – Configuration management – Software change control – Configuration management audit -Documentation control – Storage and retrieval.

UNIT IV	SOFTWARE QUALITY MANAGEMENT & METRICS	9	+	0

Project process control – Computerized tools – Software quality metrics – Objectives of quality measurement – Process metrics – Product metrics – Implementation – Limitations of software metrics – Cost of softwarequality – Classical quality cost model – Extended model – Application of Cost model.

UNIT V	STANDARDS, CERTIFICATIONS & ASSESSMENTS	9	+	0

Quality management standards – ISO 9001 and ISO 9000-3 – capability Maturity Models – CMM and CMMI assessment methodologies – Bootstrap methodology – SPICE Project – SQA project process standards – IEEE standards 1012 & 1028 – Organization of Quality Assurance – Department management responsibilities – Project management responsibilities.

Total (L+T)= 45 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	:	Utilize the concepts in software development life cycle.
CO2	:	Demonstrate their capability to adopt quality standards.
CO3	:	Assess the quality of software product.
CO4	:	Apply the concepts in preparing the quality plan & documents.

Text Books:	
1.	Daniel Galin, "Software Quality Assurance", Pearson Publication, 2009.

Reference Book:	
1.	Alan C. Gillies, "Software Quality: Theory and Management", International Thomson Computer Press,1997.
2.	Mordechai Ben-Menachem "Software Quality: Producing Practical Consistent Software", International Thompson Computer Press, 1997.

18CSPE706	COMPUTER GRAPHICS AND MULTIMEDIA	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To understand and design two-dimensional graphics.
2.	To understand and apply two dimensional transformations.
3.	To design three dimensional graphics and apply three dimensional transformations.
4.	To be familiar with various software programs used in the creation and implementation of multi-media (interactive, motion/animation, presentation, etc.).
5.	To be familiar with hypermedia messaging and distributed multimedia systems.

UNIT I	INTRODUCTION	9	+	0

Survey of computer graphics - Video display devices, Raster scan systems - Random scan systems, Graphicsmonitors and Workstations - Graphics Software.
Output Primitives: Points and Lines - Line Drawing Algorithms (DDA Algorithm, Bresenham's Line Algorithm),Circle generating algorithms.

UNIT II	TWO DIMENSIONAL GRAPHICS	9	+	0

Basic Transformations - Matrix representations and homogeneous coordinates - Composite Transformations- Other Transformations- The viewing pipeline - Viewing coordinate reference frame - Window-to-viewport coordinate transformation.
Clipping: Clipping operations - Point clipping - Line clipping (Cohen Sutherland algorithm, Liang Barsky algorithm) - Polygon Clipping (Sutherland-Hodgeman Algorithm) - Curve Clipping - Text Clipping.

UNIT III	THREE DIMENSIONAL GRAPHICS	9	+	0

Three Dimensional Object Representations: Polygon surfaces - Quadric surface - Spline representation - Bezier Curves and surfaces - B-spline curve and surfaces.
Three dimensional Geometric and Modeling Transformations: Translation — Rotation — Scaling - Composite Transformation. Three Dimensional viewing: Viewing Pipeline - Viewing Coordinates -Projections (Parallel and Perspective).

UNIT IV	MULTIMEDIA SYSTEM DESIGN AND MULTIMEDIA FILE HANDLING	9	+	0

Multimedia basics − Multimedia applications − Multimedia system architecture − Evolving technologies for multimedia − Defining objects for multimedia systems − Multimedia data interface standards − Multimedia databases. Compression and decompression − Data and file format standards − Multimedia I/O technologies
— Digital voice and audio − Video image and animation − Full motion video − Storage and retrieval technologies.

UNIT V	HYPERMEDIA	9	+	0

Multimedia authoring and user interface – Hypermedia messaging -Mobile messaging − Hypermedia message component − Creating hypermedia message − Integrated multimedia message standards − Integrated document management − Distributed multimedia systems.

Total (L+T)= 45 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	:	Design two dimensional graphics.
CO2	:	Apply two dimensional transformation
CO3	:	Design and apply three dimensional graphics and transformations.
CO4	:	Design various software programs used in the creation and implementation of multi-media(interactive, motion/animation, presentation, etc.).
CO5	:	Design hypermedia messaging and distributed multimedia systems.

Text Book:

1.	Donald Hearn and Pauline Baker M, “Computer Graphics", Prentice Hall, New Delhi, 2007.(Unit I - III).
2.	Andleigh, P. K and Kiran Thakrar, “Multimedia Systems and Design”, PHI, 2003.(Unit IV & V)

Reference Books:

1.	John F. Hughes, Andries Van Dam, Morgan McGuire, David F. Sklar, James D. Foley, Steven K. Feiner and Kurt Akeley, ”Computer Graphics: Principles and Practice”, , 3rd Edition, Addison Wesley Professional,2013.
2.	Donald Hearn and M. Pauline Baker, Warren Carithers, “Computer Graphics With Open GL”, 4th Edition, Pearson Education, 2010.
3.	Judith Jeffcoate, “Multimedia in practice: Technology and Applications”, PHI, 1998.

18CSPE707	C# & .NET FRAMEWORKS	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To identify the major elements of the .NET frame work and .NET platform
2.	To explore the object oriented concepts of C#
3.	To write C# programs and Web based applications on .NET

UNIT I	INTRODUCTION TO C#	9	+	0

Introducing C#, Understanding .NET, overview of C#, Literals, Variables, Data Types, Operators, checked and unchecked operators, Expressions, Branching, Looping, Methods, implicit and explicit casting, Constant, Arrays, Array Class, Array List, String, String Builder, Structure, Enumerations, boxing and unboxing. Font,

UNIT II	OBJECT ORIENTED ASPECTS OF C#	9	+	0

Class, Objects, Constructors and its types, inheritance, properties, indexers, index overloading, polymorphism, sealed class and methods, interface, abstract class, abstract and interface, operator overloading, delegates, events, errors and exception, Threading.

UNIT III	APPLICATION DEVELOPMENT ON .NET	9	+	0

Building windows application, Creating our own window forms with events and controls, menu creation, inheriting window forms, SDI and MDI application, Dialog Box(Modal and Modeless), accessing data with ADO.NET, DataSet, typed dataset, Data Adapter, updating database using stored procedures, SQL Server with ADO.NET, handling exceptions, validating controls, windows application configuration.

UNIT IV	WEB BASED APPLICATION DEVELOPMENT ON .NET	9	+	0

Programming web application with web forms, ASP.NET introduction, working with XML and .NET, Creating Virtual Directory and Web Application, session management techniques, web.config, web services, passing datasets, returning datasets from web services, handling transaction, handling exceptions, returning exceptions from SQL Server.

UNIT V	CLR AND .NET FRAMEWORK	9	+	0

Assemblies, Versoning, Attributes, reflection, viewing metadata, type discovery, reflection on type,marshalling, remoting, security in .NET

Total (L+T)= 45 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	:	Identify the major elements of the .NET frame work and .NET platform
CO2	:	Apply the object oriented concepts of C#
CO3	:	Write C# programs and Web based applications on .NET

Text Books:	
1.	Herbert Schildt, "The Complete Reference: C# 4.0", Tata McGraw Hill (Unit I - II)
2.	Christian Nagel et al. "Professional C# 2012 with .NET 4.5",Wiley India .(Unit III-V)

Reference Books:	
1.	Andrew Troelsen , "Pro C# 2010 and the .NET 4 Platform, Fifth Edition, A Press
2.	Ian Griffiths, Matthew Adams, Jesse Liberty, "Programming C# 4.0", Sixth Edition, O'Reilly,

18CSPE708	ADVANCED DATABASES	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To understand the importance of Distributed Databases.
2.	To impart basic concepts about object oriented databases.
3.	To understand the importance of Web databases.
4.	To know about intelligent databases such as active, temporal and deductive and knowledge databases.
5.	To know about current trends in databases such as mobile databases, multimedia databases, spatialdatabases, parallel databases etc.,

UNIT I	DISTRIBUTED DATABASES	9	+	0

Distributed DBMS Concepts and Design — Introduction — Functions and Architecture of DDBMS — Distributed Relational Database Design — Transparency in DDBMS — Distributed Transaction Management — Concurrency control — Deadlock Management — Database recovery — The X/Open Distributed Transaction Processing Model – Replication servers – Distributed Query Optimization - Distribution and Replication in Oracle.

UNIT II	OBJECT ORIENTED DATABASES	9	+	0

Object Oriented Databases – Introduction – Weakness of RDBMS – Object Oriented Concepts Storing Objects in Relational Databases – Next Generation Database Systems – Object Oriented Data models – OODBMS Perspectives – Persistence – Issues in OODBMS – Object Oriented Database Management System Manifesto – Advantages and Disadvantages of OODBMS – Object Oriented Database Design – OODBMS Standards and Systems – Object Management Group – Object Database Standard ODMG – Object Relational DBMS –Postgres - Comparison of ORDBMS and OODBMS.

UNIT III	WEB DATABASES	9	+	0

Web Technology And DBMS – Introduction – The Web – The Web as a Database Application Platform – Scripting languages – Common Gateway Interface – HTTP Cookies – Extending the Web Server – Java – Microsoft‘s Web Solution Platform – Oracle Internet Platform – Semi structured Data and XML – XML Related Technologies — XML Query Languages.

UNIT IV	INTELLIGENT DATABASES	9	+	0

Enhanced Data Models For Advanced Applications — Active Database Concepts And Triggers — Temporal Database Concepts – Deductive databases – Knowledge Databases.

UNIT V	CURRENT TRENDS	9	+	0

Mobile Database — Geographic Information Systems — Genome Data Management — Multimedia Database – Parallel Database – Spatial Databases - Database administration – Data Warehousing and DataMining.

Total (L+T)= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Understand the Distributed Database Process, Architecture, and Design Principles and apply Distributed Query Optimization Techniques and Algorithms.
CO2	:	Understand the object oriented data models, issues and their design process.
CO3	:	Develop in-depth knowledge about web database.
CO4	:	Get familiarized with intelligent databases such as active databases, deductive databases, temporaldatabases and knowledge databases.
CO5	:	Understand about the current trends in multimedia database, parallel database, mobile databasesand spatial databases and to know the advances in data warehousing and data mining.

Text Books:

1.	Thomas M. Connolly, Carolyn E. Begg, ―Database Systems - A Practical Approach to Design ,Implementation , and Management, Fourth Edition , Pearson Education, 2012 .
2.	Ramez Elmasri & Shamkant B.Navathe, ―Fundamentals of Database Systems, Sixth Edition, Pearson Education, 2011.

Reference Books:

1.	M.Tamer Ozsu , Patrick Ualduriel, ―Principles of Distributed Database Systems,Second Edition, Pearson Education, 2003.
2.	C.S.R.Prabhu, ―Object Oriented Database Systems, PHI, 2003.
3.	Peter Rob and Corlos Coronel, ―Database Systems – Design, Implementation and Management,Thompson Learning, Course Technology, 5th Edition, 2003.

18CSPE709	MACHINE LEARNING	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To understand the need for machine learning for various problem solving
2.	To study the various supervised, semi-supervised and unsupervised learning algorithms in machinelearning
3.	To understand the latest trends in machine learning
4.	To design appropriate machine learning algorithms for problem solving

UNIT I	INTRODUCTION	9	+	0

Learning Problems – Perspectives and Issues – Concept Learning – Version Spaces and Candidate Eliminations – Inductive bias – Decision Tree learning – Representation – Algorithm – Heuristic Space Search.

UNIT II	NEURAL NETWORKS AND GENETIC ALGORITHMS	9	+	0

Neural Network Representation – Problems – Perceptrons – Multilayer Networks and Back Propagation Algorithms – Advanced Topics – Genetic Algorithms – Hypothesis Space Search – Genetic Programming – Models of Evaluation and Learning.

UNIT III	BAYESIAN AND COMPUTATIONAL LEARNING	9	+	0

Bayes Theorem – Concept Learning – Maximum Likelihood – Minimum Description Length Principle – Bayes Optimal Classifier – Gibbs Algorithm – Naïve Bayes Classifier – Bayesian Belief Network – EM Algorithm – Probability Learning – Sample Complexity – Finite and Infinite Hypothesis Spaces – Mistake Bound Model.

UNIT IV	INSTANT BASED LEARNING	9	+	0

K- Nearest Neighbour Learning – Locally weighted Regression – Radial Basis Functions – Case BasedLearning.

UNIT V	ADVANCED LEARNING	9	+	0

Learning Sets of Rules – Sequential Covering Algorithm – Learning Rule Set – First Order Rules – Sets of First Order Rules – Induction on Inverted Deduction – Inverting Resolution – Analytical Learning – Perfect Domain Theories – Explanation Base Learning – FOCL Algorithm – Reinforcement Learning – Task – Q-Learning — Temporal Difference Learning.

Total (L+T)= 45 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	:	Differentiate between supervised, unsupervised, semi-supervised machine learning approaches
CO2	:	Discuss the decision tree algorithm and indentity and overcome the problem of overfitting
CO3	:	Discuss and apply the back propagation algorithm and genetic algorithms to various problems
CO4	:	Apply the Bayesian concepts to machine learning and suggest appropriate machine learningapproaches for various types of problems

Text Books:	
1.	Tom M. Mitchell, ―Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.

Reference Books:	
1.	Ethem Alpaydin, ―Introduction to Machine Learning (Adaptive Computation andMachine Learning), The MIT Press 2004.
2.	Stephen Marsland, ―Machine Learning: An Algorithmic Perspective, CRC Press, 2009.
3.	Shai Shalev-Shwartz, Shai Ben-David, Understanding Machine Learning From Theory toAlgorithms, Cambridge University Press, 2014
4.	Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997

E-References:	
1.	https://onlinecourses.nptel.ac.in/noc18_cs40/preview, (Prof. Sudeshna Sarkar,IIT KHARAGPUR)

18CSPE710	NANO COMPUTING	L	T	P	C
		3	0	0	3

Course Objectives:

1.	Learn Nano computing challenges
2.	Be familiar with the imperfections
3.	Be exposed to reliability evaluation strategies
4.	Learn Nano scale quantum computing
5.	Understand molecular computing and optimal computing

UNIT I	NANO COMPUTING-PROSPECTS AND CHALLENGES	9	+	0

Introduction - History of Computing – Nanocomputing - Quantum Computers – Nano computing Technologies - Nano Information Processing - Prospects and Challenges - Physics of

Nano computing : Digital Signals and Gates - Silicon Nano electronics - Carbon Nano tube Electronics -Carbon Nanotube Field-effect Transistors – Nanolithography.

UNIT II	NANO COMPUTING WITH IMPERFECTIONS	9	+	0

Introduction – Nano computing in the Presence of Defects and Faults - Defect Tolerance -Towards QuadrillionTransistor Logic Systems.

UNIT III	RELIABILITY OF NANO COMPUTING	9	+	0

Markov Random Fields - Reliability Evaluation Strategies - NANOLAB - NANOPRISM -

Reliable Manufacturing and Behavior from Law of Large Numbers.

UNIT IV	NANOSCALE QUANTUM COMPUTING	9	+	0

Quantum Computers - Hardware Challenges to Large Quantum Computers - Fabrication, Test, and Architectural Challenges - Quantum-dot Cellular Automata (QCA) - Computing with QCA - QCA Clocking - QCA Design Rules.

UNIT V	QCA DESIGNER SOFTWARE AND QCA IMPLEMENTATION	9	+	0

Basic QCA Circuits using QCA Designer - QCA Implementation - Molecular and Optical Computing: Molecular Computing - Optimal Computing - Ultrafast Pulse Shaping and Tb/sec Data Speeds.

Total (L)= 45 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	:	Discuss Nano computing challenge
CO2	:	Handle the imperfections.
CO3	:	Apply reliability evaluation strategies.
CO4	:	Use Nano scale quantum computing.
CO5	:	Utilize Molecular Computing and Optimal Computing.

Text Book:

1.	Sahni V. and Goswami D., Nano Computing, McGraw Hill Education Asia Ltd. (2008),ISBN (13):978007024892.

Reference Books:

1.	Sandeep K. Shukla and R. Iris Bahar., Nano, Quantum and Molecular Computing, Kluwer AcademicPublishers (2004), ISBN: 1402080670.
2.	Sahni V, Quantum Computing, McGraw Hill Education Asia Ltd. (2007).
3.	Jean-Baptiste Waldner, Nanocomputers and Swarm Intelligence, John Wiley & Sons,Inc. (2008), ISBN(13): 978-1848210097.

LIST OF PROFESSIONAL ELECTIVES

(VIII SEMESTER)

18CSPE801	INFORMATION SECURITY	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To understand the basics of Information Security
2.	To understand the common threats faced today
3.	To know the aspects of risk management
4.	To understand the Security technology and Intrusion Detection System

UNIT I	INTRODUCTION	9	+	0

History, What is Information Security?, Critical Characteristics of Information, NSTISSC Security Model, Components of an Information System, Securing the Components, Balancing Security and Access, TheSDLC, The Security SDLC.

UNIT II	SECURITY INVESTIGATION	9	+	0

Need for Security, Business Needs, Threats, Attacks, Legal, Ethical and Professional Issues.

UNIT III	SECURITY ANALYSIS	9	+	0

Risk Management-Risk Identification, Risk Assessment, Risk Control Strategies.

UNIT IV	LOGICAL DESIGN	9	+	0

Blueprint for Security, Information Security Policy, Standards and Practices, ISO 17799/BS 7799, NIST Models, VISA International Security Model, Design of Security Architecture, Planning for Continuity.

UNIT V	PHYSICAL DESIGN	9	+	0

Security Technology, IDS, Scanning and Analysis Tools, Access Control Devices, Physical Security, Security and Personnel.

Total (L+T)= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Analyze the vulnerabilities in any computing system and hence be able to design a securitysolution.
CO2	:	Understand the common threats faced today.
CO3	:	Analyze the possible security attacks in complex real time systems and their effectivecountermeasures.
CO4	:	Design the security architecture, policies, standards and practices.
CO5	:	Understand the Security technology and Intrusion Detection System.

Text Book:	
1.	Michael E Whitman and Herbert J Mattord, ―Principles of Information Security, Vikas Publishing House,New Delhi, 2003.
Reference Books:	
1.	Micki Krause, Harold F. Tipton, ―― Handbook of Information Security Management, Vol 1-3 CRC PressLLC, 2004.
2.	Stuart Mc Clure, Joel Scrambray, George Kurtz, ―Hacking Exposed, Tata McGraw-Hill, 2003
3.	Matt Bishop, ― Computer Security Art and Science, Pearson/PHI, 2002.

18CSPE802	BUSINESS INTELLIGENCE AND ITSAPPLICATIONS	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To understand the complete context of a Business
2.	To be familiar with OLAP tools and BI architecture
3.	To learn the concept of ETL in Data warehousing
4.	To learn the basics of data modelling, measurement technologies and process.

UNIT I	INTRODUCTION TO BUSINESS INTELLIGENCE	9	+	0

Business Enterprise Organizations, Functions & core business processes, Baldrige Business Framework, Keypurpose of using IT in Business, Connected World Characteristics of Internet Ready IT Application, Information users & its requirements.[Case Study Inclusions].

UNIT II	BI ARCHITECTURE ROLES AND RESPONSIBILITIES	9	+	0

Introduction to digital data and its types – structured, semi-structured and unstructured, Introduction to OLTP and OLAP (MOLAP, ROLAP, HOLAP), BI Definitions & Concepts, BI Framework, Data Warehousing conceptsand its role in BI, BI Infrastructure Components – BI Process, BI Technology, BI Roles & Responsibilities, Business Applications of BI, BI best practices.

UNIT III	BASICS OF DATA INTEGRATION	9	+	0

Concepts of data integration, needs and advantages of using data integration, introduction to common dataintegration approaches, Meta data - types and sources, Introduction to data quality, data profiling concepts and applications, introduction to ETL using Pentaho data Integration (formerly Kettle).

UNIT IV	INTRODUCTION TO MULTI-DIMENSIONAL DATA MODELING	9	+	0

Introduction to data and dimension modeling, multidimensional data model, ER Modeling vs. multi dimensional modeling, concepts of dimensions, facts, cubes, attribute, hierarchies, star and snowflake schema,introduction to business metrics and KPIs, creating cubes using Microsoft Excel.

UNIT V	BASICS OF ENTERPRISE REPORTING	9	+	0

A typical enterprise, Malcolm Baldrige - quality performance framework, balanced scorecard, enterprise dashboard, balanced scorecard vs. enterprise dashboard, enterprise reporting using MS Access / MS Excel,best practices in the design of enterprise dashboards.

Total (L+T)= 45 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	:	Explain the complete context of a Business, BI architecture and various quality performanceframework
CO2	:	Illustrate various operations of OLAP on Multidimensional data.
CO3	:	Familiarize with ETL in the context of data warehousing.
CO4	:	Design a data model at conceptual and logical levels.

Text Books:	
1.	R.N.Prasad,Seema Acharya, "Fundamentals of Business Analytics", Wiley Publications,2011.
Reference Books:	
1.	Business Intelligence by David Loshin .
2.	Business intelligence for the enterprise by Mike Biere .
3.	Business intelligence roadmap by Larissa Terpeluk Moss, Shaku Atre .
4.	Business Intelligence For Dummies – Swain Scheps
5.	Successful Business Intelligence: Secrets to making Killer BI Applications by Cindi Howson
6.	Information dashboard design by Stephen Few
7.	An introduction to Building the Data Warehouse – IBM

18CSPE803	E – COMMERCE	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To Learn the Various e-commerce business models.
2.	To Understand how companies, use e-commerce to gain competitive advantages.
3.	To develop an understanding of electronic market and market place
4.	To Familiarize with the planning and execution of e-commerce projects.
5.	To develop an understanding of business standards

UNIT I	ELECTRONIC COMMERCE	9	+	0

Frame work, anatomy of E-Commerce applications - E- Commerce Consumer applications - E-Commerce organization applications.

UNIT II	CONSUMER ORIENTED ELECTRONIC COMMERCE	9	+	0

Mercantile Process models-Electronic payment systems: Digital Token-Based - Smart Cards - Credit Cards - Risks in Electronic Payment systems.

UNIT III	MOBILE ELECTRONIC COMMERCE	9	+	0

Wireless Industry Standards - Wireless Communication Platforms for LANs - Wireless WANs - Facilitators of aWireless Environment - Concerns for the Mobile Enterprise.

UNIT IV	E-COMMERCE APPLICATIONS DEVELOPMENT	9	+	0

The Changing Face of Application Development - Enterprise Development Needs - Enhanced Web Server- Based E-Commerce Site Business Objectives - Categories of Business Value - Assessing a Site's Current Business Value - Improving Business Value - Managed Solutions.

UNIT V	E-COMMERCE SECURITY	9	+	0

Types of Security Technologies: The Internet - The Internet Is Big Business - The New Economy - Where Old Meets New - Flawed Infrastructure - Emergence of Cyber Crime - Outside Attacks - Inside Attacks - Threats Due to Lack of Security - Cyber Security Need - Internet Security Education - E-Commerce Application Security Technology Essentials.

Total (L+T)= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Develop an understanding of the foundations and importance of E-commerce
CO2	:	Analyze the impact of E-commerce on business models and strategies
CO3	:	Discuss legal issues and privacy in E-Commerce
CO4	:	Describe Internet trading relationships including Business to Consumer, Business-to-Business,Intra-organizational.
CO5	:	Understand the business standards.

Text Books:	
1.	Ravi Kalakota and Andrew B Whinston, “Frontiers of Electronic Commerce”,Addison Wesley,2008.(UNIT I - II)
2.	Pete Loshin, John Vacca, “Electronic Commerce”, IV Edition, Firewall Media, 2005.(UNIT III-V).
Reference Books:	
1.	Efraim Turban , Electronic Commerce, fourth edition, Pearson, 2006.
2.	Jeffrey F Rayport, Bernard J Jaworski , Introduction to E-Commerce, second edition, Tata McGraw Hill,2003.
3.	Gary P Schneider ,E-commerce: Strategy, Technology and Implementation, eleventh edition, CengageLearning, 2011.
4.	Kamlesh K Bajaj, DebjaniNag ,E-Commerce: The Cutting Edge of Business, second edition, TataMcGraw Hill, 2005.

18CSPE804	MOBILE COMPUTING	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To understand the basic concepts of mobile computing
2.	To familiarize with the network protocol stack
3.	To acquire the basics of mobile telecommunication system
4.	To expose theAdhoc networks
5.	To gain the knowledge about different mobile platforms and application development

UNIT I	INTRODUCTION	9	+	0

Mobile Computing – Mobile Computing Vs wireless Networking – Mobile Computing Applications – Characteristics of Mobile computing – Structure of Mobile Computing Application. MAC Protocols – WirelessMAC Issues – Fixed Assignment Schemes – Random Assignment Schemes – Reservation Based Schemes.

UNIT II	MOBILE INTERNET PROTOCOL AND TRANSPORT LAYER	9	+	0

Overview of Mobile IP – Features of Mobile IP – Key Mechanism in Mobile IP – route Optimization. Overviewof TCP/IP – Architecture of TCP/IP- Adaptation of TCP Window – Improvement in TCP Performance.

UNIT III	MOBILE TELECOMMUNICATION SYSTEM	9	+	0

Global System for Mobile Communication (GSM) – General Packet Radio Service (GPRS) – Universal Mobile Telecommunication System (UMTS).

UNIT IV	MOBILE ADHOC NETWORKS	9	+	0

Adhoc Basic Concepts – Characteristics – Applications – Design Issues – Routing – Essential of Traditional Routing Protocols –Popular Routing Protocols – Vehicular Adhoc networks (VANET) – MANET Vs VANET –Security.

UNIT V	MOBILE PLATFORMS AND APPLICATIONS	9	+	0

Mobile Device Operating Systems – Special Constrains & Requirements – Commercial Mobile OperatingSystems – Software Development Kit: iOS, Android, BlackBerry, Windows Phone – M-Commerce – Structure – Pros & Cons – Mobile Payment System – Security Issues.

Total (L)= 45 Periods

Course Outcomes:

At the end of the course students will be able to

CO1	:	Explain the basics of mobile telecommunication system
CO2	:	Decide the required functionality at each layer for given application
CO3	:	Identify solution for each functionality at each layer
CO4	:	Use simulator tools and design Adhoc networks
CO5	:	Develop a mobile application.

Text Books:	
1.	Prasant Kumar Pattnaik, Rajib Mall, “Fundamentals of Mobile Computing”, PHI Learning Pvt. Ltd, New Delhi – 2012.
Reference Books:	
1.	Jochen H. Schller, “Mobile Communications”, Second Edition, Pearson Education, New Delhi, 2007.
2.	Dharma Prakash Agarval, Qing and An Zeng, “Introduction to Wireless and Mobile systems”, Thomson Asia Pvt Ltd, 2005.
3.	Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, “Principles of Mobile Computing”, Springer, 2003.
4.	William.C.Y.Lee,“Mobile Cellular Telecommunications-Analog and Digital Systems”, Second Edition,Tata Mc Graw Hill Edition ,2006.
5.	C.K.Toh, “AdHoc Mobile Wireless Networks”, First Edition, Pearson Education, 2002.
6.	Android Developers : http://developer.android.com/index.html
7.	Apple Developer : https://developer.apple.com/
8.	Windows Phone Dev Center : http://developer.windowsphone.com 9. BlackBerry Developer : http://developer.blackberry.com/

18CSPE805	DEEP LEARNING	L	T	P	C
		3	0	0	3

Course Objectives:

1. To gain the fundamentals of neural networks as well as some advanced topics such as recurrent neural networks, long short term memory cells and convolutional neural networks

UNIT I	INTRODUCTION	9	+	0

Basics: Biological Neuron, Idea of computational units, McCulloch–Pitts unit and Thresholding logic, Linear Perceptron, Perceptron Learning Algorithm, Linear separability. Convergence theorem for Perceptron Learning Algorithm.

Feedforward Networks: Multilayer Perceptron, Gradient Descent, Backpropagation, Empirical Risk Minimization, regularization, autoencoders.

UNIT II	DEEP NEURAL NETWORKS	9	+	0

Deep Neural Networks: Difficulty of training deep neural networks, Greedy layerwise training.

Better Training of Neural Networks: Newer optimization methods for neural networks (Adagrad, adadelta, rmsprop, adam, NAG), second order methods for training, Saddle point problem in neural networks, Regularization methods (dropout, drop connect, batch normalization).

UNIT III	RECURRENT NEURAL NETWORKS	9	+	0

Recurrent Neural Networks: Back propagation through time, Long Short Term Memory, Gated RecurrentUnits, Bidirectional LSTMs, Bidirectional RNNs

Convolutional Neural Networks: LeNet, AlexNet.

UNIT IV	GENERATIVE MODELS	9	+	0

Generative models: Restrictive Boltzmann Machines (RBMs), Introduction to MCMC and Gibbs Sampling,gradient computations in RBMs, Deep Boltzmann Machines.

UNIT V	RECENT TRENDS	9	+	0

Recent trends: Variational Autoencoders, Generative Adversarial Networks, Multi-task Deep Learning, Multi-view Deep Learning

Total (L+T)= 45 Periods

Course Outcomes:

At the end of the course students will be able to

CO1	:	Understand the fundamentals of neural networks as well as some advanced topics such as recurrent neural networks, long short term memory cells and convolutional neural networks

Text Books:

1. Deep Learning, Ian Goodfellow and Yoshua Bengio and Aaron Courville, MIT Press, 2016.

Reference Books:

1. Neural Networks: A Systematic Introduction, Raúl Rojas, 1996
2. Pattern Recognition and Machine Learning, Christopher Bishop, 2007

18CSPE806	AD HOC AND SENSOR NETWORKS	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To understand the design issues in ad hoc and sensor networks
2.	To learn the different types of MAC protocols
3.	Be familiar with different types of adhoc routing protocols
4.	Be expose to the TCP issues in adhoc networks
5.	To learn the architecture and protocols of wireless sensor network

UNIT I	INTRODUCTION	9	+	0

Fundamentals of Wireless Communication Technology – The Electromagnetic Spectrum – Radio propagation Mechanisms — Characteristics of the Wireless Channel -mobile ad hoc networks (MANETs) and wireless sensor networks (WSNs): concepts and architectures. Applications of Ad Hoc and Sensor networks. DesignChallenges in Ad hoc and Sensor Networks

UNIT II	MAC PROTOCOLS FOR AD HOC WIRELESS NETWORKS	9	+	0

Issues in designing a MAC Protocol- Classification of MAC Protocols- Contention based protocols- Contention based protocols with Reservation Mechanisms- Contention based protocols with Scheduling Mechanisms —Multi channel MAC-IEEE 802.11

UNIT III	ROUTING PROTOCOLS AND TRANSPORT LAYER IN AD HOC WIRELESSNETWORKS	9	+	0

Issues in designing a routing and Transport Layer protocol for Ad hoc networks- proactive routing, reactiverouting (on-demand), hybrid routing- Classification of Transport Layer solutions-TCP over Ad hoc wireless Networks

UNIT IV	WIRELESS SENSOR NETWORKS (WSNS) AND MAC PROTOCOLS	9	+	0

Single node architecture: hardware and software components of a sensor node - WSN Network architecture: typical network architectures-data relaying and aggregation strategies -MAC layer protocols: self-organizing, Hybrid TDMA/FDMA and CSMA based MAC- IEEE 802.15.4

UNIT V	WSN ROUTING, LOCALIZATION & QOS	9	+	0

Issues in WSN routing – OLSR- Localization – Indoor and Sensor Network Localization-absolute and relative localization, triangulation-QOS in WSN-Energy Efficient Design-Synchronization-Transport Layer issues

Total (L+T)= 45 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	:	Explain the concepts, network architectures and applications of ad hoc and wireless sensornetworks
CO2	:	Analyze the protocol design issues of ad hoc and sensor networks
CO3	:	To identify and understand security issues in ad hoc and sensor networks
CO4	:	Design routing protocols for ad hoc and wireless sensor networks with respect to some protocoldesign issues
CO5	:	Evaluate the QoS related performance measurements of ad hoc and sensor networks

Text Books:	
1.	C. Siva Ram Murthy, and B. S. Manoj, "Ad Hoc Wireless Networks: Architectures and Protocols ",Prentice Hall Professional Technical Reference, 2008
Reference Books:	
1.	Carlos De Morais Cordeiro, Dharma Prakash Agrawal “Ad Hoc & Sensor Networks: Theory andApplications”, World Scientific Publishing Company, 2006
2.	Feng Zhao and Leonides Guibas, "Wireless Sensor Networks", Elsevier Publication - 2002
3.	Holger Karl and Andreas Willig “Protocols and Architectures for Wireless Sensor Networks”, Wiley, 2005
4.	Kazem Sohraby, Daniel Minoli, & Taieb Znati, “Wireless Sensor Networks-Technology, Protocols, and Applications”, John Wiley, 2007
5.	Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003

18CSPE807	CLOUD COMPUTING	L	T	P	C
		3	0	0	3

Course Objectives:

1. To introduce the broad perceptive of Parallel Computing, Distributed Computing and Cloud Computing
2. To understand the concept of Virtualization
3. To identify the approaches of SLA and programming model in Cloud
4. To understand the Cloud Platforms in Industry and Software Environments
5. To learn to design the trusted Cloud Computing system

UNIT I	INTRODUCTION	9	+	0

Principles of Parallel and Distributed Computing — Elements of Parallel and Distributed Computing, Technologies for Distributed Computing; Vision of Cloud, Defining a Cloud, characteristics and benefits; Cloud Computing Architecture-Cloud Reference Model, Types of Clouds, Open Challenges.

UNIT II	VIRTUALIZATION	9	+	0

Introduction, Characteristics of Virtualized environments, Virtualization techniques-Machine Reference Model, Hardware-Level Virtualization, Programming Language-Level Virtualization, Application-Level Virtualization , Other types of Virtualization, Virtualization and Cloud computing, Pros and cons of Virtualization, Technology examples-Xen: Paravirtualization, VMware: Full Virtualization.

UNIT III	SLA MANAGEMENT IN CLOUD COMPUTING AND PROGRAMMING MODEL	9	+	0

Traditional Approaches to SLA Management, Types of SLA, Life Cycle of SLA, SLA Management in Cloud;Data Intensive Computing - Technologies for Data Intensive Computing, MapReduce Programming Model.

UNIT IV	CLOUD INDUSTRIAL PLATFORMS AND SOFTWARE ENVIRONMENTS	9	+	0

Cloud Platforms in Industry - Amazon Web Service, Google App Engine; Cloud Software Environments — Eucalyptus, OpenNebula; Aneka Cloud Application Platform-Aneka Framework Overview, Anatomy of Aneka Container.

UNIT V	CLOUD SECURITY AND APPLICATIONS	9	+	0

An Introduction to the Idea of Data Security, The Current State of Data Security in the Cloud, Cloud Computing and Data Security Risk, Cloud Computing and Identity; The Cloud, Digital Identity, and Data Security, Content Level Security, Pros and Cons; Cloud Scientific Applications.

Total (L+T)= 45 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	:	Explain the main concepts and architecture of Parallel computing, Distributed Computing and Cloud Computing
CO2	:	Analyze the concept of Virtualization
CO3	:	Identify the approaches of SLA and programming model in Cloud
CO4	:	Analyze the Cloud Platforms in Industry and Software Environments
CO5	:	Identify the security issues in scientific and real time applications

Text Books:	
1.	Rajkumar Buyya, Christian Vecchiola, S.Tamarai Selvi, 'Mastering Cloud Computing-Foundations and Applications Programming", TMGH,2013.(Unit- I,II & IV)
2.	RajKumar Buyya, James Broberg, Andrezei M.Goscinski, "Cloud Computing: Principles and paradigms", 2011(Unit-III & V)

Reference Books:	
1.	Kai Hwang.Geoffrey C.Fox.Jack J.Dongarra, " Distributed and Cloud Computing ,From ParallelProcessing to The Internet of Things", 2012 Elsevier
2.	Barrie Sosinsky, "Cloud Computing Bible", Wiley Publisher, 2011

18CSPE808	SERVICE ORIENTED ARCHITECTURE	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To learn service oriented analysis techniques
2.	To learn technology underlying the service design
3.	To learn advanced concepts such as service composition, orchestration and choreography
4.	To know about various WS specification standards

UNIT I	SOA FUNDAMENTALS	9	+	0

Roots of SOA, Characteristics of SOA, Comparing SOA to client, server and distributed internet architectures, Anatomy of SOA, How components in an SOA interrelate, Principles of service orientation.

UNIT II	SOA AND WEB SERVICE	9	+	0

Web services, Service descriptions, Messaging with SOAP, Message exchange Patterns, Coordination, Atomic Transactions, Business activities, Orchestration, Choreography, Service layer abstraction, Application Service Layer, Business Service Layer, Orchestration Service Layer.

UNIT III	SOA DESIGN	9	+	0

Service oriented analysis, Business-centric SOA, Deriving business services, service modeling- Service Oriented Design, WSDL basics ,SOAP basics ,SOA composition guidelines,Entity-centric business service design ,Application service design ,Task - centric business service design.

UNIT IV	SOA PLATFORMS	9	+	0

SOA platform basics , SOA support in J2EE , Java API for XML based web services (JAX-WS) ,Javaarchitecture for XML binding (JAXB) ,Java API for XML Registries (JAXR) ,Java API for XML based RPC (JAX-RPC) , Web Services Interoperability Technologies (WSIT) , SOA support in .NET , Common LanguageRuntime , ASP.NET web forms , ASP.NET web services , Web Services Enhancements (WSE).

UNIT V	BUSINESS PROCESS DESIGN	9	+	0

WS-BPEL basics, WS-Coordination overview, WS-Choreography, WS-Policy, WS- Security.

Total (L+T)= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Understand the basic principles of software oriented architectures, its components and techniques.
CO2	:	Develop web services using technology elements.
CO3	:	Understand technology underlying the service design.
CO4	:	Develop SOA platforms.
CO5	:	Build SOA-based applications for intra-enterprise and inter-enterprise applications.

Text Books:	
1.	Thomas Erl, ―Service-Oriented Architecture: Concepts, Technology, and Design, Prentice HallPublication, 2005.
Reference Books:	
1.	Norbert Bieberstein, Sanjay Bose, Marc Fiammante, Keith Jones, Rawn Shah, ―Service-Oriented Architecture Compass: Business Value, Planning, and Enterprise Roadmap, IBM Press Publication,2005.
2.	Sandy Carter, ―The New Language of Business: SOA & Web 2.0, IBM Press, 2007.
3.	Thomas Erl, ―Service-Oriented Architecture: A Field Guide to Integrating XML and Web Services,Prentice Hall Publication, 2004.
4.	Dave Chappell, ―Enterprise Service Bus, O'Reilly Publications, 2004.

18CSPE809	FREE AND OPEN SOURCE SOFTWARE	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To understand concepts, strategies, and methodologies related to open source software development.
2.	To comprehend the business models, economic aspects, policies and regulations of open source software.

UNIT I	INTRODUCTION	9	+	0

An Introduction to Open Source - Paradigm Shift in Hardware and software – Internet application platform - Commoditization of software - Customizable systems and architectures - Network-enabled Collaboration

UNIT II	BUSINESS MODEL	9	+	0

Business Model Thoughts for Commodity Software - Hidden Service Business Models in Open Source Software – Platforms, types and standards

UNIT III	OPEN SOURCE SOFTWARES	9	+	0

Economic theory about open source software – Programmer's participation – open source projects – reaction of commercial vendors to open source project – supportive technological characteristics to open source development – optimal licensing – coexistence of commercial and open source software

UNIT IV	OPEN SOURCE BUSINESS STRATEGIES	9	+	0

Open source business strategies – optimization strategy – dual license strategy – support strategy – consulting strategy – patronage strategy – hosted strategy – embedded strategy. Case study: IBM opensource

UNIT V	OPEN SOURCE POLICIES	9	+	0

Government Policy About Open Source - Regulations of Open Source/Open Source as a Global Phenomenon - Enforceability of Open Source Licenses

Total (L+T)= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Explain concepts, and strategies related to open source software development.
CO2	:	Choose a business model based on the type of open source software.
CO3	:	Recall policies, regulations and economic aspects of open source software.

Text Books:	
1.	Karl Fogel, “Producing Open Source Software: How to Run a Successful Free Software Project”,O’Reilly Publication, 2005.
Reference Books:	
1.	Eric S. Raymond, “The Cathedral and the Bazaar: Musing on Linux and Open Source by an Accidental Revolutionary”, O’Reilly Publication,2001.
E-References:	
1.	“Open source paradigm shift,” Tim O’Reilly
2.	"The Simple Economics of Open Source" Josh Lerner and Jean Tirole
3.	“Seven Open source Business Strategies for Competitive Advantage,” John Koenig
4.	" IBM’s Pragmatic Embrace of Open Source," Pamela Samuelson
5.	"Politics And Programming: Government Preferences for Promoting Open Source Software," David S.Evans
6.	"The Limits in Open Code: Regulatory Standards & the Future of the Net," Lawrence Lessig
7.	"Legal Implications of Open Source Software," David McGowan

18CSPE810	NATURAL LANGUAGE PROCESSING	L	T	P	C
		3	0	0	3

Course Objectives:

1.	This course introduces the fundamental concepts and techniques of natural language processing (NLP).
2.	Students will gain an in-depth understanding of the computational properties of natural languages andthe commonly used algorithms for processing linguistic information.
3.	The course examines NLP models and algorithms using both the traditional symbolic and the morerecent statistical approaches.

UNIT I	INTRODUCTION	9	+	0

Semantics and Knowledge Representation - Natural Language Processing - Information Extraction - Main Challenges in Information Extraction - Approaches to Information Extraction - Performance Measures - General Architecture for Information Extraction.

UNIT II	DATA GATHERING, PREPARATION AND ENRICHMENT	9	+	0

Process Overview -Tokenization and Sentence Boundary Detection -Representative Tools: Punkt and iSentenizer - Morphological Analysis and Part-of-Speech Tagging -Representative Tools: Stanford POS Tagger, -SVM Tool, and TreeTagger -Syntactic Parsing -Representative Tools: Epic, StanfordParser, - MaltParser, TurboParser -Representative Software Suites -Stanford NLP - Natural Language Toolkit (NLTK)
-GATE.

UNIT III	IDENTIFYING THINGS, RELATIONS AND SEMANTIZING DATA	9	+	0

Identifying the Who, the Where, and the When -Relating Who, What, When, and Where -Getting EverythingTogether - Ontology -Ontology-Based Information Extraction (OBIE).

UNIT IV	EXTRACTING RELEVANT INFORMATION USING A GIVEN SEMANTIC	9	+	0

Introduction -Defining How and What Information Will Be Extracted -Architecture -Implementation of a Prototype Using State-of-the-Art Tools -Natural Language Processing -Domain Representation -Semantic Extraction and Integration.

UNIT V	APPLICATIONS	9	+	0

Selecting and Obtaining Software Tools -Tools Setup -Processing the Target Document -Using for Other Languages and for Syntactic Parsing -Application Example 2: IE Applied to Electronic Government -Goals - Documents -Obtaining the Documents -Application Setup -Making Available Extracted Information Using a Map -Conducting Semantic Information Queries.

Total (L+T)= 45 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	:	Understand approaches to syntax and semantics in NLP.
CO2	:	Have a basic understanding of a variety of NLP tools.
CO3	:	Understand approaches to discourse, generation, dialogue and summarization within NLP.
CO4	:	Understand current methods for statistical approaches to machine translation.
CO5	:	Understand machine learning techniques used in NLP, including hidden Markov models and probabilistic context-free grammars, clustering and unsupervised methods, log-linear anddiscriminative models, and the EM algorithm as applied within NLP.

Text Books:

1.	"Advanced Applications of Natural Language Processing for Performing Information Extraction",-MárioRodrigues, AntónioTeixeira.

Reference Books:

1.	"Analyzing Discourse and Text Complexity for Learning and Collaborating_ A CognitiveApproach Based on Natural Language Processing",-MihaiDascălu.
2.	"Natural Language Processing for Social Media",-Farzindar, Atefeh_ Inkpen, Diana
3.	"Natural Language Processing and Cognitive Science",-Bernadette Sharp, Rodolfo Delmonte.

LIST OF OPEN ELECTIVES OFFEREDTO OTHER DEPARTMENTS

18CSOE01	OBJECT ORIENTED PROGRAMMING USING C++	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To understand and develop the object oriented programming concepts.
2.	To familiarize and design the template functions and classes
3.	To disseminate and apply exception handling mechanisms.
4.	To learn and exploit steam classes.

UNIT I	INTRODUCTION	9	+	0

Procedure oriented programming paradigm - Object oriented programming paradigm - Basic concepts of object oriented programming, benefits of OOP, application of OOP - C++ fundamentals –structure of C++ program, tokens, data types - Operators and expressions - Control structures - Functions.

UNIT II	CLASSES AND OBJECTS	9	+	0

Classes and objects - friend functions- constructors and destructors- Operator overloading – binary and unaryoperator overloading using member function and friend function - Type Conversion.

UNIT III	INHERITANCE AND VIRTUAL FUNCTIONS	9	+	0

Inheritance — defining derived classes, types, virtual base classes, abstract classes, constructor in derivedclasses - Pointers- pointers to objects, this pointer, pointer to derived classes - Virtual functions.

UNIT IV	TEMPLATES AND EXCEPTION HANDLING	9	+	0

Generic Classes — class template, class templates with multiple parameters - Generic Functions - function templates, function templates with multiple parameters, member function templates - Exception handling —basics, exception handling mechanism, rethrowing an exception.

UNIT V	CONSOLE I/O AND FILE HANDLING	9	+	0

C++ Stream Classes — unformatted I/O operations, formatted console I/O operations, manipulators - Files- classes for file operation, opening and closing a file, detecting end of file, files modes, sequential file operations, random file operations.

Total (L+T)= 45 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	:	Construct the object oriented programming concepts.
CO2	:	Familiarize and build the template functions and classes
CO3	:	Disseminate and apply exception handling mechanisms.
CO4	:	Depict and exploit steam classes.
Text Books:		
1.	E. Balagurusamy “Object –Oriented Programming with C++” Sixth Edition Tata McGraw-Hill	
Reference Books:		
1.	Herbert Schildt, "The Complete Reference C++", Fifth Edition, Tata McGraw Hill	
2.	Bjarne Stroustrup, “The C++ programming language”, Fourth Edition Addison Wesley	
3.	K.R. Venugopal, Rajkumar Buyya “Mastering in C++” Second Edition, Tata McGraw Hill	

18CSOE02	OPERATING SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives:

1. To understand the structure and functions of Operating systems
2. To understand the process concepts and scheduling algorithms
3. To understand the concept of process synchronization and deadlocks
4. To learn various memory management schemes
5. To illustrate various file systems and disk management strategies

UNIT I	INTRODUCTION AND OPERATING SYSTEM STRUCTURES	9	+	0

Main frame Systems, Desktop Systems, Multiprocessor Systems, Distributed Systems, Clustered Systems, Real Time systems, Hand held Systems; Operating Systems Structures - System Components, Operating System Services, System calls, System Programs, System Design and Implementation.

UNIT II	PROCESS MANAGEMENT	9	+	0

Processes-Process Concepts, Process Scheduling, Operation on Processes, Co-Operating Processes, Inter Process Communication; Threads- Multithreading Models, Threading Issues; CPU Scheduling-Basic Concepts, Scheduling Criteria, Scheduling Algorithms.

UNIT III	PROCESS SYNCHRONIZATION AND DEADLOCKS	9	+	0

Process Synchronization- The Critical Section Problem, Semaphores, Classical Problem of Synchronization, Monitors; Deadlocks- Deadlock Characterization, Methods for handling Deadlocks, Deadlock Prevention, Deadlock Avoidance ,Deadlock Detection, Recovery from Deadlock.

UNIT IV	MEMORY MANAGEMENT AND VIRTUAL MEMORY	9	+	0

Memory Management- Background, Swapping, Contiguous Memory Allocation, Paging, Segmentation,Segmentation with paging; Virtual Memory - Demand paging, Page Replacement, Thrashing.

UNIT V	FILE SYSTEM AND MASS-STORAGE STRUCTURE	9	+	0

File System Interface - File Concepts, Access methods, Directory Structure, File Sharing, File Protection; File System Implementation - File System Structure and Implementation, Directory Implementation, Allocation Methods, Free Space Management; Mass-Storage Structure - Disk Structure, Disk scheduling, Disk Management, RAID Structure.

Total (L+T)= 45 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	:	Identify the components and their functionalities in the operating system
CO2	:	Apply various CPU scheduling algorithms to solve problems
CO3	:	Analyze the needs and applications of process synchronization and deadlocks
CO4	:	Apply the concepts of memory management including virtual memory and page replacement to theissues that occur in real time applications
CO5	:	Solve issues related to file system implementation and disk management

Text Books:	
1.	Abraham Silberschatz, P.B.Galvin, G.Gagne ―Operating System Concepts 6th edition, John Wiley & Sons, 2003.

Reference Books:	
1.	Andrew S. Tanenbaum, ―Modern Operating Systems, PHI , 2nd edition, 2001
2.	D.M.Dhamdhere, "Systems Programming and Operating Systems ", 2nd edition, Tata McGraw HillCompany, 1999.
3.	Maurice J. Bach, ―The Design of the Unix Operating System, 1st edition, PHI, 2004.

18CSOE03	COMPUTER NETWORKS	L	T	P	C
		3	0	0	3

Course Objectives:

1. To study the concepts of data communications and functions of different ISO/OSI reference architecture
2. To understand the error detection and correction methods and also the types of LAN
3. To study the concepts of subnetting and routing mechanisms
4. To understand the different types of protocols and congestion control
5. To study the application protocols and network security

UNIT I	DATA COMMUNICATIONS AND PHYSICAL LAYER	9	+	0

Data Communication; Networks- Physical Structures (Types of Connections, Physical Topology), Categories of Networks, Interconnection of Networks: Internetwork; Protocols and Standards; Network Models-The OSIModel,Layers in the OSI Model,Addressing;Transmission media-Guided Media,Unguided Media.

UNIT II	DATA LINK LAYER	9	+	0

Introduction-Types of errors,Redundancy,Detection versus Correction -Error Detection and Correction (VRC,LRC,CRC,Checksum,Hamming Code);Data link Control- Flow Control (Stop-and-Wait,Sliding Window),Error Control (Automatic Repeat Request, Stop-and-wait ARQ,Sliding Window ARQ); Local Area Networks- Ethernet, Token Bus, Token Ring, FDDI.

UNIT III	NETWORK LAYER	9	+	0

Network Layer services-Packet Switching-Network Layer Performance-IPv4 addresses-IPv6 addressing-Subnetting-Bridges-Gateways- Routers-Routing Algorithm-Distance Vector Routing, Link State Routing.

UNIT IV	TRANSPORT LAYER	9	+	0

Duties of the Transport layer-User Datagram Protocol-Transmission Control Protocol- Congestion Control andQuality of Service-Congestion, Congestion Control, Quality of Service, Techniques to improve QoS.

UNIT V	PRESENTATION LAYER AND APPLICATION LAYER	9	+	0

Translation, Encryption/Decryption, Authentication, Data Compression; Domain Name System – FTP-SMTP-HTTP-World Wide Web.

Total (L+T)= 45 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	:	Classify the fundamentals of data communications and functions of layered architecture
CO2	:	Apply the error detection and correction methods and also identify the different networktechnologies
CO3	:	Analyze the requirements for a given organizational structure and select the most appropriate networking architecture and routing technologies
CO4	:	Illustrate the transport layer principles and reliable data transfer using protocols
CO5	:	Analyze the application layer protocols and also the use of network security

Text Books:

1.	Behrouz A.Ferouzan, "Data Communications and Networking", 4th Edition, Tata McGraw-Hill, 2007

Reference Books:

1.	Andrew S. Tanenbaum, "Computer networks "PHI, 4th edition 2008
2.	William Stallings," Data and computer communications", 10th edition,PHI, 2012
3.	Douglas E. comer," Internetworking with TCP/IP-Volume-I", 6th edition,PHI, 2008

18CSOE04	PYTHON PROGRAMMING	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To Learn Python data structures, conditional and control structures and files.
2.	To study Python Modules, packages, Functions and Exceptions.
3.	To Describe Object oriented programming features and Regular Expressions.

UNIT I	INTRODUCTION	9	+	0

Python: Features - The Basics-Numbers, Sequence: Strings, Lists and Tuples, Mapping and set types.

UNIT II	CONDITIONS,CONTROL STRUCTURES AND FILES	9	+	0

Conditionals and loops-if statement-else statement-elif-Conditional Expressions-while statement-for statement-break-continue –pass-Iterators-list Comprehensions-Generator Expressions; Files and Input/ Output.

UNIT III	PYTHON EXCEPTIONS MODULES AND PACKAGES	9	+	0

Errors and Exceptions-Introduction-Detecting and handling Exceptions-Context Management-Raising Exceptions-Assertions-Standard Exceptions- Modules-Packages.

UNIT IV	FUNCTIONS	9	+	0

Functions-Calling functions-Creating functions-Passing Functions-Formal Arguments-Variable length arguments-variable scope-Recursion-map, filter , reduce and list comprehensions-Operator Module-The itertools and collection modules.

UNIT V	OBJECT ORIENTED PROGRAMMING AND REGULAR EXPRESSION	9	+	0

Introduction-Classes-class Attributes-Instances-Instances attributes-Building and Method Invocation-Staticmethods and class Methods-Inheritance-Operator overloading-Regular Expression.

Total (L+T)= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Develop programs using control structures and files.
CO2	:	Create own Python Modules, packages , functions and Exceptions.
CO3	:	Illustrate Object oriented Programming features and Regular Expressions.

Text Books:

1.	Wesley J.Chun-“Core Python Programming” –Prentice Hall, Second Edition, 2006.

Reference Books:

1.	Swaroop C N, “ A Byte of Python “, ebshelf Inc., 1st Edition, 2013
2.	“A Practical Introduction to python programming”, Brian Heinold,Mount St.Mary’s University,2012
3.	Learning to Program with Python,” Richard L. Halterman”., Southern Adventist University

E-References:

1.	Introduction to Python Programming NPTEL video lectures by Dr. Sudip Misra , IIT Kharagpur 2017.

18CSOE05	JAVA PROGRAMMING	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To familiarize and apply the Object Oriented concepts and java features
2.	To write the standalone applications and applet applications
3.	To build simple chart application and Database Connectivity

UNIT I	INTRODUCTION TO JAVA	9	+	0

Fundamentals of object oriented programming- java features, comparing JAVA with C and C++, JAVA environment; Overview of java language - java program structure, java tokens, java statements, implementing java program, java virtual machine, command line arguments; constants, variables and data types - Operators and expressions - Decision making — branching and looping.

UNIT II	JAVA FEATURES	9	+	0

Classes, objects methods – arrays, Strings and Vectors– Interfaces – Packages - Multithreaded programming - Exception handling.

UNIT III	APPLET AND EVENT HANDLING	9	+	0

Applet programming- build applet code, applet life cycle, creating executable applet, designing a web page,applet tag, running the applet; Graphics programming – graphics class, lines, rectangles, circles, ellipses, arcs and polygons;

UNIT IV	EVENTS AND AWT CONTROLS	9	+	0

Event handling – two event handling Mechanisms, delegation event model, event classes, sources of events, event listener interfaces; AWT - AWT controls, Layout Managers, Menu Bars and Menus, Dialog Boxes, FileDialogs;

UNIT V	I/O FILES AND JDBC	9	+	0

I/O Files- concepts of stream, stream classes, byte stream classes, character stream classes, file classes, creation of files, reading and writing characters and bytes; Design of JDBC - JDBC drivers; JDBC programming concepts - Database concepts, making connection, executing SQL commands, managing connections, statements, and result sets; Query execution - Prepared Statements.

Total (L+T)= 45 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	:	Familiarize and apply the Object Oriented concepts and java features
CO2	:	Build the standalone applications and applet applications
CO3	:	Develop simple application using files and Database

Text Books:	
1.	E. Balaguruswamy, “Programming with java”, Fifth, TMH (Unit- I-III)
2.	PatricNaughton , Herbert Schildt, “The Complete Reference Java 2” , Eighth edition Tata McGraw Hills ,(Unit IV - V)

Reference Books:	
1.	Cay S. Horstmann, Gary Cornell “ Core Java 2” Eighth Edition, Pearson Education
2.	Graham Hamilton , Rick Cattell, Maydene Fisher ,”JDBC Database access with java”.
3.	PaulDeitel and Harvey Deitel, “Java How to Program”, Tenth Edition, Pearson Prentice Hall 2014.

18CSOE06	COMPUTER ORGANIZATION AND ARCHITECTURE	L	T	P	C
		3	0	0	3

Course Objectives:

1. To understand the basic structure and operations of digital computer
2. To learn the working of different arithmetic operations
3. To understand the different types of control and the concept of pipelining
4. To study the hierarchical memory system including cache memory and virtual memory
5. To understand the different ways of communication with I/O devices and standard I/O interfaces

UNIT I	INTRODUCTION	9	+	0

Computer Types - Functional units - Basic Operational Concepts - Bus Structure - Numbers, Arithmetic Operations and Characters - Memory Locations and Addresses - Memory Operations - Instruction and Instruction Sequencing - Addressing modes.

UNIT II	ARITHMETIC UNIT	9	+	0

Addition and Subtraction of Signed Numbers - Design of Fast Adders - Multiplication of Positive Numbers,Booth Algorithm - Fast Multiplication - Integer Division - Floating point number operations.

UNIT III	PROCESSOR UNIT AND PIPELINING	9	+	0

Fundamental Concepts - Execution of Instruction - Multi Bus Organization - Hardwired control - Micro programmed control - Basic Concepts of pipelining - Data Hazards - Instruction Hazards - Data path & Control Considerations - Superscalar Operation.

UNIT IV	MEMORY SYSTEMS	9	+	0

Basic Concepts - Semiconductor RAM - ROM - Cache memory - Improving Cache Performance - Virtualmemory - Memory Management requirements - Secondary Storage Device.

UNIT V	INPUT AND OUTPUT ORGANIZATION	9	+	0

Accessing I/O devices - Programmed I/O- Interrupts - Direct Memory Access - Interface circuits - StandardI/O Interfaces (PCI, SCSI, USB).

Total (L+T)= 45 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	:	Explain the working principle and implementation of computer hardware components and its variousfunctional units
CO2	:	Apply the operations of arithmetic unit to perform specific task
CO3	:	Analyze the different types of control and the concept of pipelining
CO4	:	Illustrate various memory components including Cache memory and Virtual memory
CO5	:	Explain the different ways of communication with I/O devices and standard I/O interfaces

Text Books:

1.	Carl Hamacher V.,Zvonko G.Vranesic, Safwat G. Zaky, " Computer organization ", Tata McGraw Hill,5th Edition, 2008.

Reference Books:

1.	Patterson and Hennessey, “Computer Organization and Design ". The Hardware/Software interface,Harcourt Asia Morgan Kaufmann, 3rd Edition, 2007
2.	Hayes, “Computer Architecture and Organization ", 3rd edition,Tata McGraw Hill, 2006
3.	Heuring V.P., Jordan H.F., " Computer System Design and Architecture ", 6th edition ,Addison Wesley,2008

18CSOE07	DATA STRUCTURES USING C++	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To comprehend the fundamentals of object oriented programming, particularly in C++
2.	To use object oriented programming to implement data structures
3.	To introduce linear, non-linear data structures and their applications

UNIT I	DATA ABSTRACTION & OVERLOADING	9	+	0

Overview of C++ — Structures — Class Scope and Accessing Class Members — Reference Variables — Initialization – Constructors – Destructors – Member Functions and Classes – Friend Function – Dynamic Memory Allocation – Static Class Members – Container Classes and Integrators – Overloading: Function overloading and Operator Overloading.

UNIT II	INHERITANCE AND POLYMORPHISM	9	+	0

Base Classes and Derived Classes – Protected Members – Casting Class pointers and Member Functions –Overriding – Public, Protected and Private Inheritance – Constructors and Destructors in derived Classes – Implicit Derived – Class Object to Base – Class Object Conversion – Virtual functions – this Pointer – Abstract Base Classes and Concrete Classes – Virtual Destructors – Dynamic Binding

UNIT III	LINEAR DATA STRUCTURES	9	+	0

Abstract Data Types (ADTs) – List ADT – array-based implementation – linked list implementation — singly linked lists –Polynomial Manipulation – Stack ADT – Queue ADT – Evaluating arithmetic expressions.

UNIT IV	NON-LINEAR DATA STRUCTURES	9	+	0

Trees – Binary Trees – Binary tree representation and traversals – Application of trees – Binary Search Tree - Heaps - Operations of Heaps - Binary Heap - Max Heap - Min Heap - Graph and its representations – GraphTraversals – Representation of Graphs – Breadth-first search – Depth-first search.

UNIT V	SORTING AND SEARCHING	9	+	0

Sorting algorithms: Insertion sort – Quick sort – Merge sort – Searching: Linear search –Binary Search

Total (L+T)= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Explain the concepts of Object oriented programming

CO2	:	Write simple applications using C++.
CO3	:	Discuss the different methods of organizing large amount of data.

Text Books:

1.	Deitel and Deitel, "C++, How To Program", Fifth Edition, Pearson Education, 2005 (Unit I & II)
2.	Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", Third Edition, Addison Wesley, 2007-(Unit — III,IV &V)

Reference Books:

1.	Bhushan Trivedi, "Programming with ANSI C++, A Step-By-Step approach", Oxford University Press,2010.
2.	Goodrich, Michael T., Roberto Tamassia, David Mount, "Data Structures and Algorithms in C++", 7thEdition, Wiley. 2004.
3.	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", Second Edition, Mc Graw Hill, 2002.
4.	Bjarne Stroustrup, "The C++ Programming Language", 3rd Edition, Pearson Education, 2007.
5.	Ellis Horowitz, Sartaj Sahni and Dinesh Mehta, "Fundamentals of Data Structures in C++", Galgotia Publications, 2007.

18CSOE08	NEURAL NETWORKS	L	T	P	C
		3	0	0	3

Course Objectives:

1. To gain exposure in the field of neural networks and relate the human neural system into the digitalworld
2. To provide knowledge of computation and dynamical systems using neural networks

UNIT I	INTRODUCTION	9	+	0

Architecture- Single-Neuron Perceptron- Multi-Neuron Perceptron- Perceptron

UNIT II	PERCEPTRON	9	+	0

Perceptron Learning Rule- Constructing Learning Rules- Training Multiple-Neuron Perceptrons.

UNIT III	ASSOCIATIVE NETWORKS	9	+	0

Simple Associative Networks- Unsupervised Hebb Rule- Hebb Rule with Decay-Instar Rule-Outstar Rule-Kohonen Rule.

UNIT IV	ADALINE NETWORK & BACK PROPAGATION	9	+	0

Adaline Network- Madaline Network -Mean Square Error- LMS Algorithm- Back Propagationa Neural networks – Hopfield Networks

UNIT V	ADAPTIVE FILTERING	9	+	0

Adaptive Filtering- Adaptive Noise Cancellation- Forecasting – Neural control applications – Characterrecognition.

Total (L+T)= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Acquire skill set to innovate and build a smart and intelligent engineering application using ANN

Text Books:	
1.	Hagan Demuth Beale, 'Neural network design', PWS publishing company, 1995
2.	Freeman, J.A and Skapura, D.M., 'Neural networks-Algorithms, applications and programming techniques' Addison Wesley, 1991
3.	Satish Kumar, Neural Networks – A classroom approach', Tata McGraw-Hill Publishing Company Limited,2004
Reference Books:	
1.	Patterson and Hennessey, "Computer Organization and Design ". The Hardware/Software interface,Harcourt Asia Morgan Kaufmann, 3rd Edition, 2007
2.	Hayes, "Computer Architecture and Organization ", 3rd edition,Tata McGraw Hill, 2006
3.	Heuring V.P., Jordan H.F., " Computer System Design and Architecture ", 6th edition ,Addison Wesley,2008

18CSOE09	SOFT COMPUTING	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To learn the basic concepts of Soft Computing
2.	To become familiar with various techniques like neural networks, genetic algorithms and fuzzy systems.
3.	To apply soft computing techniques to solve problems.

UNIT I	INTRODUCTION TO SOFT COMPUTING	9	+	0

Introduction-Artificial Intelligence-Artificial Neural Networks-Fuzzy Systems-Genetic Algorithm and Evolutionary Programming-Swarm Intelligent Systems-Classification of ANNs-McCulloch and Pitts Neuron Model-Learning Rules: Hebbian and Delta- Perceptron Network-Adaline Network-Madaline Network.

UNIT II	ARTIFICIAL NEURAL NETWORKS	9	+	0

Back propagation Neural Networks — Kohonen Neural Network -Learning Vector Quantization -Hamming Neural Network — Hopfield Neural Network- Bi-directional Associative Memory -Adaptive Resonance Theory Neural Networks- Support Vector Machines – Spike Neuron Models.

UNIT III	FUZZY SYSTEMS	9	+	0

Introduction to Fuzzy Logic, Classical Sets and Fuzzy Sets — Classical Relations and Fuzzy Relations - Membership Functions -Defuzzification — Fuzzy Arithmetic and Fuzzy Measures-Fuzzy Rule Base and Approximate Reasoning – Introduction to Fuzzy Decision Making.

UNIT IV	GENETIC ALGORITHMS	9	+	0

Basic Concepts- Working Principles -Encoding- Fitness Function – Reproduction - Inheritance Operators – Cross Over – Inversion and Deletion -Mutation Operator – Bit- wise Operators -Convergence of Genetic Algorithm.

UNIT V	HYBRID SYSTEMS	9	+	0

Hybrid Systems -Neural Networks, Fuzzy Logic and Genetic -GA Based Weight Determination – LR-Type Fuzzy Numbers – Fuzzy Neuron – Fuzzy BP Architecture – Learning in Fuzzy BP- Inference by Fuzzy BP – Fuzzy ArtMap: A Brief Introduction – Soft Computing Tools – GA in Fuzzy Logic Controller Design – Fuzzy Logic Controller

Total (L+T)= 45 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	:	Apply suitable soft computing techniques for various applications and integrate various soft computing techniques for complex problems.

Text Books:

1.	N.P.Padhy, S.P.Simon, "Soft Computing with MATLAB Programming", Oxford University Press, 2015.
2.	S.N.Sivanandam , S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt. Ltd., 2nd Edition, 2011.
3.	S.Rajasekaran, G.A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesisand Applications ", PHI Learning Pvt. Ltd., 2017.

Reference Books:

1.	Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, ―Neuro-Fuzzy and Soft Computing, Prentice-Hallof India, 2002
2.	KwangH.Lee,―FirstcourseonFuzzyTheoryandApplications,Springer,2005.
3.	GeorgeJ.KlirandBoYuan,―FuzzySetsandFuzzyLogic-TheoryandApplications, Prentice Hall,1996.
4.	JamesA.FreemanandDavidM.Skapura,―NeuralNetworksAlgorithms, Applications, and Programming Techniques, Addison Wesley,2003.

18CSOE10	ARTIFICIAL INTELLIGENCE ANDMACHINE LEARNING	L	T	P	C
		3	0	0	3

Course Objectives:

1. To learn the various characteristics of Intelligent agents, different search strategies and representknowledge in solving AI problems
2. To understand the need for machine learning for various problem solving
3. To study the various supervised, semi-supervised and unsupervised learning algorithms in machinelearning

UNIT I	INTRODUCTION	9	+	0

Introduction–Definition – Future of Artificial Intelligence – Characteristics of Intelligent Agents–TypicalIntelligent Agents – Problem Solving Approach to Typical AI problems.

UNIT II	PROBLEM SOLVING METHODS	9	+	0

Problem solving Methods – Search Strategies- Uninformed – Informed – Heuristics – Local Search Algorithms and Optimization Problems – Searching with Partial Observations – Constraint Satisfaction Problems – Constraint Propagation – Backtracking Search – Game Playing – Optimal Decisions in Games – Alpha – BetaPruning.

UNIT III	KNOWLEDGE REPRESENTATION	9	+	0

First Order Predicate Logic – Forward Chaining-Backward Chaining – Resolution – Knowledge Representation – Ontological Engineering-Categories and Objects – Events – Mental Events and Mental Objects – ReasoningSystems for Categories – Reasoning with Default Information.

UNIT IV	LEARNING PROBLEMS	9	+	0

Perspectives and Issues – Concept Learning – Version Spaces and Candidate Eliminations – Inductive bias –Decision Tree learning – Representation – Algorithm – Heuristic Space Search

UNIT V	NEURAL NETWORKS AND GENETIC ALGORITHMS	9	+	0

Neural Network Representation – Problems – Perceptrons – Multilayer Networks and Back Propagation Algorithms – Advanced Topics – Genetic Algorithms – Hypothesis Space Search – Genetic Programming – Models of Evaluation and Learning.

Total (L+T)= 45 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	:	Use appropriate search algorithms for any AI problem
CO2	:	Represent a problem using first order and predicate logic
CO3	:	Differentiate between supervised, unsupervised, semi-supervised machine learning approaches
CO4	:	Discuss the decision tree algorithm and indentity and overcome the problem of overfitting

Text Books:	
1.	S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach‖, Prentice Hall, Third Edition, 2009
2.	I. Bratko, ―Prolog: Programming for Artificial Intelligence‖, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011
3.	Tom M. Mitchell, ―Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.

Reference Books:	
1.	M. Tim Jones, ―Artificial Intelligence: A Systems Approach(Computer Science)‖, Jones and Bartlett Publishers, Inc.; First Edition, 2008
2.	Nils J. Nilsson, ―The Quest for Artificial Intelligence, Cambridge University Press, 2009
3.	William F. Clocksin and Christopher S. Mellish,Programming in Prolog: Using the ISO Standard‖, Fifth Edition, Springer, 2003
4.	Shai Shalev-Shwartz, Shai Ben-David, Understanding Machine Learning From Theory toAlgorithms, Cambridge University Press, 2014
5.	Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997

E-References:	
1.	https://builtin.com/artificial-intelligence
2.	https://science.howstuffworks.com/robot6.htm
3.	https://onlinecourses.nptel.ac.in/noc18_cs40/preview, (Prof. Sudeshna Sarkar,IIT KHARAGPUR)

PROTOSEM COURSES SYLLABUS

18MEPS11	APPLIED DESIGN THINKING		Semester			VI
PREREQUISITES		Category	PE	Credit		3
		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives

1	The course enables product innovators and early-stage startup founders to learn the customer development process
2	To familiarize with the tools & techniques & validate the inherent risks by linking their progress to customer-motivation, customer-commitment & customer-acceptance.
3	To learn the system thinking concepts by reverse engineering technique.

Unit I	**DESIGN THINKING PRINCIPLES**	**9**	**0**	**0**	**9**

Exploring Human – Centered Design – Understanding the innovation process, discovering areas of opportunity, interviewing &empathy –building techniques, Mitigate validate risk with FIR(Forge Innovation Rubric) – Case Studies.

Unit II	**CUSTOMER-CENTRIC INNOVATION**	**9**	**0**	**0**	**9**

Importance of customer-centric innovation – Problem Validation and Customer Discovery – Understanding problem significance and problem incidence- Customer Validation. Target user, User persona & user stories. Activity : Customer development process – Customer interviews and field visit.

Unit III	**APPLIED DESIGN THINKING TOOLS**	**9**	**0**	**0**	**9**

Concept of Minimum Usable Prototype(MUP) – MUP challenge brief – Designing & Crafting the value proposition – Designing and Testing Value Proposition: Design a compelling value proposition: Process, tools and techniques of Value Proposition Design.

Unit IV	**CONCEPT GENERATION**	**9**	**0**	**0**	**9**

Solution Exploration, Concepts Generation and MUP design – Conceptualize the solution concept: explore, iterate and learn; build the right prototype: Assess capability, usability and feasibility. Systematic concept generation; evaluation technology alternatives and the solution concepts.

Unit V	**SYSTEM THINKING & REVERSE ENGINEERING**	**9**	**0**	**0**	**9**

System Thinking, Understanding Systems, Examples and Understandings, Complex Systems, Reverse Engineering Methodology, Identify building blocks/Components – Re-Engineering a complex system.

Total = 45 Periods

Text Books:

1	Steve Blank, (2013), The four steps to epiphany: Successful strategies for products that win, Wiley.
2	Alexander Osterwalder, Yves Pigneur, Gregory Bernarda, Alan Smith, Trish Papadakos, (2014), Value
3	Proposition Design: How to Create Products and Services Customers Want, Wiley
4	Donella H. Meadows, (2015), “Thinking in Systems -A Primer”, Sustainability Institute.
5	Tim Brown,(2012) “Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation”, Harper Business.

Reference Books:	
1	https://www.ideou.com/pages/design-thinking#process
2	https://blog.forgeforward.in/valuation-risk-versus-validation-risk-in-product-innovations-49f253c a8624
3	https://blog.forgeforward.in/product-innovation-rubric-adf5ebdfd356
4	https://blog.forgeforward.in/evaluating-product-innovations-e8178e58b86e
5	https://blog.forgeforward.in/user-guide-for-product-innovation-rubric-857181b253dd 6
6	https://blog.forgeforward.in/startup-failure-is-like-true-lie-7812cdfe9b85

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Define & treat various hypotheses to mitigate the inherent risks in product innovations	L1: Remembering
CO2	Design the solution concept based on the proposed value by exploring various alternate solutions to achieve value-price fit.	L6: Creating
CO3	Develop skills in empathizing, critical thinking, analyzing, storytelling & pitching.	L3: Applying
CO4	Apply system thinking to reverse engineer a product/prototype and understand its internal correlations.	L3: Applying

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	3	2	1	1	1	1	1	1	1	2	2	3
CO2	2	2	3	2	2	1	1	1	1	1	1	1	3	3	2
CO3	1	2	2	1	1	3	1	1	3	3	1	1	1	1	1
CO4	2	3	3	3	3	2	2	1	2	2	1	1	3	3	3
AVG	**1.75**	**2.5**	**2.5**	**2.25**	**2**	**1.75**	**1.25**	**1**	**1.75**	**1.75**	**1**	**1**	**2.25**	**2.25**	**2.25**

0: No correlation, 1: Low correlation, 2: Medium correlation, 3: High correlation

18MEPS12	STARTUP FUNDAMENTALS		Semester			VI
PREREQUISITES		Category		Credit		3
		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives

1	Learn the science of to transforming an innovative idea into high-growth enterprises.
2	To understand the basic concepts of IPR, and develop a patent draft for a potential IP

Unit I	**ENTREPRENEURIAL MINDSET & METHOD**	**9**	**0**	**0**	**9**

Introduction to Innovation-led, tech-powered entrepreneurship - Understand from research the attributes of an expert entrepreneur - Effectuation principles - Dealing with the unknowns - Case studies of startup failures.

Unit II	**IDEA TO ENTERPRISE**	**9**	**0**	**0**	**9**

Design and Planning of Product Concept - Business Model - Business Planning - Building Proof of Product and Value Testing - Target Market and Revenue Planning

Unit III	**MINIMUM VIABLE BUSINESS**	**9**	**0**	**0**	**9**

Framework for Minimum Viable Business - Disruptive Innovation - Theory of Disruption - Competitive advantage - Building proof of viable business model - Demystifying Scalability - Funding Opportunities

Unit IV	**INTELLECTUAL PROPERTY**	**9**	**0**	**0**	**9**

Introduction and the need for Intellectual Property Rights - IPR Genesis and Development - Copyright - Trademark - Trade Secret - Geographical Indicators - Industrial Designs - Types of Patent – Sample Patent Application - IPR in INDIA; Global trends - Patent fees

Unit V	**PRIOR ART SEARCH AND PATENT DRAFTING**	**9**	**0**	**0**	**9**

Prior Art Search - IP Licensing – IP Commercialization - IP Infringement- Case Study on Apple vs Samsung, Case study on basmati rice. The invention as a concept - Keywords formation - Structure of patent - Key attributes in patent drafting - Drafting provisional specifications - Drafting complete specifications - Draft claims - Case studies on patent drafting

Total = 45 Periods

Text Books:

1	Steven Blank and Bob Dorf, (2012), The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company, K&S Ranch
2	Dr Saras Sarasvathy, (2008), Effectuation: Elements of Entrepreneurial Expertise, New Horizons in Entrepreneurship series.
3	Elizabeth Verkey, (2005), Law of Patents, Eastern Book Company
4	Prabuddha Ganguli, (2017), Intellectual Property Rights: Unleashing the Knowledge Economy, McGraw Hill Education; 1st edition

Reference Books:	
1	WIPO Intellectual Property Handbook https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf
2	https://assets.entrepreneur.com/static/20220301113822-Marketing.pdf
3	https://www.deluxe.com/blog/startup-fundamentals-guide/
4	https://www.forbes.com/sites/allbusiness/2018/07/15/35-step-guide-entrepreneurs-starting-a-business/?sh=69a6031e184b

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Develop an entrepreneurial mindset to identify, assess, shape & act on opportunities.	L3: Applying
CO2	Demonstrate the potential of an innovative idea to create economic value, as a startup	L2: Understanding
CO3	Understand the scientific process to explore a viable business model	L2: Understanding
CO4	Demonstrate knowledge on the fundamental concepts of Intellectual Property	L2: Understanding

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2	1	1	2	1	2	2	2	3	3	1	1	2
CO2	2	2	3	1	1	1	1	2	2	1	3	2	2	2	2
CO3	1	2	2	2	1	1	1	1	1	1	3	2	1	1	1
CO4	1	1	1	1	1	1	1	3	1	1	1	1	1	1	1
AVG	**1.25**	**1.75**	**2**	**1.25**	**1**	**1.25**	**1**	**2**	**1.5**	**1.25**	**2.5**	**2**	**1.25**	**1.25**	**1.5**

0: No correlation, 1: Low correlation, 2: Medium correlation, 3: High correlation

18MEPS13	COMPUTATIONAL HARDWARE	Semester	VI
PREREQUISITES	Category	PE	Credit 3

	L	T	P	TH
Hours/Week	3	0	0	3

Course Learning Objectives

1	To learn basic concepts of Embedded Systems by familiarizing the functionalities of embedded platforms with development boards.
2	To understand the core concepts of GPIO Pins, Functionality of peripherals, Selection of I/O devices , Usage of Internal functions, and Communication protocols.
3	To familiarize the current technologies and protocols used in the Internet of Things (IoT) and to learn the Cloud services.

Unit I	**BASICS OF EMBEDDED SYSTEM**	**9**	**0**	**0**	**9**

Embedded Platform: Architecture and working - Factors for Microcontroller/Microprocessor selection. Arduino - Boards and schematics – Tool chain - Setup and Configuration - Input/Output Configurations and Access - Libraries - Digital I/O - ADC - Analog I/O - Timers, Interrupts - Pulse Width Modulation - Display: 7-segment , LCD , OLED.

Unit II	**BASICS OF RASPBERRY PI**	**9**	**0**	**0**	**9**

Raspberry Pi: Raspberry pi Board - Processor - Setup and Configuration - Installing Python IDLE using Command Terminal - General Purpose I/O Pins - Protocol Pins - GPIO Access - Pulse Width Modulation - Network Libraries - Web services - Twitter APIs - Twitter Bot - Interfacing pi with camera modules.

Unit III	**SENSORS AND ACTUATORS**	**9**	**0**	**0**	**9**

Interfacing of Sensors and Actuators - Sensors: Introduction, Characteristics: Analog - Potentiometer, Temperature Sensor, Soil Moisture Sensor, LDR - Digital - PIR Sensor, Smoke Sensor, Infrared - Sensor, Ultra- Sonic Sensor. Actuators - Introduction, Characteristics and working with relay, DC motors, Servo motor, Stepper motor and its drivers.

Unit IV	**COMMUNICATION PROTOCOLS**	**9**	**0**	**0**	**9**

Protocols - Wired: RS232 Standard - UART, SPI, I2C - Comparative study of wired protocols - Implementation of wired Serial Communication protocols Wireless: Standards - Bluetooth, RF - Comparative study of wireless protocols - Implementation of wireless Serial Communication protocols.

Unit V	**INTERNET OF THINGS**	**9**	**0**	**0**	**9**

Definition and Architecture of IoT, Building blocks of IoT, Programming with IoT protocols - MQTT, CoAP - Connecting embedded target board to Web, Basics networking in IoT: creating a web page - Creating a server on target board - Controlling I/O peripherals from the webpage, Embedded Application Development, Creating communication between different nodes - Cloud platforms for IoT, Cloud data logging and monitoring, Interfacing with web services.

Total = 45 Periods

Text Books:

1	Raj Kamal, " Embedded Systems - SoC, IoT, AI and Real-Time Systems", 4th Edition, McGraw Hill, 2020.
2	Mohit Arora, "Embedded System Design", 1st Edition, Learning Bytes Publishing, 2016.
3	Elecia White, "Making Embedded Systems", 1st Edition, Shroff/ O' Reilly, 2012.
4	Jack Ganssle, " The Firmware Handbook", 1st Edition, Newnes, 2004.

Reference Books:	
1	https://juniorfall.files.wordpress.com/2011/11/arduino-cookbook.pdf
2	https://drive.google.com/file/d/13s0m3lHPEFP2f2aCuVNRWeBZNKXWKTW5/view?ts=6231cab 3
3	https://ptolemy.berkeley.edu/books/leeseshia/releases/LeeSeshia_DigitalV2_2.pdf 4.
4	https://www.riverpublishers.com/pdf/ebook/RP9788793519046.pdf

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Understand and implement the functions & Capabilities of embedded platforms for easy prototyping.	L2: Understanding
CO2	Identify the type of sensors and actuators for required applications.	L3: Applying
CO3	Develop communication between devices using different protocols.	L3: Applying
CO4	Develop IoT based systems with wireless network connections and accessing devices over cloud.	L3: Applying

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	0	0	0	0	0	0	0	3	2	2
CO2	3	3	2	2	2	0	0	0	0	0	0	0	3	2	2
CO3	3	2	3	2	3	0	0	0	0	0	0	0	3	3	3
CO4	3	2	3	2	3	0	0	0	0	0	0	0	3	3	3
AVG	**3**	**2.25**	**2.75**	**2**	**2.75**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**2.5**	**2.5**

0: No correlation, 1: Low correlation, 2: Medium correlation, 3: High correlation

18MEPS14	CODING FOR INNOVATORS		Semester			VI
PREREQUISITES		Category		Credit		3
		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives

1	To learn and express creativity using coding skills.
2	To gain knowledge of Python programming with hands-on experience.
3	To demonstrate a problem solving using OOPs concepts.
4	To learn basics of Linux by familiarizing the concepts of management and file structure.
5	To practise full stack development using cloud platform.

Unit I	PROGRAMMING PARADIGMS	9	0	0	9

Need for programming - Outside box thinking to solve problems - Need for algorithms and data structures - Flowcharts & Algorithms - Memory Allocation - Conditions and loops - Creating effective functions - Case studies - Visual Programming - Types of programming languages & paradigms - Getting started with development - Build & test an algorithm - best practices

Unit II	BASIC OF PROGRAMMING	9	0	0	9

Introduction to Python: statements, variables, functions, operators, modules, conditional statements, loop statements, Lists: list operations, traversing a list, slicing a list - Text Handling: Strings, string functions, conversion functions, Dictionaries - File Operations: File open, close, read, copy, word frequency, creating word histograms from text file.

Unit III	OOPS 5	9	0	0	9

OOPS- Why OOPS- verticals- implementation in python - Classes and Objects, Methods, Constructors and Destructors, Inheritance, Polymorphism, Abstraction, Encapsulation.

Unit IV	SOFTWARE DEVELOPMENT TO DELIVERY	9	0	0	9

Software Engineering - Life Cycle (Tools), Agile Methodologies - Framework - Why Frameworks - Software Testing(Tool Based) - Data Structures - Database Management System - A case study to experiment from Development to Deployment(D2D) - Source code management and version control - GitHub - GitHub Actions - GitBash - Continuous Integration - Platform as service - Heroku - Build Packs AWS- Anaconda

Unit V	OPERATING SYSTEMS	9	0	0	9

Introduction to Linux - Process Management - Process Scheduling - Memory Management - Storage Management - System calls - File System Structure - Multithreading - Multicore Programming - Deadlock Handling - Disk Structure - Disk Management - Dockers - Kubernetes

Total = 45 Periods

Text Books:

1	Zed A. Shaw, “Learn Python 3 the Hard Way”, 3rd edition, Addison-Wesley Professional, 2013.
2	Silberschatz Abraham, “Operating System Concepts”, 9th edition, John Wiley & Sons Inc (Sea) Pte Ltd, 2016.
3	Paul Barry, "Head-First Python", 2nd edition, O'Reilly Media, Inc, 2016.
4	Anton Spraul, “Think Like a Programmer”, 1st edition, No Starch Press, 2012.

E-References :	
1	https://www.geeksforgeeks.org/python-programming-language/
2	https://www.guru99.com/python-tutorials.html
3	https://www.tutorialspoint.com/python/python_tutorial.pdf

Course Outcomes: Upon completion of this course, the students will be able to:		Bloom's Taxonomy Level
CO1	Understand the aspects of programming protocols	L2: Understanding
CO2	Develop optimized code for real-world problems	L3: Applying
CO3	Build full-stack development to deployment	L3: Applying
CO4	Demonstrate problem solving and continuous development	L2: Understanding

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	1	3	0	0	0	0	0	0	0	2	1	1
CO2	3	3	3	2	3	0	0	0	0	0	0	0	3	2	2
CO3	3	2	3	1	3	0	0	0	0	0	0	0	3	2	2
CO4	2	3	2	1	2	0	0	0	0	0	0	3	2	1	1
AVG	**2.5**	**2.5**	**2.5**	**1.25**	**2.75**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**2.5**	**1.5**	**1.5**

0: No correlation, 1: Low correlation, 2: Medium correlation, 3: High correlation

18MEPS15	INDUSTRIAL DESIGN AND RAPID PROTOTYPING TECHNIQUES		Semester			VI
PREREQUISITES		Category	OE	Credit		3
		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives

1	Learn to design a UI/UX design and develop an android application.
2	Provide working CAD model for prototype development.
3	Knowledge in hardware, 3D Printers and Laser cutters.
4	Acquire basic knowledge in designing electrical circuits and fabrication of electronic devices.

Unit I	UI / UX	9	0	0	9

Fundamental concepts in UI & UX - Tools - Fundamentals of design principles - Psychology and Human Factors for User Interface Design - Layout and composition for Web, Mobile and Devices - Typography - Information architecture - Colour theory - Design process flow, wireframes, best practices in the industry -User engagement ethics - Design alternatives

Unit II	APP DEVELOPMENT	9	0	0	9

SDLC - Introduction to App Development - Types of Apps - web Development - understanding Stack - Frontend - backend - Working with Databases - Introduction to API - Introduction to Cloud services - Cloud environment Setup- Reading and writing data to cloud - Embedding ML models to Apps - Deploying application.

Unit III	INDUSTRIAL DESIGN	9	0	0	9

Introduction to Industrial Design - Points, lines, and planes - Sketching and concept generation - Sketch to CAD - Introduction to CAD tools - Types of 3D modeling - Basic 3D Modeling Tools - Part creation - Assembly - Product design and rendering basics - Dimensioning & Tolerancing

Unit IV	MECHANICAL RAPID PROTOTYPING	9	0	0	9

Need for prototyping - Domains in prototyping - Difference between actual manufacturing and prototyping - Rapid prototyping methods - Tools used in different domains - **Mechanical Prototyping:** 3DPrinting and classification - Laser Cutting and engraving - RD Works - Additive manufacturing

Unit V	ELECTRICAL RAPID PROTOTYPING	9	0	0	9

Electronic Prototyping: Basics of electronic circuit design - lumped circuits - Electronic Prototyping - Working with simulation tool - simple PCB design with EDA

Total = 45 Periods

Text Books:

1	Peter Fiell, Charlotte Fiell, Industrial Design A-Z, TASCHEN America Llc(2003)
2	Samar Malik, Autodesk Fusion 360 - The Master Guide.
3	Steve Krug, Don't Make Me Think, Revisited: A Common Sense Approach to Web Usability, Pearson,3rd edition (2014)

E - References:	
1	https://www.adobe.com/products/xd/learn/get-started.html
2	https://developer.android.com/guide
3	https://help.autodesk.com/view/fusion360/ENU/courses/
4	https://help.prusa3d.com/en/category/prusaslicer_204

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Create quick UI/UX prototypes for customer needs	L6: Creating
CO2	Develop web application to test product traction / product feature	L3: Applying
CO3	Develop 3D models for prototyping various product ideas	L3: Applying
CO4	Built prototypes using Tools and Techniques in a quick iterative methodology	L3: Applying

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	2	3	0	0	0	1	1	0	0	2	1	1
CO2	3	3	3	2	3	0	0	0	1	1	0	0	3	2	2
CO3	3	2	3	2	3	0	0	0	1	1	0	0	3	2	2
CO4	3	2	3	2	3	0	0	0	1	1	0	0	3	2	2
AVG	**2.75**	**2.25**	**3**	**2**	**3**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**2.75**	**1.75**	**1.75**

0: No correlation, 1: Low correlation, 2: Medium correlation, 3: High correlation

18MEPS16	INDUSTRIAL AUTOMATION DATA LIFE CYCLE MANAGEMENT	Semester			VI
PREREQUISITES	**Category**	**OE**	**Credit**		**3**
	Hours/Week	**L**	**T**	**P**	**TH**
		3	**0**	**0**	**3**

Course Learning Objectives

1	Acquire conceptual knowledge in Industrial Controllers by scaling of on-board devices and embedded board interfacing with various I/O peripherals.
2	Learn PLC by working on internal features and also interfacing with Sensors and actuators along HMI concept using SCADA and standard communication protocols.
3	To work with FPGA boards and RT controllers for reprogrammable embedded applications using LabVIEW
4	Understand the concepts and design electronics circuits

Unit I	**INDUSTRIAL CONTROLLERS - I**	**9**	**0**	**0**	**9**

Industrial Controllers - Introduction to RIO Controllers - Platform - Connection and Configuring controllers - Accessing onboard devices - Module SOM - Interfacing with Input and Output devices - Interfacing protocol based Analog and Digital sensors - Acquiring and Data Logging from sensors - Interfacing Actuators: Relay, DC Motor, Servo Motor - Creating standalone applications.

Unit II	**INDUSTRIAL CONTROLLERS - II**	**9**	**0**	**0**	**9**

Industrial Controllers - II - PLC - Introduction - Mode of Operation - IEC 61131 Programming languages for PLC - Programming & sequence control - Instruction set - Scan Time - Timers - Counters - Interfacing with Input/Output devices - Interfacing with Sensors - Interfacing with Actuators - Interfacing with Human Machine Interface - Commissioning and operational safety of PLC – SCADA.

Unit III	**INDUSTRIAL COMMUNICATION PROTOCOLS**	**9**	**0**	**0**	**9**

Serial Communication Protocols - I2C, SPI - Serial Field bus protocols CAN, PROFIBUS - Ethernet, HTTP, TCP/UDI, WiF, Cloud data logging. Multi-sensor communication, Data parsing between Embedded platforms. Comparative study of Industrial communication protocols - Implementation of Industrial Communication protocols.

Unit IV	**FPGA AND RT CONTROLLER PROGRAMMING**	**9**	**0**	**0**	**9**

Introduction to FPGA - Architecture - Operations in FPGA programming - FPGA Programming in LabVIEW and implementation in myRIO - Introduction to RT controllers - Architecture - Programming RT Controllers - Creating standalone applications.

Unit V	**INDUSTRIAL CIRCUIT BOARD DESIGN**	**9**	**0**	**0**	**9**

Designing basics circuits and to simulate in environment setup - Component selection - Creating libraries - Schematic design - Design rules, supply & communication track rules - Component and footprint editor - Understanding component package types - Test point creation for measurement - PCB Layout, placement rules - Footprint, 3D models, BoMs - Generating GERBER and output documentation.

Total = 45 Periods

Text Books:	
1	Ed Doering, NI myRIO Project Essential Guide, National Instruments, 2016.
2	Willian Bolton, Programmable Logic Controllers, 6th edition, Newnes Publications, 2015
3	Richard Zurawski, Industrial Communication Technology Handbook, Second edition, CRC Press, 2014
4	Simon Monk, Make Your Own PCBs with EAGLE, McGraw Hill Education, 2014.
References Books:	
1	Jeffrey Travis, Jim Kring, LabVIEW for Everyone: Graphical Programming Made Easy and Fun, 3rd edition, Prentice Hall
2	Mikell P. Groover, Automation, Production Systems, and Computer-integrated Manufacturing, Fourth edition, Pearson Education, 2016
3	Michael J. Hamill, Industrial Communications and Control Protocols, PDH centre, 2016
4	Ema Design Automation, The Hitchhiker's Guide to PCB Design, First edition, Blurb Publishers, December 2021

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Understand the usage of controllers in an industrial environment	L2: Understanding
CO2	Build Real-Time systems for Industrial embedded monitoring and controlling deterministic applications	L3: Applying
CO3	Communicate between devices at different levels using industrial protocols	L3: Applying
CO4	Understand the process involved in PCB design using EDA tools and fabricate it	L2: Understanding

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	3	0	0	0	0	0	0	0	3	2	2
CO2	3	3	3	2	3	0	0	0	0	0	0	0	3	3	3
CO3	3	2	3	2	3	0	0	0	0	0	0	0	3	3	3
CO4	3	2	3	2	3	0	0	0	0	0	0	0	3	3	2
AVG	3	2.25	2.75	1.75	3	0	0	0	0	0	0	0	3	2.75	2.5

0: No correlation, 1: Low correlation, 2: Medium correlation, 3: High correlation

18MEPS17	ROBOTICS/ML&MLOps		Semester			VI
PREREQUISITES		Category	EE	Credit		3
		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives

1	Learn the fundamentals of ROS
2	Understand the requirements and choose the right sensors and actuators for the application development
3	Create Bot in the virtual environment and simulate it to know the functionalities of the system developed
4	Learn the basics of Robotics Vision System
5	Integrate ROS and Computer Vision to build systems for various use cases

Unit I	INTRODUCTION TO ROBOT KINEMATICS	9	0	0	9

Introduction to Robotics - Transformations - Forward Kinematics - Kinematics equations - Link transformations - Inverse Kinematics - Kinematic analysis - Numerical Inverse Kinematic Solutions - Analytical Inverse Kinematic Solutions

Unit II	SELECTION OF SENSORS AND ACTUATORS	9	0	0	9

Introduction - Sensors & Actuators - Types - Selection criteria - Design considerations: Motor sizing - Selection of motors based on torque and speed characteristics - Hardware Interface & Assembly

Unit III	INTRODUCTION TO ROBOT OPERATING SYSTEM	9	0	0	9

Introduction to ROS framework and prerequisites - Understanding communications in ROS - ROS Ecosystem - Introduction to ROS programming - ROS nodes, topics, messages - ROS services - ROS Tools and Utilities - URDF , Rviz - Simulation - Gazebo - ROS Motion

Unit IV	INTRODUCTION TO ROBOTICS VISION SYSTEM	9	0	0	9

Image basics - Image Processing - Histograms - Gray scale, Color, Equalization - Smoothing and blurring/filtering - Averaging, Gaussian, Median, Bilateral - Thresholding - Simple, Adaptive, Otsu - Gradients and Edge detection - Laplacian, Sobel, Canny - Contours - Camera calibration

Unit V	INTEGRATION OF ROS AND COMPUTER VISION	9	0	0	9

Introduction - Installation - CV Bridge - Image publisher node - Image subscriber node - Nodes building and launching - Building real world applications

Total = 45 Periods

Text Books:

1	Introduction to Robotics: Mechanics and Control by John J Craig, Pearson Publishers.
2	Robot Operating System (ROS) for Absolute Beginners by Lentin Joseph, A press; Publishers (2018).
3	Learning OpenCV by Gary Bradski, Adrian Kaehler, O'Reilly Media, Inc.

Reference Books:	
1	https://www.intechopen.com/chapters/379
2	https://www.plantengineering.com/articles/eight-selection-criteria-for-actuation-components/
3	https://www.controleng.com/articles/tips-on-sensor-selection/
4	https://www.toptal.com/robotics/introduction-to-robot-operating-system
5	https://www.thomasnet.com/articles/automation-electronics/machine-vision-systems/
6	https://automaticaddison.com/working-with-ros-and-opencv-in-ros-noetic/

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Understand kinematics considerations of robot	L2: Understanding
CO2	Selection of sensors and actuators according to application	L3: Applying
CO3	Utilize the ROS environment to simulate and communicate between robot	L3: Applying
CO4	Develop algorithms to extract features and data from image	L3: Applying
CO5	Utilize the open CV for robotic applications	L3: Applying

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	1	2	0	0	0	0	0	0	0	3	3	2
CO2	3	3	2	1	2	0	0	0	0	0	0	0	3	3	3
CO3	3	2	3	2	3	0	0	0	0	0	0	0	3	3	3
CO4	3	3	3	2	3	0	0	0	0	0	0	0	3	3	2
AVG	**3**	**2.5**	**2.75**	**1.5**	**2.5**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**3**	**2.5**

0: No correlation, 1: Low correlation, 2: Medium correlation, 3: High correlation

PROTOSEM COURSES SYLLABUS

18MEPS11	APPLIED DESIGN THINKING		Semester			VI
PREREQUISITES		Category	PE	Credit		3
		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives

1	The course enables product innovators and early-stage startup founders to learn the customer development process
2	To familiarize with the tools & techniques & validate the inherent risks by linking their progress to customer-motivation, customer-commitment & customer-acceptance.
3	To learn the system thinking concepts by reverse engineering technique.

Unit I	**DESIGN THINKING PRINCIPLES**	**9**	**0**	**0**	**9**

Exploring Human – Centered Design – Understanding the innovation process, discovering areas of opportunity, interviewing &empathy –building techniques, Mitigate validate risk with FIR(Forge Innovation Rubric) – Case Studies.

Unit II	**CUSTOMER-CENTRIC INNOVATION**	**9**	**0**	**0**	**9**

Importance of customer-centric innovation – Problem Validation and Customer Discovery – Understanding problem significance and problem incidence- Customer Validation. Target user, User persona & user stories. Activity : Customer development process – Customer interviews and field visit.

Unit III	**APPLIED DESIGN THINKING TOOLS**	**9**	**0**	**0**	**9**

Concept of Minimum Usable Prototype(MUP) – MUP challenge brief – Designing & Crafting the value proposition – Designing and Testing Value Proposition: Design a compelling value proposition: Process, tools and techniques of Value Proposition Design.

Unit IV	**CONCEPT GENERATION**	**9**	**0**	**0**	**9**

Solution Exploration, Concepts Generation and MUP design – Conceptualize the solution concept: explore, iterate and learn; build the right prototype: Assess capability, usability and feasibility. Systematic concept generation; evaluation technology alternatives and the solution concepts.

Unit V	**SYSTEM THINKING & REVERSE ENGINEERING**	**9**	**0**	**0**	**9**

System Thinking, Understanding Systems, Examples and Understandings, Complex Systems, Reverse Engineering Methodology, Identify building blocks/Components – Re-Engineering a complex system.

Total = 45 Periods

Text Books:

1	Steve Blank, (2013), The four steps to epiphany: Successful strategies for products that win, Wiley.
2	Alexander Osterwalder, Yves Pigneur, Gregory Bernarda, Alan Smith, Trish Papadakos, (2014), Value
3	Proposition Design: How to Create Products and Services Customers Want, Wiley
4	Donella H. Meadows, (2015), “Thinking in Systems -A Primer”, Sustainability Institute.
5	Tim Brown,(2012) “Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation”, Harper Business.

Reference Books:	
1	https://www.ideou.com/pages/design-thinking#process
2	https://blog.forgeforward.in/valuation-risk-versus-validation-risk-in-product-innovations-49f253c a8624
3	https://blog.forgeforward.in/product-innovation-rubric-adf5ebdfd356
4	https://blog.forgeforward.in/evaluating-product-innovations-e8178e58b86e
5	https://blog.forgeforward.in/user-guide-for-product-innovation-rubric-857181b253dd 6
6	https://blog.forgeforward.in/startup-failure-is-like-true-lie-7812cdfe9b85

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Define & treat various hypotheses to mitigate the inherent risks in product innovations	L1: Remembering
CO2	Design the solution concept based on the proposed value by exploring various alternate solutions to achieve value-price fit.	L6: Creating
CO3	Develop skills in empathizing, critical thinking, analyzing, storytelling & pitching.	L3: Applying
CO4	Apply system thinking to reverse engineer a product/prototype and understand its internal correlations.	L3: Applying

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	3	2	1	1	1	1	1	1	1	2	2	3
CO2	2	2	3	2	2	1	1	1	1	1	1	1	3	3	2
CO3	1	2	2	1	1	3	1	1	3	3	1	1	1	1	1
CO4	2	3	3	3	3	2	2	1	2	2	1	1	3	3	3
AVG	**1.75**	**2.5**	**2.5**	**2.25**	**2**	**1.75**	**1.25**	**1**	**1.75**	**1.75**	**1**	**1**	**2.25**	**2.25**	**2.25**

0: No correlation, 1: Low correlation, 2: Medium correlation, 3: High correlation

18MEPS12	STARTUP FUNDAMENTALS		Semester			VI
PREREQUISITES		Category		Credit		3
		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives

1	Learn the science of to transforming an innovative idea into high-growth enterprises.
2	To understand the basic concepts of IPR, and develop a patent draft for a potential IP

Unit I	**ENTREPRENEURIAL MINDSET & METHOD**	**9**	**0**	**0**	**9**

Introduction to Innovation-led, tech-powered entrepreneurship - Understand from research the attributes of an expert entrepreneur - Effectuation principles - Dealing with the unknowns - Case studies of startup failures.

Unit II	**IDEA TO ENTERPRISE**	**9**	**0**	**0**	**9**

Design and Planning of Product Concept - Business Model - Business Planning - Building Proof of Product and Value Testing - Target Market and Revenue Planning

Unit III	**MINIMUM VIABLE BUSINESS**	**9**	**0**	**0**	**9**

Framework for Minimum Viable Business - Disruptive Innovation - Theory of Disruption - Competitive advantage - Building proof of viable business model - Demystifying Scalability - Funding Opportunities

Unit IV	**INTELLECTUAL PROPERTY**	**9**	**0**	**0**	**9**

Introduction and the need for Intellectual Property Rights - IPR Genesis and Development - Copyright - Trademark - Trade Secret - Geographical Indicators - Industrial Designs - Types of Patent – Sample Patent Application - IPR in INDIA; Global trends - Patent fees

Unit V	**PRIOR ART SEARCH AND PATENT DRAFTING**	**9**	**0**	**0**	**9**

Prior Art Search - IP Licensing – IP Commercialization - IP Infringement- Case Study on Apple vs Samsung, Case study on basmati rice. The invention as a concept - Keywords formation - Structure of patent - Key attributes in patent drafting - Drafting provisional specifications - Drafting complete specifications - Draft claims - Case studies on patent drafting

Total = 45 Periods

Text Books:

1	Steven Blank and Bob Dorf, (2012), The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company, K&S Ranch
2	Dr Saras Sarasvathy, (2008), Effectuation: Elements of Entrepreneurial Expertise, New Horizons in Entrepreneurship series.
3	Elizabeth Verkey, (2005), Law of Patents, Eastern Book Company
4	Prabuddha Ganguli, (2017), Intellectual Property Rights: Unleashing the Knowledge Economy, McGraw Hill Education; 1st edition

Reference Books:	
1	WIPO Intellectual Property Handbook https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf
2	https://assets.entrepreneur.com/static/20220301113822-Marketing.pdf
3	https://www.deluxe.com/blog/startup-fundamentals-guide/
4	https://www.forbes.com/sites/allbusiness/2018/07/15/35-step-guide-entrepreneurs-starting-a-business/?sh=69a6031e184b

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Develop an entrepreneurial mindset to identify, assess, shape & act on opportunities.	L3: Applying
CO2	Demonstrate the potential of an innovative idea to create economic value, as a startup	L2: Understanding
CO3	Understand the scientific process to explore a viable business model	L2: Understanding
CO4	Demonstrate knowledge on the fundamental concepts of Intellectual Property	L2: Understanding

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2	1	1	2	1	2	2	2	3	3	1	1	2
CO2	2	2	3	1	1	1	1	2	2	1	3	2	2	2	2
CO3	1	2	2	2	1	1	1	1	1	1	3	2	1	1	1
CO4	1	1	1	1	1	1	1	3	1	1	1	1	1	1	1
AVG	**1.25**	**1.75**	**2**	**1.25**	**1**	**1.25**	**1**	**2**	**1.5**	**1.25**	**2.5**	**2**	**1.25**	**1.25**	**1.5**

0: No correlation, 1: Low correlation, 2: Medium correlation, 3: High correlation

18MEPS13	COMPUTATIONAL HARDWARE	Semester	VI
PREREQUISITES	Category	PE	Credit 3

	L	T	P	TH
Hours/Week	3	0	0	3

Course Learning Objectives

1	To learn basic concepts of Embedded Systems by familiarizing the functionalities of embedded platforms with development boards.
2	To understand the core concepts of GPIO Pins, Functionality of peripherals, Selection of I/O devices , Usage of Internal functions, and Communication protocols.
3	To familiarize the current technologies and protocols used in the Internet of Things (IoT) and to learn the Cloud services.

Unit I	**BASICS OF EMBEDDED SYSTEM**	**9**	**0**	**0**	**9**

Embedded Platform: Architecture and working - Factors for Microcontroller/Microprocessor selection. Arduino - Boards and schematics – Tool chain - Setup and Configuration - Input/Output Configurations and Access - Libraries - Digital I/O - ADC - Analog I/O - Timers, Interrupts - Pulse Width Modulation - Display: 7-segment , LCD , OLED.

Unit II	**BASICS OF RASPBERRY PI**	**9**	**0**	**0**	**9**

Raspberry Pi: Raspberry pi Board - Processor - Setup and Configuration - Installing Python IDLE using Command Terminal - General Purpose I/O Pins - Protocol Pins - GPIO Access - Pulse Width Modulation - Network Libraries - Web services - Twitter APIs - Twitter Bot - Interfacing pi with camera modules.

Unit III	**SENSORS AND ACTUATORS**	**9**	**0**	**0**	**9**

Interfacing of Sensors and Actuators - Sensors: Introduction, Characteristics: Analog - Potentiometer, Temperature Sensor, Soil Moisture Sensor, LDR - Digital - PIR Sensor, Smoke Sensor, Infrared - Sensor, Ultra- Sonic Sensor. Actuators - Introduction, Characteristics and working with relay, DC motors, Servo motor, Stepper motor and its drivers.

Unit IV	**COMMUNICATION PROTOCOLS**	**9**	**0**	**0**	**9**

Protocols - Wired: RS232 Standard - UART, SPI, I2C - Comparative study of wired protocols - Implementation of wired Serial Communication protocols Wireless: Standards - Bluetooth, RF - Comparative study of wireless protocols - Implementation of wireless Serial Communication protocols.

Unit V	**INTERNET OF THINGS**	**9**	**0**	**0**	**9**

Definition and Architecture of IoT, Building blocks of IoT, Programming with IoT protocols - MQTT, CoAP - Connecting embedded target board to Web, Basics networking in IoT: creating a web page - Creating a server on target board - Controlling I/O peripherals from the webpage, Embedded Application Development, Creating communication between different nodes - Cloud platforms for IoT, Cloud data logging and monitoring, Interfacing with web services.

Total = 45 Periods

Text Books:

1	Raj Kamal, " Embedded Systems - SoC, IoT, AI and Real-Time Systems", 4th Edition, McGraw Hill, 2020.
2	Mohit Arora, "Embedded System Design", 1st Edition, Learning Bytes Publishing, 2016.
3	Elecia White, "Making Embedded Systems", 1st Edition, Shroff/ O' Reilly, 2012.
4	Jack Ganssle, " The Firmware Handbook", 1st Edition, Newnes, 2004.

Reference Books:	
1	https://juniorfall.files.wordpress.com/2011/11/arduino-cookbook.pdf
2	https://drive.google.com/file/d/13s0m3lHPEFP2f2aCuVNRWeBZNKXWKTW5/view?ts=6231cab 3
3	https://ptolemy.berkeley.edu/books/leeseshia/releases/LeeSeshia_DigitalV2_2.pdf 4.
4	https://www.riverpublishers.com/pdf/ebook/RP9788793519046.pdf

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Understand and implement the functions & Capabilities of embedded platforms for easy prototyping.	L2: Understanding
CO2	Identify the type of sensors and actuators for required applications.	L3: Applying
CO3	Develop communication between devices using different protocols.	L3: Applying
CO4	Develop IoT based systems with wireless network connections and accessing devices over cloud.	L3: Applying

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	0	0	0	0	0	0	0	3	2	2
CO2	3	3	2	2	2	0	0	0	0	0	0	0	3	2	2
CO3	3	2	3	2	3	0	0	0	0	0	0	0	3	3	3
CO4	3	2	3	2	3	0	0	0	0	0	0	0	3	3	3
AVG	**3**	**2.25**	**2.75**	**2**	**2.75**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**2.5**	**2.5**

0: No correlation, 1: Low correlation, 2: Medium correlation, 3: High correlation

18MEPS14	CODING FOR INNOVATORS		Semester			VI
PREREQUISITES		Category		Credit		3
		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives

1	To learn and express creativity using coding skills.
2	To gain knowledge of Python programming with hands-on experience.
3	To demonstrate a problem solving using OOPs concepts.
4	To learn basics of Linux by familiarizing the concepts of management and file structure.
5	To practise full stack development using cloud platform.

Unit I	PROGRAMMING PARADIGMS	9	0	0	9

Need for programming - Outside box thinking to solve problems - Need for algorithms and data structures - Flowcharts & Algorithms - Memory Allocation - Conditions and loops - Creating effective functions - Case studies - Visual Programming - Types of programming languages & paradigms - Getting started with development - Build & test an algorithm - best practices

Unit II	BASIC OF PROGRAMMING	9	0	0	9

Introduction to Python: statements, variables, functions, operators, modules, conditional statements, loop statements, Lists: list operations, traversing a list, slicing a list - Text Handling: Strings, string functions, conversion functions, Dictionaries - File Operations: File open, close, read, copy, word frequency, creating word histograms from text file.

Unit III	OOPS 5	9	0	0	9

OOPS- Why OOPS- verticals- implementation in python - Classes and Objects, Methods, Constructors and Destructors, Inheritance, Polymorphism, Abstraction, Encapsulation.

Unit IV	SOFTWARE DEVELOPMENT TO DELIVERY	9	0	0	9

Software Engineering - Life Cycle (Tools), Agile Methodologies - Framework - Why Frameworks - Software Testing(Tool Based) - Data Structures - Database Management System - A case study to experiment from Development to Deployment(D2D) - Source code management and version control - GitHub - GitHub Actions - GitBash - Continuous Integration - Platform as service - Heroku - Build Packs AWS- Anaconda

Unit V	OPERATING SYSTEMS	9	0	0	9

Introduction to Linux - Process Management - Process Scheduling - Memory Management - Storage Management - System calls - File System Structure - Multithreading - Multicore Programming - Deadlock Handling - Disk Structure - Disk Management - Dockers - Kubernetes

Total = 45 Periods

Text Books:

1	Zed A. Shaw, “Learn Python 3 the Hard Way”, 3rd edition, Addison-Wesley Professional, 2013.
2	Silberschatz Abraham, “Operating System Concepts”, 9th edition, John Wiley & Sons Inc (Sea) Pte Ltd, 2016.
3	Paul Barry, "Head-First Python", 2nd edition, O'Reilly Media, Inc, 2016.
4	Anton Spraul, “Think Like a Programmer”, 1st edition, No Starch Press, 2012.

E-References :	
1	https://www.geeksforgeeks.org/python-programming-language/
2	https://www.guru99.com/python-tutorials.html
3	https://www.tutorialspoint.com/python/python_tutorial.pdf

Course Outcomes: Upon completion of this course, the students will be able to:		Bloom's Taxonomy Level
CO1	Understand the aspects of programming protocols	L2: Understanding
CO2	Develop optimized code for real-world problems	L3: Applying
CO3	Build full-stack development to deployment	L3: Applying
CO4	Demonstrate problem solving and continuous development	L2: Understanding

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	1	3	0	0	0	0	0	0	0	2	1	1
CO2	3	3	3	2	3	0	0	0	0	0	0	0	3	2	2
CO3	3	2	3	1	3	0	0	0	0	0	0	0	3	2	2
CO4	2	3	2	1	2	0	0	0	0	0	0	3	2	1	1
AVG	**2.5**	**2.5**	**2.5**	**1.25**	**2.75**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**2.5**	**1.5**	**1.5**

0: No correlation, 1: Low correlation, 2: Medium correlation, 3: High correlation

18MEPS15	INDUSTRIAL DESIGN AND RAPID PROTOTYPING TECHNIQUES		Semester			VI
PREREQUISITES		Category	OE	Credit		3
		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives

1	Learn to design a UI/UX design and develop an android application.
2	Provide working CAD model for prototype development.
3	Knowledge in hardware, 3D Printers and Laser cutters.
4	Acquire basic knowledge in designing electrical circuits and fabrication of electronic devices.

Unit I	UI / UX	9	0	0	9

Fundamental concepts in UI & UX - Tools - Fundamentals of design principles - Psychology and Human Factors for User Interface Design - Layout and composition for Web, Mobile and Devices - Typography - Information architecture - Colour theory - Design process flow, wireframes, best practices in the industry -User engagement ethics - Design alternatives

Unit II	APP DEVELOPMENT	9	0	0	9

SDLC - Introduction to App Development - Types of Apps - web Development - understanding Stack - Frontend - backend - Working with Databases - Introduction to API - Introduction to Cloud services - Cloud environment Setup- Reading and writing data to cloud - Embedding ML models to Apps - Deploying application.

Unit III	INDUSTRIAL DESIGN	9	0	0	9

Introduction to Industrial Design - Points, lines, and planes - Sketching and concept generation - Sketch to CAD - Introduction to CAD tools - Types of 3D modeling - Basic 3D Modeling Tools - Part creation - Assembly - Product design and rendering basics - Dimensioning & Tolerancing

Unit IV	MECHANICAL RAPID PROTOTYPING	9	0	0	9

Need for prototyping - Domains in prototyping - Difference between actual manufacturing and prototyping - Rapid prototyping methods - Tools used in different domains - **Mechanical Prototyping:** 3DPrinting and classification - Laser Cutting and engraving - RD Works - Additive manufacturing

Unit V	ELECTRICAL RAPID PROTOTYPING	9	0	0	9

Electronic Prototyping: Basics of electronic circuit design - lumped circuits - Electronic Prototyping - Working with simulation tool - simple PCB design with EDA

Total = 45 Periods

Text Books:

1	Peter Fiell, Charlotte Fiell, Industrial Design A-Z, TASCHEN America Llc(2003)
2	Samar Malik, Autodesk Fusion 360 - The Master Guide.
3	Steve Krug, Don't Make Me Think, Revisited: A Common Sense Approach to Web Usability, Pearson,3rd edition (2014)

E - References:	
1	https://www.adobe.com/products/xd/learn/get-started.html
2	https://developer.android.com/guide
3	https://help.autodesk.com/view/fusion360/ENU/courses/
4	https://help.prusa3d.com/en/category/prusaslicer_204

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Create quick UI/UX prototypes for customer needs	L6: Creating
CO2	Develop web application to test product traction / product feature	L3: Applying
CO3	Develop 3D models for prototyping various product ideas	L3: Applying
CO4	Built prototypes using Tools and Techniques in a quick iterative methodology	L3: Applying

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	2	3	0	0	0	1	1	0	0	2	1	1
CO2	3	3	3	2	3	0	0	0	1	1	0	0	3	2	2
CO3	3	2	3	2	3	0	0	0	1	1	0	0	3	2	2
CO4	3	2	3	2	3	0	0	0	1	1	0	0	3	2	2
AVG	**2.75**	**2.25**	**3**	**2**	**3**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**2.75**	**1.75**	**1.75**

0: No correlation, 1: Low correlation, 2: Medium correlation, 3: High correlation

18MEPS16	INDUSTRIAL AUTOMATION DATA LIFE CYCLE MANAGEMENT	Semester			VI
PREREQUISITES	**Category**	**OE**	**Credit**		**3**
	Hours/Week	**L**	**T**	**P**	**TH**
		3	**0**	**0**	**3**

Course Learning Objectives

1	Acquire conceptual knowledge in Industrial Controllers by scaling of on-board devices and embedded board interfacing with various I/O peripherals.
2	Learn PLC by working on internal features and also interfacing with Sensors and actuators along HMI concept using SCADA and standard communication protocols.
3	To work with FPGA boards and RT controllers for reprogrammable embedded applications using LabVIEW
4	Understand the concepts and design electronics circuits

Unit I	**INDUSTRIAL CONTROLLERS - I**	**9**	**0**	**0**	**9**

Industrial Controllers - Introduction to RIO Controllers - Platform - Connection and Configuring controllers - Accessing onboard devices - Module SOM - Interfacing with Input and Output devices - Interfacing protocol based Analog and Digital sensors - Acquiring and Data Logging from sensors - Interfacing Actuators: Relay, DC Motor, Servo Motor - Creating standalone applications.

Unit II	**INDUSTRIAL CONTROLLERS - II**	**9**	**0**	**0**	**9**

Industrial Controllers - II - PLC - Introduction - Mode of Operation - IEC 61131 Programming languages for PLC - Programming & sequence control - Instruction set - Scan Time - Timers - Counters - Interfacing with Input/Output devices - Interfacing with Sensors - Interfacing with Actuators - Interfacing with Human Machine Interface - Commissioning and operational safety of PLC – SCADA.

Unit III	**INDUSTRIAL COMMUNICATION PROTOCOLS**	**9**	**0**	**0**	**9**

Serial Communication Protocols - I2C, SPI - Serial Field bus protocols CAN, PROFIBUS - Ethernet, HTTP, TCP/UDI, WiF, Cloud data logging. Multi-sensor communication, Data parsing between Embedded platforms. Comparative study of Industrial communication protocols - Implementation of Industrial Communication protocols.

Unit IV	**FPGA AND RT CONTROLLER PROGRAMMING**	**9**	**0**	**0**	**9**

Introduction to FPGA - Architecture - Operations in FPGA programming - FPGA Programming in LabVIEW and implementation in myRIO - Introduction to RT controllers - Architecture - Programming RT Controllers - Creating standalone applications.

Unit V	**INDUSTRIAL CIRCUIT BOARD DESIGN**	**9**	**0**	**0**	**9**

Designing basics circuits and to simulate in environment setup - Component selection - Creating libraries - Schematic design - Design rules, supply & communication track rules - Component and footprint editor - Understanding component package types - Test point creation for measurement - PCB Layout, placement rules - Footprint, 3D models, BoMs - Generating GERBER and output documentation.

Total = 45 Periods

Text Books:	
1	Ed Doering, NI myRIO Project Essential Guide, National Instruments, 2016.
2	Willian Bolton, Programmable Logic Controllers, 6th edition, Newnes Publications, 2015
3	Richard Zurawski, Industrial Communication Technology Handbook, Second edition, CRC Press, 2014
4	Simon Monk, Make Your Own PCBs with EAGLE, McGraw Hill Education, 2014.
References Books:	
1	Jeffrey Travis, Jim Kring, LabVIEW for Everyone: Graphical Programming Made Easy and Fun, 3rd edition, Prentice Hall
2	Mikell P. Groover, Automation, Production Systems, and Computer-integrated Manufacturing, Fourth edition, Pearson Education, 2016
3	Michael J. Hamill, Industrial Communications and Control Protocols, PDH centre, 2016
4	Ema Design Automation, The Hitchhiker's Guide to PCB Design, First edition, Blurb Publishers, December 2021

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Understand the usage of controllers in an industrial environment	L2: Understanding
CO2	Build Real-Time systems for Industrial embedded monitoring and controlling deterministic applications	L3: Applying
CO3	Communicate between devices at different levels using industrial protocols	L3: Applying
CO4	Understand the process involved in PCB design using EDA tools and fabricate it	L2: Understanding

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	3	0	0	0	0	0	0	0	3	2	2
CO2	3	3	3	2	3	0	0	0	0	0	0	0	3	3	3
CO3	3	2	3	2	3	0	0	0	0	0	0	0	3	3	3
CO4	3	2	3	2	3	0	0	0	0	0	0	0	3	3	2
AVG	3	2.25	2.75	1.75	3	0	0	0	0	0	0	0	3	2.75	2.5

0: No correlation, 1: Low correlation, 2: Medium correlation, 3: High correlation

18MEPS17	ROBOTICS/ML&MLOps		Semester			VI
PREREQUISITES		Category	EE	Credit		3
		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives

1	Learn the fundamentals of ROS
2	Understand the requirements and choose the right sensors and actuators for the application development
3	Create Bot in the virtual environment and simulate it to know the functionalities of the system developed
4	Learn the basics of Robotics Vision System
5	Integrate ROS and Computer Vision to build systems for various use cases

Unit I	INTRODUCTION TO ROBOT KINEMATICS	9	0	0	9

Introduction to Robotics - Transformations - Forward Kinematics - Kinematics equations - Link transformations - Inverse Kinematics - Kinematic analysis - Numerical Inverse Kinematic Solutions - Analytical Inverse Kinematic Solutions

Unit II	SELECTION OF SENSORS AND ACTUATORS	9	0	0	9

Introduction - Sensors & Actuators - Types - Selection criteria - Design considerations: Motor sizing - Selection of motors based on torque and speed characteristics - Hardware Interface & Assembly

Unit III	INTRODUCTION TO ROBOT OPERATING SYSTEM	9	0	0	9

Introduction to ROS framework and prerequisites - Understanding communications in ROS - ROS Ecosystem - Introduction to ROS programming - ROS nodes, topics, messages - ROS services - ROS Tools and Utilities - URDF , Rviz - Simulation - Gazebo - ROS Motion

Unit IV	INTRODUCTION TO ROBOTICS VISION SYSTEM	9	0	0	9

Image basics - Image Processing - Histograms - Gray scale, Color, Equalization - Smoothing and blurring/filtering - Averaging, Gaussian, Median, Bilateral - Thresholding - Simple, Adaptive, Otsu - Gradients and Edge detection - Laplacian, Sobel, Canny - Contours - Camera calibration

Unit V	INTEGRATION OF ROS AND COMPUTER VISION	9	0	0	9

Introduction - Installation - CV Bridge - Image publisher node - Image subscriber node - Nodes building and launching - Building real world applications

Total = 45 Periods

Text Books:

1	Introduction to Robotics: Mechanics and Control by John J Craig, Pearson Publishers.
2	Robot Operating System (ROS) for Absolute Beginners by Lentin Joseph, A press; Publishers (2018).
3	Learning OpenCV by Gary Bradski, Adrian Kaehler, O'Reilly Media, Inc.

Reference Books:	
1	https://www.intechopen.com/chapters/379
2	https://www.plantengineering.com/articles/eight-selection-criteria-for-actuation-components/
3	https://www.controleng.com/articles/tips-on-sensor-selection/
4	https://www.toptal.com/robotics/introduction-to-robot-operating-system
5	https://www.thomasnet.com/articles/automation-electronics/machine-vision-systems/
6	https://automaticaddison.com/working-with-ros-and-opencv-in-ros-noetic/

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Understand kinematics considerations of robot	L2: Understanding
CO2	Selection of sensors and actuators according to application	L3: Applying
CO3	Utilize the ROS environment to simulate and communicate between robot	L3: Applying
CO4	Develop algorithms to extract features and data from image	L3: Applying
CO5	Utilize the open CV for robotic applications	L3: Applying

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	1	2	0	0	0	0	0	0	0	3	3	2
CO2	3	3	2	1	2	0	0	0	0	0	0	0	3	3	3
CO3	3	2	3	2	3	0	0	0	0	0	0	0	3	3	3
CO4	3	3	3	2	3	0	0	0	0	0	0	0	3	3	2
AVG	**3**	**2.5**	**2.75**	**1.5**	**2.5**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**3**	**2.5**

0: No correlation, 1: Low correlation, 2: Medium correlation, 3: High correlation

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

PROFESSIONAL ELECTIVE COURSES: VERTICALS

(2018 Regulation)

Vertical I **Data Science**	**Vertical II** **Full Stack Development**	**Vertical III** **Cloud Computing and Data Center Technologies**	**Vertical IV** **Cyber Security and Data Privacy**
18CSH101/ Exploratory Data Analysis	18CSH201/Full Stack Web Application Development	18CSH301/Cloud Computing	18CSH401/Cyber Physical Systems
18CSH102/Recommender Systems	18CSH202/App Development	18CSH302/ Virtualization	18CSH402/Ethical Hacking
18CSH103/Neural Networks and Deep Learning	18CSH203/Service Oriented Architecture	18CSH303/Cloud Services Management	18CSH403/Digital and Mobile Forensics
18CSH104/Text and Speech Analysis	18CSH204/UI and UX Design	18CSH304/Data Warehousing	18CSH404/Social Network Security
18CSH105/ Business Analytics	18CSH205/Software Testing and Automation	18CSH305/Storage Technologies	18CSH405/Modern Cryptography
18CSH106/ Image and Video Analytics	18CSH206/Web Application Security	18CSH306/Software Defined Networks	18CSH406/Engineering Secure Software Systems
18CSH107/ Computer Vision	18CSH207/DevOps	18CSH307/Stream Processing	18CSH407/ Cryptocurrency and Blockchain Technologies
18CSH108/Big Data Analytics	18CSH208/Principles of Programming Languages	18CSH308/Security and Privacy in Cloud	18CSH408/Cyber Security

VERTICAL I : DATA SCIENCE

VERTICAL II : FULL STACK DEVELOPMENT

S.No.	Course Code	Course Title	Category	Hours per week				Maximum Marks		
				L	T	P	C	CA	FE	Total
1.	18CSH101	Exploratory Data Analysis	PE	3	0	0	3	40	60	100
2.	18CSH102	Recommender Systems	PE	3	0	0	3	40	60	100
3.	18CSH103	Neural Networks and Deep Learning	PE	3	0	0	3	40	60	100
4.	18CSH104	Text and Speech Analysis	PE	3	0	0	3	40	60	100
5.	18CSH105	Business Analytics	PE	3	0	0	3	40	60	100
6.	18CSH106	Image and Video Analytics	PE	3	0	0	3	40	60	100
7.	18CSH107	Computer Vision	PE	3	0	0	3	40	60	100
8.	18CSH108	Big Data Analytics	PE	3	0	0	3	40	60	100

S.No.	Course Code	Course Title	Category	Hours per week				Maximum Marks		
				L	T	P	C	CA	FE	Total
1.	18CSH201	Full Stack Web Application Development	PE	3	0	0	3	40	60	100
2.	18CSH202	App Development	PE	3	0	0	3	40	60	100
3.	18CSH203	Service Oriented Architecture	PE	3	0	0	3	40	60	100
4.	18CSH204	UI and UX Design	PE	3	0	0	3	40	60	100
5.	18CSH205	Software Testing and Automation	PE	3	0	0	3	40	60	100
6.	18CSH206	Web Application Security	PE	3	0	0	3	40	60	100
7.	18CSH207	DevOps	PE	3	0	0	3	40	60	100
8.	18CSH208	Principles of Programming Languages	PE	3	0	0	3	40	60	100

VERTICAL III : CLOUD COMPUTING AND DATA CENTER TECHNOLOGIES

S.No.	Course Code	Course Title	Category	Hours per week				Maximum Marks		
				L	T	P	C	CA	FE	Total
1.	18CSH301	Cloud Computing	PE	3	0	0	3	40	60	100
2.	18CSH302	Virtualization	PE	3	0	0	3	40	60	100
3.	18CSH303	Cloud Services Management	PE	3	0	0	3	40	60	100
4.	18CSH304	Data Warehousing	PE	3	0	0	3	40	60	100
5.	18CSH305	Storage Technologies	PE	3	0	0	3	40	60	100
6.	18CSH306	Software Defined Networks	PE	3	0	0	3	40	60	100
7.	18CSH307	Stream Processing	PE	3	0	0	3	40	60	100
8.	18CSH308	Security and Privacy in Cloud	PE	3	0	0	3	40	60	100

VERTICAL IV : CYBER SECURITY AND DATA PRIVACY

S.No.	Course Code	Course Title	Category	Hours per week				Maximum Marks		
				L	T	P	C	CA	FE	Total
1.	18CSH401	Cyber Physical Systems	PE	3	0	0	3	40	60	100
2.	18CSH402	Ethical Hacking	PE	3	0	0	3	40	60	100
3.	18CSH403	Digital and Mobile Forensics	PE	3	0	0	3	40	60	100
4.	18CSH404	Social Network Security	PE	3	0	0	3	40	60	100
5.	18CSH405	Modern Cryptography	PE	3	0	0	3	40	60	100
6.	18CSH406	Engineering Secure Software Systems	PE	3	0	0	3	40	60	100
7.	18CSH407	Cryptocurrency and Blockchain Technologies	PE	3	0	0	3	40	60	100
8.	18CSH408	Cyber Security	PE	3	0	0	3	40	60	100

18CSH101	EXPLORATORY DATA ANALYSIS		Semester			
PREREQUISITES		Category	PE	Credit		3
		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives

1	To outline an overview of exploratory data analysis.
2	To implement data visualization using Matplotlib.
3	To perform univariate data exploration and analysis.
4	To apply bivariate data exploration and analysis.
5	To use Data exploration and visualization techniques for multivariate and time series data.

UNIT I	EXPLORATORY DATA ANALYSIS	9	0	0	9

EDA fundamentals – Understanding data science – Significance of EDA – Making sense of data – Comparing EDA with classical and Bayesian analysis – Software tools for EDA - Visual Aids for EDA- Data transformation techniques-merging database, reshaping and pivoting, Transformation techniques.

UNIT II	EDA USING PYTHON	9	0	0	9

Data Manipulation using Pandas – Pandas Objects – Data Indexing and Selection – Operating on Data – Handling Missing Data – Hierarchical Indexing – Combining datasets – Concat, Append, Merge and Join – Aggregation and grouping – Pivot Tables – Vectorized String Operations.

UNIT III	UNIVARIATE ANALYSIS	9	0	0	9

Introduction to Single variable: Distribution Variables - Numerical Summaries of Level and Spread - Scaling and Standardizing – Inequality.

UNIT IV	BIVARIATE ANALYSIS	9	0	0	9

Relationships between Two Variables - Percentage Tables - Analysing Contingency Tables - Handling Several Batches - Scatterplots and Resistant Lines.

UNIT V	MULTIVARIATE AND TIME SERIES ANALYSIS	9	0	0	9

Introducing a Third Variable - Causal Explanations - Three-Variable Contingency Tables and Beyond – Fundamentals of TSA – Characteristics of time series data – Data Cleaning – Time-based indexing – Visualizing – Grouping – Resampling.

Total (45 L) =45 Periods

Text Books:

1	Suresh Kumar Mukhiya, Usman Ahmed, “Hands-On Exploratory Data Analysis with Python”, Packt Publishing, 2020. (Unit 1)
2	Jake Vander Plas, "Python Data Science Handbook: Essential Tools for Working with Data", First Edition, O Reilly, 2017. (Unit 2)
3.	Catherine Marsh, Jane Elliott, “Exploring Data: An Introduction to Data Analysis for Social Scientists”, Wiley Publications, 2nd Edition, 2008. (Unit 3,4,5)

Reference Books:	
1	Eric Pimpler, Data Visualization and Exploration with R, GeoSpatial Training service, 2017.
2	Claus O. Wilke, “Fundamentals of Data Visualization”, O’reilly publications, 2019.
3	Matthew O. Ward, Georges Grinstein, Daniel Keim, “Interactive Data Visualization: Foundations, Techniques, and Applications”, 2nd Edition, CRC press, 2015.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom’s Taxonomy Level**
CO1	Understand the fundamentals of exploratory data analysis.	L2
CO2	Implement the data visualization using Matplotlib.	L6
CO3	Perform univariate data exploration and analysis.	L3
CO4	Apply bivariate data exploration and analysis.	L3
CO5	Use Data exploration and visualization techniques for multivariate and time series data	L3

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	2	3	3	3	-	-	-	2	2	3	2	2	2
CO 2	2	2	2	3	3	-	-	-	3	2	2	2	2	2
CO 3	2	3	2	2	3	-	-	-	2	2	2	1	2	2
CO 4	2	2	2	2	3	-	-	-	3	2	2	1	2	2
CO 5	2	2	3	2	1	-	-	-	1	2	2	1	2	2
Avg	**2.2**	**2.2**	**2.4**	**2.4**	**2.6**	**-**	**-**	**-**	**2.2**	**2**	**2.2**	**1.4**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

18CSH102	RECOMMENDER SYSTEMS	Semester			
PREREQUISITES	Category	PE	Credit		3
	Hours/Week	L	T	P	TH
		3	0	0	3

Course Learning Objectives

1	To understand the foundations of the recommender system.
2	To learn the significance of machine learning and data mining algorithms for Recommender systems
3	To learn about collaborative filtering
4	To make students design and implement a recommender system.
5	To learn collaborative filtering

UNIT I	INTRODUCTION	9	0	0	9

Introduction and basic taxonomy of recommender systems - Traditional and non-personalized Recommender Systems - Overview of data mining methods for recommender systems- similarity measures- Dimensionality reduction – Singular Value Decomposition (SVD)

Suggested Activities:

- Practical learning – Implement Data similarity measures.
- External Learning – Singular Value Decomposition (SVD) applications

Suggested Evaluation Methods:

- Quiz on Recommender systems.
- Quiz of python tools available for implementing Recommender systems

UNIT II	CONTENT-BASED RECOMMENDATION SYSTEMS	9	0	0	9

High-level architecture of content-based systems - Item profiles, Representing item profiles, Methods for learning user profiles, Similarity-based retrieval, and Classification algorithms.

Suggested Activities:

- Assignment on content-based recommendation systems
- Assignment of learning user profiles

Suggested Evaluation Methods:

- Quiz on similarity-based retrieval.
- Quiz of content-based filtering

UNIT III	COLLABORATIVE FILTERING	9	0	0	9

A systematic approach, Nearest-neighbor collaborative filtering (CF), user-based and item-based CF, components of neighborhood methods (rating normalization, similarity weight computation, and neighborhood selection.

Suggested Activities:

- Practical learning – Implement collaborative filtering concepts
- Assignment of security aspects of recommender systems

Suggested Evaluation Methods:

- Quiz on collaborative filtering
- Seminar on security measures of recommender systems

UNIT IV	ATTACK-RESISTANT RECOMMENDER SYSTEMS	9	0	0	9

Introduction – Types of Attacks – Detecting attacks on recommender systems – Individual attack – Group attack – Strategies for robust recommender design - Robust recommendation algorithms.

Suggested Activities:

- Group Discussion on attacks and their mitigation
- Study of the impact of group attacks
- External Learning – Use of CAPTCHAs

Suggested Evaluation Methods:

- Quiz on attacks on recommender systems
- Seminar on preventing attacks using the CAPTCHAs

UNIT V	EVALUATING RECOMMENDER SYSTEMS	9	0	0	9

Evaluating Paradigms – User Studies – Online and Offline evaluation – Goals of evaluation design – Design Issues – Accuracy metrics – Limitations of Evaluation measures.

Suggested Activities:

- Group Discussion on goals of evaluation design
- Study of accuracy metrics

Suggested Evaluation Methods:

- Quiz on evaluation design
- Problems on accuracy measures

Total (45 L) =45 Periods

Text Books:

1	Charu C. Aggarwal, Recommender Systems: The Textbook, Springer, 2016.
2	Dietmar Jannach , Markus Zanker , Alexander Felfernig and Gerhard Friedrich , Recommender Systems: An Introduction, Cambridge University Press (2011), 1st ed.
3	Francesco Ricci , Lior Rokach , Bracha Shapira , Recommender Sytems Handbook, 1st ed, Springer (2011)
4	Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Mining of massive datasets, 3rd edition, Cambridge University Press, 2020.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Understand the basic concepts of recommender systems.	L2
CO2	Implement machine-learning and data-mining algorithms in recommender systems data sets.	L6
CO3	Implementation of Collaborative Filtering in carrying out performance evaluation of recommender systems based on various metrics.	L6
CO4	Design and implement a simple recommender system.	L6
CO5	Learn about advanced topics of recommender systems	L1
CO6	Learn about advanced topics of recommender systems applications	L1

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	2	2	1	2	1	-	-	-	1	-	-	1	2	2
CO 2	1	2	-	-	1	-	-	-	-	-	-	1	2	2
CO 3	2	3	1	-	1	-	-	-	**2**	-	-	-	2	2
CO 4	3	2	2	2	1	-	-	-	**2**	-	-	2	2	2
CO 5	1	1	-	2	1	-	-	-	-	-	-	1	2	2
CO 6	2	2	1	1	1	-	-	-	-	-	-	1	2	2
Avg	**1.83**	**2**	**0.83**	**1.16**	**1**	**-**	**-**	**-**	**0.83**	**-**	**-**	**1**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

18CSH103	NEURAL NETWORKS AND DEEP LEARNING	Semester			
PREREQUISITES	Category		Credit		
	Hours/Week	L	T	P	TH

Course Learning Objectives

1	To understand the basics in deep neural networks
2	To understand the basics of associative memory and unsupervised learning networks
3	To apply CNN architectures of deep neural networks
4	To analyze the key computations underlying deep learning, then use them to build and train deep neural networks for various tasks.
5	To apply autoencoders and generative models for suitable applications.

UNIT I	INTRODUCTION	9	0	0	9

Neural Networks-Application Scope of Neural Networks-Artificial Neural Network: An Introduction-Evolution of Neural Networks-Basic Models of Artificial Neural Network- Important Terminologies of ANNs-Supervised Learning Network.

UNIT II	ASSOCIATIVE MEMORY AND UNSUPERVISED LEARNING NETWORKS	9	0	0	9

Training Algorithms for Pattern Association-Autoassociative Memory Network-Heteroassociative Memory Network-Bidirectional Associative Memory (BAM)-Hopfield Networks-Iterative Autoassociative Memory Networks-Temporal Associative Memory Network-Fixed Weight Competitive Nets-Kohonen Self-Organizing Feature Maps-Learning Vector Quantization-Counter propagation Networks-Adaptive Resonance Theory Network.

UNIT III	THIRD-GENERATION NEURAL NETWORKS	9	0	0	9

Spiking Neural Networks-Convolutional Neural Networks-Deep Learning Neural Networks-Extreme Learning Machine Model-Convolutional Neural Networks: The Convolution Operation – Motivation – Pooling – Variants of the basic Convolution Function – Structured Outputs – Data Types – Efficient Convolution Algorithms – Neuro scientific Basis – Applications: Computer Vision, Image Generation, Image Compression.

UNIT IV	DEEP FEEDFORWARD NETWORKS	9	0	0	9

History of Deep Learning- A Probabilistic Theory of Deep Learning- Gradient Learning – Chain Rule and Back propagation - Regularization: Dataset Augmentation – Noise Robustness -Early Stopping, Bagging and Dropout - batch normalization- VC Dimension and Neural Nets.

UNIT V	RECURRENT NEURAL NETWORKS	9	0	0	9

Recurrent Neural Networks: Introduction – Recursive Neural Networks – Bidirectional RNNs – Deep Recurrent Networks – Applications: Image Generation, Image Compression, Natural Language Processing. Complete Auto encoder, Regularized Auto encoder, Stochastic Encoders and Decoders, Contractive Encoders.

Total (45+15) = 60 Periods

Text Books:

1	Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2016.
2	Francois Chollet, “Deep Learning with Python”, Second Edition, Manning Publications,2021.

Reference Books:

1	Aurélien Géron, “Hands-On Machine Learning with Scikit-Learn and TensorFlow”, Oreilly,2018.

2	Josh Patterson, Adam Gibson, “Deep Learning: A Practitioner’s Approach”, O’Reilly Media,2017.
3	Charu C. Aggarwal, “Neural Networks and Deep Learning: A Textbook”, Springer International Publishing, 1st Edition, 2018.
4	Learn Keras for Deep Neural Networks, Jojo Moolayil, Apress,2018
5	Deep Learning Projects Using TensorFlow 2, Vinita Silaparasetty, Apress, 2020
6	Deep Learning with Python, FRANÇOIS CHOLLET, MANNING SHELTER ISLAND,2017.
7	S Rajasekaran, G A Vijayalakshmi Pai, “Neural Networks, FuzzyLogic and Genetic Algorithm, Synthesis and Applications”, PHI Learning, 2017.
8	Pro Deep Learning with TensorFlow, Santanu Pattanayak, Apress,2017
9	James A Freeman, David M S Kapura, “Neural Networks Algorithms, Applications, and Programming Techniques”, Addison Wesley, 2003.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom’s Taxonomy Level**
CO1	Apply Convolution Neural Network for image processing.	L3
CO2	Understand the basics of associative memory and unsupervised learning networks.	L2
CO3	Apply CNN and its variants for suitable applications.	L3
CO4	Analyze the key computations underlying deep learning and use them to build and train deep neural networks for various tasks.	L4
CO5	Apply autoencoders and generative models for suitable applications.	L3

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	2	3	2	3	1	-	-	2	1	-	-	1	2
CO 2	3	1	2	1	-	-	-	-	-	1	2	2	2	2
CO 3	3	3	3	3	3	1	-	-	2	1	-	-	2	2
CO 4	3	3	3	3	3	-	-	-	2	-	2	3	2	2
CO 5	1	1	3	2	3	-	-	-	2	-	-	-	2	2
Avg	**2.6**	**2**	**2.8**	**2.2**	**2.4**	**0.4**	**0**	**0**	**1.6**	**0.6**	**0.8**	**1**	**1.8**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

18CSH104	TEXT AND SPEECH ANALYSIS	Semester	

PREREQUISITES	Category	Credit	

	Hours/Week	L	T	P	TH

Course Learning Objectives

1	Understand natural language processing basics
2	Apply classification algorithms to text documents
3	Build question-answering and dialogue systems
4	Develop a speech recognition system
5	Develop a speech synthesizer

UNIT I	NATURAL LANGUAGE BASICS	9	0	0	9

Foundations of natural language processing – Language Syntax and Structure- Text Preprocessing and Wrangling – Text tokenization – Stemming – Lemmatization – Removing stop-words – Feature Engineering for Text representation – Bag of Words model- Bag of N-Grams model – TF-IDF model

Suggested Activities

- Flipped classroom on NLP
- Implementation of Text Preprocessing using NLTK
- Implementation of TF-IDF models

Suggested Evaluation Methods

- Quiz on NLP Basics
- Demonstration of Programs

UNIT II	TEXT CLASSIFICATION	9	0	0	9

Vector Semantics and Embeddings -Word Embeddings - Word2Vec model – Glove model –FastText model – Overview of Deep Learning models – RNN – Transformers – Overview of Text summarization and Topic Models

Suggested Activities

- Flipped classroom on Feature extraction of documents
- Implementation of SVM models for text classification
- External learning: Text summarization and Topic models

Suggested Evaluation Methods

- Assignment on above topics
- Quiz on RNN, Transformers
- Implementing NLP with RNN and Transformers

UNIT III	QUESTION ANSWERING AND DIALOGUE SYSTEMS	9	0	0	9

Information retrieval – IR-based question answering – knowledge-based question answering –language models for QA – classic QA models – chatbots – Design of dialogue systems -–evaluating dialogue systems

Suggested Activities

- Flipped classroom on language models for QA
- Developing a knowledge-based question-answering system
- Classic QA model development

Suggested Evaluation Methods

- Assignment on the above topics
- Quiz on knowledge-based question answering system
- Development of simple chatbots

UNIT IV	TEXT-TO-SPEECH SYNTHESIS	9	0	0	9

Overview. Text normalization. Letter-to-sound. Prosody, Evaluation. Signal processing - Concatenative and parametric approaches, WaveNet and other deep learning-based TTS systems

Suggested Activities

- Flipped classroom on Speech signal processing
- Exploring Text normalization
- Data collection
- Implementation of TTS systems

Suggested Evaluation Methods

- Assignment on the above topics
- Quiz on wavenet, deep learning-based TTS systems
- Finding accuracy with different TTS systems

UNIT V	AUTOMATIC SPEECH RECOGNITION	9	0	0	9

Speech recognition: Acoustic modelling – Feature Extraction - HMM, HMM-DNN systems

Suggested Activities

- Flipped classroom on Speech recognition.
- Exploring Feature extraction

Suggested Evaluation Methods

- Assignment on the above topics
- Quiz on acoustic modelling

Total (45+15) = 60 Periods

Text Books:

1	Daniel Jurafsky and James H. Martin, "Speech and Language Processing: An Introduction to Natural Langua Processing, Computational Linguistics, and Speech Recognition", Third Edition, 2022

Reference Books:

1	Dipanjan Sarkar, "Text Analytics with Python: A Practical Real-World approach to Gaining Actionable insights from your data", APress,2018.
2	Tanveer Siddiqui, Tiwary U S, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.
3	Lawrence Rabiner, Biing-Hwang Juang, B. Yegnanarayana, "Fundamentals of Speech Recognition" 1st Edition, Pearson, 2009.
4	Steven Bird, Ewan Klein, and Edward Loper, "Natural language processing with Python", O'REILLY.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Explain existing and emerging deep learning architectures for text and speech processing	L2
CO2	Apply deep learning techniques for NLP tasks, language modelling and machine translation	L3
CO3	Explain coreference and coherence for text processing	L2
CO4	Build question-answering systems, chatbots and dialogue systems.	L6
CO5	Apply deep learning models for building speech recognition and text-to-speech systems	L3

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2	3	1	3	-	-	-	1	2	1	2	2	2
CO 2	3	1	2	1	2	-	-	-	2	2	1	3	2	2
CO 3	2	2	1	3	1	-	-	-	3	3	1	2	2	2
CO 4	2	1	1	1	2	-	-	-	2	1	2	2	2	2
CO 5	1	3	2	2	1	-	-	-	3	2	1	1	2	2
Avg	**2.2**	**1.8**	**1.8**	**1.6**	**2**	**-**	**-**	**-**	**2.2**	**2**	**1.2**	**2**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

18CSH105	BUSINESS ANALYTICS	Semester	
PREREQUISITES	Category	Credit	

	Hours/Week	L	T	P	TH

Course Learning Objectives

1	To understand the Analytics Life Cycle.
2	To comprehend the process of acquiring Business Intelligence
3	To understand various types of analytics for Business Forecasting
4	To model the supply chain management for Analytics.
5	To apply analytics for different functions of a business

UNIT I	INTRODUCTION TO BUSINESS ANALYTICS	9	0	0	9

Analytics and Data Science – Analytics Life Cycle – Types of Analytics – Business Problem Definition – Data Collection – Data Preparation – Hypothesis Generation – Modeling – Validation and Evaluation – Interpretation – Deployment and Iteration

UNIT II	BUSINESS INTELLIGENCE	9	0	0	9

Data Warehouses and Data Mart - Knowledge Management –Types of Decisions - Decision Making Process - Decision Support Systems – Business Intelligence –OLAP – Analytic functions .

UNIT III	BUSINESS FORECASTING	9	0	0	9

Introduction to Business Forecasting and Predictive analytics - Logic and Data Driven Models –Data Mining and Predictive Analysis Modelling –Machine Learning for Predictive analytics.

UNIT IV	HR & SUPPLY CHAIN ANALYTICS	9	0	0	9

Human Resources – Planning and Recruitment – Training and Development - Supply chain network - Planning Demand, Inventory and Supply – Logistics – Analytics applications in HR & Supply Chain - Applying HR Analytics to make a prediction of the demand for hourly employees for a year.

UNIT V	MARKETING & SALES ANALYTICS	9	0	0	9

Marketing Strategy, Marketing Mix, Customer Behaviour –selling Process – Sales Planning – Analytics applications in Marketing and Sales - predictive analytics for customers' behaviour in marketing and sales.

Total (45+15) = 60 Periods

Text Books:

1	R. Evans James, Business Analytics, 2nd Edition, Pearson, 2017
2	R N Prasad, Seema Acharya, Fundamentals of Business Analytics, 2nd Edition, Wiley, 2016
3	Philip Kotler and Kevin Keller, Marketing Management, 15th edition, PHI, 2016
4	VSP RAO, Human Resource Management, 3rd Edition, Excel Books, 2010.
5	Mahadevan B, “Operations Management -Theory and Practice”,3rd Edition, Pearson Education,2018.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Explain the real world business problems and model with analytical solutions.	L2
CO2	Identify the business processes for extracting Business Intelligence	L3
CO3	Apply predictive analytics for business fore-casting	L3
CO4	Apply analytics for supply chain and logistics management	L3
CO5	Use analytics for marketing and sales.	L3

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	2	2	3	1	1	-	-	-	1	2	1	1	2	2
CO 2	3	3	3	2	3	-	-	-	1	2	2	2	2	2
CO 3	2	2	3	3	2	-	-	-	3	1	1	3	2	2
CO 4	2	1	1	2	2	-	-	-	3	3	2	1	2	2
CO 5	2	3	2	3	2	-	-	-	3	3	1	3	2	2
Avg	**2.2**	**2.2**	**2.4**	**2.2**	**2**	**-**	**-**	**-**	**2.2**	**2.2**	**1.4**	**2**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

18CSH106	IMAGE AND VIDEO ANALYTICS	Semester	

PREREQUISITES	Category	Credit	

	Hours/Week	L	T	P	TH

Course Learning Objectives

1	To understand the basics of image processing techniques for computer vision.
2	To learn the techniques used for image pre-processing.
3	To discuss the various object detection techniques.
4	To understand the various Object recognition mechanisms.
5	To elaborate on the video analytics techniques.

UNIT I	INTRODUCTION	9	0	0	9

Computer Vision – Image representation and image analysis tasks - Image representations –digitization – properties – color images – Data structures for Image Analysis - Levels of image data representation - Traditional and Hierarchical image data structures.

UNIT II	IMAGE PRE-PROCESSING	9	0	0	9

Local pre-processing - Image smoothing - Edge detectors - Zero-crossings of the second derivative - Scale in image processing - Canny edge detection - Parametric edge models - Edges in multisperalct images - Local pre-processing in the frequency domain - Line detection by local preprocessing operators - Image restoration.

UNIT III	OBJECT DETECTION USING MACHINE LEARNING	9	0	0	9

Object detection– Object detection methods – Deep Learning framework for Object detection–bounding box approach-Intersection over Union (IoU) –Deep Learning Architectures-R-CNN-Faster R-CNN-You Only Look Once(YOLO)-Salient features-Loss Functions-YOLO architectures

UNIT IV	FACE RECOGNITION AND GESTURE RECOGNITION	9	0	0	9

Face Recognition-Introduction-Applications of Face Recognition-Process of Face RecognitionDeepFace solution by Facebook-FaceNet for Face Recognition- Implementation using FaceNetGesture Recognition

UNIT V	VIDEO ANALYTICS	9	0	0	9

Video Processing – use cases of video analytics-Vanishing Gradient and exploding gradient problemRestNet architecture-RestNet and skip connections-Inception Network-GoogleNet architectureImprovement in Inception v2-Video analytics-RestNet and Inception v3.

Total (45 L) =45 Periods

Text Books:

1	Milan Sonka, Vaclav Hlavac, Roger Boyle, “Image Processing, Analysis, and Machine Vision”, 4nd edition, Thomson Learning, 2013.
2	Vaibhav Verdhan,(2021, Computer Vision Using Deep Learning Neural Network Architecture with Python and Keras,Apress 2021(UNIT-III,IV and V)

Reference Books:

1	VSRichard Szeliski, “Computer Vision: Algorithms and Applications”, Springer Verlag London Limited,2011.
2	Caifeng Shan, FatihPorikli, Tao Xiang, Shaogang Gong, “Video Analytics for Business Intelligence”, Springer, 2012.
3	D. A. Forsyth, J. Ponce, “Computer Vision: A Modern Approach”, Pearson Education, 2003.
4	E. R. Davies, (2012), “Computer & Machine Vision”, Fourth Edition, Academic Press.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Understand the basics of image processing techniques for computer vision and video analysis.	L2
CO2	Explain the techniques used for image pre-processing.	L2
CO3	Develop various object detection techniques.	L6
CO4	Understand the various face recognition mechanisms.	L2
CO5	Elaborate on deep learning-based video analytics.	L4

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	1	2	2	2	-	-	-	3	3	2	1	2	2
CO 2	2	2	3	3	3	-	-	-	3	2	1	1	2	2
CO 3	1	2	2	2	3	-	-	-	1	2	1	2	2	2
CO 4	1	2	3	2	3	-	-	-	2	2	2	3	2	2
CO 5	3	2	1	3	2	-	-	-	2	1	1	3	2	2
Avg	**2**	**1.8**	**2.2**	**2.4**	**2.6**	**-**	**-**	**-**	**2.2**	**2**	**1.4**	**2**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

18CSH107	COMPUTER VISION		Semester		
PREREQUISITES		Category		Credit	
		Hours/Week	L	T	P	TH

Course Learning Objectives

1	To understand the fundamental concepts related to Image formation and processing.
2	To learn feature detection, matching and detection.
3	To become familiar with feature based alignment and motion estimation
4	To develop skills on 3D reconstruction
5	To understand image based rendering and recognition

UNIT I	INTRODUCTION TO IMAGE FORMATION AND PROCESSING	9	0	0	9

Computer Vision - Geometric primitives and transformations - Photometric image formation - The digital camera - Point operators - Linear filtering - More neighbourhood operators - Fourier transforms - Pyramids and wavelets - Geometric transformations - Global optimization.

UNIT II	FEATURE DETECTION, MATCHING AND SEGMENTATION	9	0	0	9

Points and patches - Edges - Lines - Segmentation - Active contours - Split and merge - Mean shift and mode finding - Normalized cuts - Graph cuts and energy-based methods.

UNIT III	FEATURE-BASED ALIGNMENT & MOTION ESTIMATION	9	0	0	9

2D and 3D feature-based alignment - Pose estimation - Geometric intrinsic calibration - Triangulation - Two-frame structure from motion - Factorization - Bundle adjustment - Constrained structure and motion - Translational alignment - Parametric motion - Spline-based motion - Optical flow - Layered motion.

UNIT IV	3D RECONSTRUCTION	9	0	0	9

Shape from X - Active range finding - Surface representations - Point-based representations Volumetric representations - Model-based reconstruction - Recovering texture maps and albedos.

UNIT V	IMAGE-BASED RENDERING AND RECOGNITION	9	0	0	9

View interpolation Layered depth images - Light fields and Lumigraphs - Environment mattes -Video-based rendering-Object detection - Face recognition - Instance recognition – Category recognition - Context and scene understanding- Recognition databases and test sets.

Total (45 L) =45 Periods

Text Books:

1	Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer- Texts in Computer Science, Second Edition, 2022.
2	Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, Second Edition, 2015.

Reference Books:

1	Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
2	Christopher M. Bishop; Pattern Recognition and Machine Learning, Springer, 2006
3	E. R. Davies, Computer and Machine Vision, Fourth Edition, Academic Press, 2012.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	To understand basic knowledge, theories and methods in image processing and computer vision.	L2
CO2	To implement basic and some advanced image processing techniques in OpenCV.	L3
CO3	To apply 2D a feature-based based image alignment, segmentation and motion estimations.	L3
CO4	To apply 3D image reconstruction techniques	L3
CO5	To design and develop innovative image processing and computer vision applications.	L6

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	1	1	1	1	-	-	-	2	1	3	2	2	2
CO 2	3	3	3	2	3	-	1	-	2	1	2	2	2	2
CO 3	3	3	2	2	3	-	-	-	1	1	2	2	2	2
CO 4	2	3	3	2	3	-	-	-	2	1	2	3	2	2
CO 5	2	3	3	2	2	2	-	-	3	1	2	3	2	2
Avg	**2.6**	**2.6**	**2.4**	**1.8**	**2.4**	**0.4**	**0.25**	**-**	**2**	**1**	**2.2**	**2.4**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

18CSH108	BIG DATA ANALYTICS		Semester		
PREREQUISITES		Category		Credit	
		Hours/Week	L	T	P	TH

Course Learning Objectives

1	To understand big data
2	To learn and use NoSQL big data management.
3	To learn map reduce analytics using Hadoop and related tools.
4	To work with map reduce applications
5	To understand the usage of Hadoop related tools for Big Data Analytics

UNIT I	UNDERSTANDING BIG DATA	9	0	0	9

Introduction to big data – convergence of key trends – unstructured data – industry examples of big data – web analytics – big data applications– big data technologies – introduction to Hadoop – open source technologies – cloud and big data – mobile business intelligence – Crowd sourcing analytics – inter and trans firewall analytics.

UNIT II	NOSQL DATA MANAGEMENT	9	0	0	9

Introduction to NoSQL – aggregate data models – key-value and document data models –relationships – graph databases – schemaless databases – materialized views – distribution models – master-slave replication – consistency - Cassandra – Cassandra data model – Cassandra examples – Cassandra clients

UNIT III	MAP REDUCE APPLICATIONS	9	0	0	9

Map Reduce workflows – unit tests with MR Unit – test data and local tests – anatomy of Map Reduce job run – classic Map-reduce – YARN – failures in classic Map-reduce and YARN – job scheduling – shuffle and sort – task execution – Map Reduce types – input formats – output formats.

UNIT IV	BASICS OF HADOOP	9	0	0	9

Data format – analyzing data with Hadoop – scaling out – Hadoop streaming – Hadoop pipes – design of Hadoop distributed file system (HDFS) – HDFS concepts – Java interface – data flow –Hadoop I/O – data integrity – compression – serialization – Avro – file-based data structures -Cassandra – Hadoop integration.

UNIT V	HADOOP RELATED TOOLS	9	0	0	9

Hbase – data model and implementations – Hbase clients – Hbase examples – praxis.
Pig – Grunt – pig data model – Pig Latin – developing and testing Pig Latin scripts.
Hive – data types and file formats – Hive QL data definition – Hive QL data manipulation – Hive QL queries.

Total (45 L) =45 Periods

Text Books:

1	Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
2	Eric Sammer, "Hadoop Operations", O'Reilley, 2012
3	Sadalage, Pramod J. “NoSQL distilled”, 2013

Reference Books:

1	E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012.
2	Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.
3	Eben Hewitt, "Cassandra: The Definitive Guide", O'Reilley, 2010.

4	Alan Gates, "Programming Pig", O'Reilley, 2011.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Describe big data and use cases from selected business domains. .	L1
CO2	Explain NoSQL big data management	L2
CO3	Install, configure, and run Hadoop and HDFS.	L3
CO4	Perform map-reduce analytics using Hadoop	L3
CO5	Use Hadoop-related tools such as HBase, Cassandra, Pig, and Hive for big data analytics.	L3

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	3	3	3	3	-	-	-	2	2	3	1	2	2
CO 2	3	3	2	3	2	-	-	-	2	2	3	3	2	2
CO 3	3	3	3	2	3	-	-	-	2	2	1	2	2	2
CO 4	2	3	3	3	3	-	-	-	2	2	3	2	2	2
CO 5	3	3	3	3	3	-	-	-	3	1	3	2	2	2
Avg	**2.8**	**3**	**2.8**	**2.8**	**2.8**	**-**	**-**	**-**	**2.2**	**1.8**	**2.6**	**2**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

18CSH201	FULL STACK WEB APPLICATION DEVELOPMENT	Semester	

PREREQUISITES	Category	Credit	

	Hours/Week	L	T	P	TH

Course Learning Objectives

1	Develop TypeScript Application
2	Develop Single Page Application (SPA)
3	Able to communicate with a server over the HTTP protocol
4	Learning all the tools need to start building applications with Node.js
5	Implement the Full Stack Development using MEAN Stack

UNIT I	FUNDAMENTALS & TYPESCRIPT LANGUAGE	9	0	0	9

Server-Side Web Applications. Client-Side Web Applications. Single Page Application. About TypeScript. Creating TypeScript Projects. TypeScript Data Types. Variables. Expression and Operators. Functions. OOP in Typescript. Interfaces. Generics. Modules. Enums. Decorators. Enums. Iterators. Generators.

UNIT II	ANGULAR	9	0	0	9

About Angular. Angular CLI. Creating an Angular Project. Components. Components Interaction. Dynamic Components. Angular Elements. Angular Forms. Template Driven Forms. Property, Style, Class and Event Binding. Two way Bindings. Reactive Forms. Form Group. Form Controls. About Angular Router. Router Configuration. Router State. Navigation Pages. Router Link. Query Parameters. URL matching. Matching Strategies. Services. Dependency Injection. Http Client. Read Data from the Server. CRUD Operations. Http Header Operations. Intercepting requests and responses.

UNIT III	NODE.js	9	0	0	9

About Node.js. Configuring Node.js environment. Node Package Manager NPM. Modules. Asynchronous Programming. Call Stack and Event Loop. Call back functions. call back errors. Abstracting call backs. Chaining call backs. File System. Synchronous vs. asynchronous I/O. Path and directory operations. File Handle. File Synchronous API. File Asynchronous API. File Call back API. Timers. Scheduling Timers. Timers Promises API. Node.js Events. Event Emitter. Event Target and Event API. Buffers. Buffers and Typed Arrays. Buffers and iteration. Using buffers for binary data. Flowing vs. non-flowing streams. JSON.

UNIT IV	EXPRESS.Js	9	0	0	9

Express.js. How Express.js Works. Configuring Express.js App Settings. Defining Routes. Starting the App. Express.js Application Structure. Configuration, Settings. Middleware. body-parser. cookie-parser. express-session. response-time. Template Engine. Jade. EJS. Parameters. Routing. router. route(path). Router Class. Request Object. Response Object. Error Handling.

UNIT V	MONGODB	9	0	0	9

Introduction to Mongo DB. Documents. Collections. Sub collections. Database. Data Types. Dates. Arrays. Embedded Documents. CRUD Operations. Batch Insert. Insert Validation. Querying The Documents. Cursors. Indexing. Unique Indexes. Sparse Indexes. Special Index and Collection Types. Full-Text Indexes. Geospatial Indexing. Aggregation framework.

Total (45 L) =45 Periods

Text Books:

1	Adam Freeman, Essential TypeScript, Apress, 2019
2	Mark Clow, Angular Projects, Apress, 2018
3	Alex R. Young, Marc Harter,Node.js in Practice, Manning Publication, 2014
4	Pro Express.js, Azat Mardan, Apress, 2015

5	MongoDB in Action, Kyle Banker, Peter Bakkum, Shaun Verch, Douglas Garrett, Tim Hawkins, Manning Publication, Second edition, 2016

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Develop basic programming skills using Javascript .	L6
CO2	Implement a front-end web application using Angular.	L3
CO3	Will be able to create modules to organise the server	L6
CO4	Build RESTful APIs with Node, Express and MongoDB with confidence.	L6
CO5	Will learn to Store complex, relational data in MongoDB using Mongoose .	L2

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	2	3	3	3	-	-	-	1	3	3	1	2	2
CO 2	2	2	2	1	2	-	-	-	2	2	1	3	2	2
CO 3	1	1	3	2	3	-	-	-	1	2	1	1	2	2
CO 4	2	3	3	1	2	-	-	-	3	1	2	2	2	2
CO 5	1	2	3	2	2	-	-	-	2	1	3	1	2	2
Avg	**1.8**	**2**	**2.8**	**1.8**	**2.4**	**-**	**-**	**-**	**1.8**	**1.8**	**2**	**1.6**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

18CSH202	APP DEVELOPMENT		Semester			
PREREQUISITES		Category		Credit		
		Hours/Week	L	T	P	TH

Course Learning Objectives

1	To learn development of native applications with basic GUI Components
2	To develop cross-platform applications with event handling
3	To develop applications with location and data storage capabilities
4	To develop web applications with database access

UNIT I	FUNDAMENTALS OF MOBILE & WEB APPLICATION DEVELOPMENT	9	0	0	9

Basics of Web and Mobile application development, Native App, Hybrid App, Cross-platform App, What is Progressive Web App, Responsive Web design

UNIT II	NATIVE APP DEVELOPMENT USING JAVA	9	0	0	9

Native Web App, Benefits of Native App, Scenarios to create Native App, Tools for creating Native App, Cons of Native App, Popular Native App Dev elopment Frameworks, Java & Kotlin for Android, Swift & Objective-C for iOS, Basics of React Native, Native Components, JSX, State, Props

UNIT III	HYBRID APP DEVELOPMENT	9	0	0	9

Hybrid Web App, Benefits of Hybrid App, Criteria for creating Native App, Tools for creating Hybrid App, Cons of Hybrid App, Popular Hybrid App Development Frameworks, Ionic, Apache Cordova

UNIT IV	CROSS-PLATFORM APP DEVELOPMENT USING REACT-NATIVE	9	0	0	9

What is Cross-platform App, Benefits of Cross-platform App, Criteria for creating Cross-platform App, Tools for creating Cross-platform App, Cons of Cross-platform App, Popular Crossplatform App Development Frameworks, Flutter, Xamarin, React-Native, Basics of React Native, Native Components, JSX, State, Props

UNIT V	NON-FUNCTIONAL CHARACTERISTICS OF APP FRAMEWORKS	9	0	0	9

Comparison of different App frameworks, Build Performance, App Performance, Debugging capabilities, Time to Market, Maintainability, Ease of Development, UI/UX, Reusability

Total (45 L) =45 Periods

Text Books:

1	Head First Android Development, Dawn Griffiths, O'Reilly, 1st edition
2	Apache Cordova in Action, Raymond K. Camden, Manning. 2015
	Full Stack React Native: Create beautiful mobile apps with JavaScript and React Native, Anthony Accomazzo, Houssein Djirdeh, Sophia Shoemaker, Devin Abbott, FullStack publishing

Reference Books:

1	Android Programming for Beginners, John Horton, Packt Publishing, 2nd Edition
2	Native Mobile Development by Shaun Lewis, Mike Dunn
3	Building Cross-Platform Mobile and Web Apps for Engineers and Scientists: An Active Learning Approach, Pawan Lingras, Matt Triff, Rucha Lingras
4	Apache Cordova 4 Programming, John M Wargo, 2015
5	React Native Cookbook, Daniel Ward, Packt Publishing, 2nd Edition

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Develop Native applications with GUI Components. .	L6
CO2	Develop hybrid applications with basic event handling.	L6
CO3	Implement cross-platform applications with location and data storage capabilities.	L3
CO4	Implement cross platform applications with basic GUI and event handling.	L3
CO5	Develop web applications with cloud database access.	L6

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	2	2	1	2	3	-	-	-	1	1	2	1	2	2
CO 2	2	1	3	2	2	-	-	-	3	2	2	3	2	2
CO 3	2	2	2	1	2	-	-	-	1	1	1	1	2	2
CO 4	1	3	1	1	3	-	-	-	1	1	3	2	2	2
CO 5	1	1	3	1	3	-	-	-	1	1	2	1	2	2
Avg	**1.6**	**1.8**	**2**	**1.4**	**2.6**	**-**	**-**	**-**	**1.4**	**1.2**	**2**	**1.6**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

18CSH203	SERVICE ORIENTED ARCHITECTURE		Semester		
PREREQUISITES		Category		Credit	
		Hours/Week	L	T	P	TH

Course Learning Objectives

1	To provide an overview of XML Technology and modeling databases in XML
2	To provide an Basics concepts of Service Oriented Architecture
3	To provide an Basics concepts of Service Oriented Architecture
4	To introduce Security solutions in XML and Web Services and to introduce Security standards for Web Services
5	To provide concepts about Big data and SOA with its Business case analysis.

UNIT I	XML TECHNOLOGY	9	0	0	9

XML – XML and Web - Name Spaces – XML Document Structure - Structuring with Schemas and DTD - Modeling Databases in XML – XQuery.

UNIT II	SOA BASICS	9	0	0	9

Service Oriented Architecture (SOA) – Comparing SOA with Client-Server and Distributed architectures - Characteristics of SOA – Benefits of SOA -- Principles of Service orientation – Service layers - Business Process management

UNIT III	WEB SERVICES	9	0	0	9

SOA and Web Services – Web Services Protocol Stack – Service descriptions – WSDL – Messaging with SOAP – Service discovery – UDDI. Service-Level Interaction patterns – XML and Web Services - Enterprise Service Bus - .NET and J2EE Interoperability.

UNIT IV	WS TECHNOLOGIES AND STANDARDS	9	0	0	9

Web Services Technologies - JAX-RPC, JAX-WS. Web Service Standards – WS-RM, WSAddressing, WS-Policy. Service Orchestration and Choreography – Composition Standards - BPEL. Service Oriented Analysis and Design.

UNIT V	BIG DATA AND SOA	9	0	0	9

Big Data and SOA: Concepts, Big Data and its characteristics, Technologies for Big Data, Service-orientation for Big Data Solutions.
Business Case for SOA: Stakeholder Objectives, Benefits of SOA, Cost Savings, Return on Investment (ROI), Build a Case for SOA

Total (45 L) =45 Periods

Text Books:

1	Ron Schmelzer et al. "XML and Web Services", Pearson Education, 2008. (Unit 1 and 3)
2	Thomas Erl, " Service Oriented Architecture: Concepts, Technology, and Design", Pearson Education, 2005 (Unit 2, 3, 4, and 5)
3	Frank P.Coyle, "XML, Web Services and the Data Revolution", Pearson Education, 2002 (Unit 5)
4	Shankar Kambhampaty; Service - Oriented Architecture & Microservices Architecture: For Enterprise, Cloud, Big Data and Mobile; Wiley; 3rd Edition; 2018; ISBN: 9788126564064.

Reference Books:

1	Eric Newcomer, Greg Lomow, "Understanding SOA with Web Services", Addison Wesley, 2005.
2	James McGovern, Sameer Tyagi, Michael E Stevens, Sunil Mathew, "Java Web Services Architecture", Elsevier, 2011.

3	Sandeep Chatterjee and James Webber, "Developing Enterprise Web Services: An Architect's Guide", Prentice Hall, 2004

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Explain the basics of XML	L2
CO2	Describe the concepts of SOA	L1
CO3	Apply the Web services, some of the prevailing standards and technologies of Web Services	L3
CO4	Design approaches for providing security for XML documents as well as messages exchanged among Web Services	L6
CO5	Explain the concepts about Big data and SOA with its Business case analysis	L4

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	3	1	1	1	-	-	-	2	1	3	2	2	2
CO 2	3	1	2	3	2	-	-	-	1	2	3	1	2	2
CO 3	1	1	3	1	3	-	-	-	3	3	1	1	2	2
CO 4	1	1	1	2	3	-	-	-	2	3	3	1	2	2
CO 5	1	3	3	2	2	-	-	-	1	3	1	2	2	2
Avg	**1.8**	**1.8**	**2**	**1.8**	**2.2**	**-**	**-**	**-**	**1.8**	**2.4**	**2.2**	**1.4**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

18CSH204	UI AND UX DESIGN		Semester			
PREREQUISITES		Category	PE	Credit		3
		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives

1	To provide a sound knowledge in UI & UX
2	To understand the need for UI and UX
3	To understand the various Research Methods used in Design
4	To explore the various Tools used in UI & UX
5	Creating a wireframe and prototype

UNIT I	FOUNDATIONS OF DESIGN	9	0	0	9

UI vs. UX Design - Core Stages of Design Thinking - Divergent and Convergent Thinking - Brainstorming and Game storming - Observational Empathy.

UNIT II	FOUNDATIONS OF UI DESIGN	9	0	0	9

Visual and UI Principles - UI Elements and Patterns - Interaction Behaviors and Principles – Branding - Style Guides

UNIT III	FOUNDATIONS OF UX DESIGN	9	0	0	9

Introduction to User Experience - Why You Should Care about User Experience - Understanding User Experience - Defining the UX Design Process and its Methodology - Research in User Experience Design - Tools and Method used for Research - User Needs and its Goals - Know about Business Goals

UNIT IV	WIREFRAMING, PROTOTYPING AND TESTING	9	0	0	9

Sketching Principles - Sketching Red Routes - Responsive Design – Wireframing - Creating Wireflows - Building a Prototype - Building High-Fidelity Mockups - Designing Efficiently with Tools - Interaction Patterns - Conducting Usability Tests - Other Evaluative User Research Methods - Synthesizing Test Findings - Prototype Iteration

UNIT V	RESEARCH, DESIGNING, IDEATING, & INFORMATION ARCHITECTURE	9	0	0	9

Identifying and Writing Problem Statements - Identifying Appropriate Research Methods - Creating Personas - Solution Ideation - Creating User Stories - Creating Scenarios - Flow Diagrams - Flow Mapping - Information Architecture

Total (45+15) = 60 Periods

Text Books:

1	Joel Marsh, “UX for Beginners”, O’Reilly , 2022
2	Jon Yablonski, “Laws of UX using Psychology to Design Better Product & Services” O’Reilly 2021

Reference Books:

1	Jenifer Tidwell, Charles Brewer, Aynne Valencia, “Designing Interface” 3 rd Edition , O’Reilly 2020
2	Steve Schoger, Adam Wathan “Refactoring UI”, 2018
3	Steve Krug, “Don't Make Me Think, Revisited: A Commonsense Approach to Web & Mobile”, Third Edition, 2015
4	https://www.nngroup.com/articles/
5	https://www.interaction-design.org/literature

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Build UI for user Applications	L6
CO2	Evaluate UX design of any product or application	L5
CO3	Demonstrate UX Skills in product development	L1
CO4	Implement Sketching principles	L3
CO5	Create Wireframe and Prototype	L6

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	1	1	3	1	-	-	-	3	3	2	1	2	2
CO 2	2	3	1	3	2	-	-	-	1	2	2	2	2	2
CO 3	1	3	3	2	2	-	-	-	2	3	1	2	2	2
CO 4	1	2	3	3	1	-	-	-	3	2	1	3	2	2
CO 5	1	2	3	2	1	-	-	-	2	1	1	1	2	2
Avg	**1.6**	**2.2**	**2.2**	**2.6**	**1.4**	**-**	**-**	**-**	**2.2**	**2.2**	**1.4**	**1.8**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

18CSH205	SOFTWARE TESTING AND AUTOMATION		Semester			
PREREQUISITES		Category	PE	Credit		3
		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives

1	To understand the basics of software testing
2	To learn how to do the testing and planning effectively
3	To build test cases and execute them
4	To focus on wide aspects of testing and understanding multiple facets of testing
5	To get an insight about test automation and the tools used for test automation

UNIT I	FOUNDATIONS OF SOFTWARE TESTING	9	0	0	9

Why do we test Software?, Black-Box Testing and White-Box Testing, Software Testing Life Cycle, V-model of Software Testing, Program Correctness and Verification, Reliability versus Safety, Failures, Errors and Faults (Defects), Software Testing Principles, Program Inspections, Stages of Testing: Unit Testing, Integration Testing, System Testing

UNIT II	TEST PLANNING	9	0	0	9

The Goal of Test Planning, High Level Expectations, Intergroup Responsibilities, Test Phases, Test Strategy, Resource Requirements, Tester Assignments, Test Schedule, Test Cases, Bug Reporting, Metrics and Statistics.

UNIT III	TEST DESIGN AND EXECUTION	9	0	0	9

Test Objective Identification, Test Design Factors, Requirement identification, Testable Requirements, Modeling a Test Design Process, Modeling Test Results, Boundary Value Testing, Equivalence Class Testing, Path Testing, Data Flow Testing, Test Design Preparedness Metrics, Test Case Design Effectiveness, Model-Driven Test Design, Test Procedures, Test Case Organization and Tracking, Bug Reporting, Bug Life Cycle.

UNIT IV	ADVANCED TESTING CONCEPTS	9	0	0	9

Performance Testing: Load Testing, Stress Testing, Volume Testing, Fail-Over Testing, Recovery Testing, Configuration Testing, Compatibility Testing, Usability Testing, Testing the Documentation, Security testing, Testing in the Agile Environment, Testing Web and Mobile Applications.

UNIT V	TEST AUTOMATION AND TOOLS	9	0	0	9

Automated Software Testing, Automate Testing of Web Applications, Selenium: Introducing Web Driver and Web Elements, Locating Web Elements, Actions on Web Elements, Different Web Drivers, Understanding Web Driver Events, Testing: Understanding Testing.xml, Adding Classes, Packages, Methods to Test, Test Reports.

Total (45 L) =45 Periods

Text Books:

1	Yogesh Singh, “Software Testing”, Cambridge University Press, 2012
2	Unmesh Gundecha, Satya Avasarala, "Selenium WebDriver 3 Practical Guide" - Second Edition 2018

Reference Books:

1	Glenford J. Myers, Corey Sandler, Tom Badgett, The Art of Software Testing, 3rd Edition, 2012, John Wiley & Sons, Inc
2	Ron Patton, Software testing, 2nd Edition, 2006, Sams Publishing
3	Paul C. Jorgensen, Software Testing: A Craftsman’s Approach, Fourth Edition, 2014, Taylor & Francis Group.
4	Carl Cocchiaro, Selenium Framework Design in Data-Driven Testing, 2018, Packt Publishing.

5	Elfriede Dustin, Thom Garrett, Bernie Gaurf, Implementing Automated Software Testing, 2009, Pearson Education, Inc
6	Satya Avasarala, Selenium WebDriver Practical Guide, 2014, Packt Publishing
7	Varun Menon, TestNg Beginner's Guide, 2013, Packt Publishing.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Understand the basic concepts of software testing and the need for software testing	L2
CO2	Design Test planning and different activities involved in test planning	L6
CO3	Design effective test cases that can uncover critical defects in the application	L6
CO4	Carry out advanced types of testing	L2
CO5	Automate the software testing using Selenium and TestNG	L3

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	3	2	1	2	-	-	-	1	1	3	2	2	2
CO 2	2	3	1	1	1	-	-	-	2	2	1	2	2	2
CO 3	2	2	1	3	1	-	-	-	1	3	1	2	2	2
CO 4	2	1	3	2	1	-	-	-	1	1	1	2	2	2
CO 5	2	2	1	3	1	-	-	-	1	3	2	1	2	2
Avg	**2.2**	**2.2**	**1.6**	**2**	**1.2**	**-**	**-**	**-**	**1.2**	**2**	**1.6**	**1.8**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

18CSH206	WEB APPLICATION SECURITY	Semester			
PREREQUISITES	Category	PE	Credit		3
	Hours/Week	L	T	P	TH
		3	0	0	3

Course Learning Objectives

1	To understand the fundamentals of web application security
2	To focus on wide aspects of secure development and deployment of web applications
3	To learn how to build secure APIs
4	To learn the basics of vulnerability assessment and penetration testing
5	To get an insight about Hacking techniques and Tools

UNIT I	FUNDAMENTALS OF WEB APPLICATION SECURITY	9	0	0	9

The history of Software Security-Recognizing Web Application Security Threats, Web Application Security, Authentication and Authorization, Secure Socket layer, Transport layer Security, Session Management-Input Validation

UNIT II	SECURE DEVELOPMENT AND DEPLOYMENT	9	0	0	9

Web Applications Security - Security Testing, Security Incident Response Planning,The Microsoft Security Development Lifecycle (SDL), OWASP Comprehensive Lightweight Application Security Process (CLASP), The Software Assurance Maturity Model (SAMM)

UNIT III	SECURE API DEVELOPMENT	9	0	0	9

API Security- Session Cookies, Token Based Authentication, Securing Natter APIs: Addressing threats with Security Controls, Rate Limiting for Availability, Encryption, Audit logging, Securing service-to-service APIs: API Keys , OAuth2, Securing Microservice APIs: Service Mesh, Locking Down Network Connections, Securing Incoming Requests.

UNIT IV	VULNERABILITY ASSESSMENT AND PENETRATION TESTING	9	0	0	9

Vulnerability Assessment Lifecycle, Vulnerability Assessment Tools: Cloud-based vulnerability scanners, Host-based vulnerability scanners, Network-based vulnerability scanners, Databasebased vulnerability scanners, Types of Penetration Tests: External Testing, Web Application Testing, Internal Penetration Testing, SSID or Wireless Testing, Mobile Application Testing.

UNIT V	HACKING TECHNIQUES AND TOOLS	9	0	0	9

Social Engineering, Injection, Cross-Site Scripting(XSS), Broken Authentication and Session Management, Cross-Site Request Forgery, Security Misconfiguration, Insecure Cryptographic Storage, Failure to Restrict URL Access, Tools: Comodo, OpenVAS, Nexpose, Nikto, Burp Suite, etc.

Total (45 L) =45 Periods

Text Books:

1	Andrew Hoffman, Web Application Security: Exploitation and Countermeasures for Modern Web Applications, First Edition, 2020, O'Reilly Media, Inc.
2	Bryan Sullivan, Vincent Liu, Web Application Security: A Beginners Guide, 2012, The McGrawHill Companies.
3	Neil Madden, API Security in Action, 2020, Manning Publications Co., NY, USA

Reference Books:

1	Michael Cross, Developer's Guide to Web Application Security, 2007, Syngress Publishing, Inc
2	Ravi Das and Greg Johnson, Testing and Securing Web Applications, 2021, Taylor & Francis Group, LLC.
3	Prabath Siriwardena, Advanced API Security, 2020, Apress Media LLC, USA.
4	Malcom McDonald, Web Security for Developers, 2020, No Starch Press, Inc.

5	Allen Harper, Shon Harris, Jonathan Ness, Chris Eagle, Gideon Lenkey, and Terron Williams Grey Hat Hacking: The Ethical Hacker's Handbook, Third Edition, 2011, The McGraw-Hill Companies.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Understanding the basic concepts of web application security and the need for it	L2
CO2	Be acquainted with the process for secure development and deployment of web applications	L2
CO3	Acquire the skill to design and develop Secure Web Applications that use Secure APIs	L2
CO4	Be able to get the importance of carrying out vulnerability assessment and penetration testing	L2
CO5	Acquire the skill to think like a hacker and to use hackers tool sets	L2

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	1	2	2	1	3	-	-	-	-	-	-	1	2	2
CO 2	2	1	2	1	3	-	-	-	-	-	-	-	2	2
CO 3	1	1	1	2	3	-	-	-	-	-	-	1	2	2
CO 4	1	2	1	1	2	-	-	-	-	-	-	-	2	2
CO 5	1	2	2	2	2	-	-	-	-	-	-	1	2	2
Avg	**1.2**	**1.6**	**1.6**	**1.4**	**2.6**	**-**	**-**	**-**	**-**	**-**	**-**	**0.6**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

18CSH207	DEVOPS	Semester			
PREREQUISITES	Category	PE	Credit		3
	Hours/Week	L	T	P	TH
		3	0	0	3

Course Learning Objectives

1	To introduce DevOps terminology, definition & concepts
2	To understand the different Version control tools like Git, Mercurial
3	To understand the concepts of Continuous Integration/ Continuous Testing/ Continuous Deployment)
4	To understand Configuration management using Ansible
5	Illustrate the benefits and drive the adoption of cloud-based Devops tools to solve real world problems

UNIT I	INTRODUCTION TO DEVOPS	9	0	0	9

Devops Essentials - Introduction To AWS, GCP, Azure - Version control systems: Git and Github.

UNIT II	COMPILE AND BUILD USING MAVEN & GRADLE	9	0	0	9

Introduction, Installation of Maven, POM files, Maven Build lifecycle, Build phases(compile build, test, package) Maven Profiles, Maven repositories(local, central, global),Maven plugins, Maven create and build Artificats, Dependency management, Installation of Gradle, Understand build using Gradle

UNIT III	CONTINUOUS INTEGRATION USING JENKINS	9	0	0	9

Install & Configure Jenkins, Jenkins Architecture Overview, Creating a Jenkins Job, Configuring a Jenkins job, Introduction to Plugins, Adding Plugins to Jenkins, Commonly used plugins (Git Plugin, Parameter Plugin, HTML Publisher, Copy Artifact and Extended choice parameters). Configuring Jenkins to work with java, Git and Maven, Creating a Jenkins Build and Jenkins workspace.

UNIT IV	CONFIGURATION MANAGEMENT USING ANSIBLE	9	0	0	9

Ansible Introduction, Installation, Ansible master/slave configuration, YAML basics, Ansible modules, Ansible Inventory files, Ansible playbooks, Ansible Roles, adhoc commands in ansible

UNIT V	BUILDING DEVOPS PIPELINES USING AZURE	9	0	0	9

Create Github Account, Create Repository, Create Azure Organization, Create a new pipeline, Build a sample code, Modify azure-pipelines. yaml file

Total (45+15) = 60 Periods

Text Books:

1	Roberto Vormittag, “A Practical Guide to Git and GitHub for Windows Users: From Beginner to Expert in Easy Step-By-Step Exercises”, Second Edition, Kindle Edition, 2016.
2	Jason Cannon, “Linux for Beginners: An Introduction to the Linux Operating System and Command Line”, Kindle Edition, 2014.

Reference Books:

1	Hands-On Azure Devops: Cicd Implementation For Mobile, Hybrid, And Web Applications Using Azure Devops And Microsoft Azure: CICD Implementation for ... DevOps and Microsoft Azure (English Edition) Paperback – 1 January 2020 by Mitesh Soni
2	Jeff Geerling, “Ansible for DevOps: Server and configuration management for humans”, First Edition, 2015.
3	David Johnson, “Ansible for DevOps: Everything You Need to Know to Use Ansible for DevOps”, Second Edition, 2016..
4	Mariot Tsitoara, “Ansible 6. Beginning Git and GitHub: A Comprehensive Guide to Version Control, Project Management, and Teamwork for the New Developer”, Second Edition, 2019.
5	https://www.jenkins.io/user-handbook.pd

6	https://maven.apache.org/guides/getting-started/

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Understand different actions performed through Version control tools like Git.	L2
CO2	Perform Continuous Integration and Continuous Testing and Continuous Deployment using Jenkins by building and automating test cases using Maven & Gradle.	L3
CO3	Ability to Perform Automated Continuous Deployment	L3
CO4	Ability to do configuration management using Ansible	L3
CO5	Understand to leverage Cloud-based DevOps tools using Azure DevOps	L2

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	3	3	2	3	-	-	-	-	-	-	-	2	2
CO 2	3	3	3	2	3	-	-	-	-	-	-	-	2	2
CO 3	3	3	3	2	3	-	-	-	-	-	-	-	2	2
CO 4	3	3	3	2	3	-	-	-	-	-	-	-	2	2
CO 5	3	3	3	2	3	-	-	-	-	-	-	-	2	2
Avg	**3**	**3**	**3**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

18CSH208	PRINCIPLES OF PROGRAMMING LANGUAGES	Semester			
PREREQUISITES	Category	PE	Credit		3
	Hours/Week	L	T	P	TH
		3	0	0	3

Course Learning Objectives

1	To understand and describe syntax and semantics of programming languages
2	To understand data, data types, and basic statements
3	To understand call-return architecture and ways of implementing them
4	To understand object-orientation, concurrency, and event handling in programming languages
5	To develop programs in non-procedural programming paradigms

UNIT I	SYNTAX AND SEMANTICS	9	0	0	9

Evolution of programming languages – describing syntax – context-free grammars – attribute grammars – describing semantics – lexical analysis – parsing – recursive-descent – bottom up parsing

UNIT II	DATA, DATA TYPES, AND BASIC STATEMENTS	9	0	0	9

Names – variables – binding – type checking – scope – scope rules – lifetime and garbage collection – primitive data types – strings – array types – associative arrays – record types – union types – pointers and references – Arithmetic expressions – overloaded operators – type conversions – relational and boolean expressions – assignment statements – mixed mode assignments – control structures – selection – iterations – branching – guarded statements

UNIT III	SUBPROGRAMS AND IMPLEMENTATIONS	9	0	0	9

Subprograms – design issues – local referencing – parameter passing – overloaded methods – generic methods – design issues for functions – semantics of call and return – implementing simple subprograms – stack and dynamic local variables – nested subprograms – blocks – dynamic scoping.

UNIT IV	OBJECT-ORIENTATION, CONCURRENCY, AND EVENT HANDLING	9	0	0	9

Object-orientation – design issues for OOP languages – implementation of object-oriented constructs – concurrency – semaphores – monitors – message passing – threads – statement level concurrency – exception handling – event handling

UNIT V	FUNCTIONAL AND LOGIC PROGRAMMING LANGUAGES	9	0	0	9

Introduction to lambda calculus – fundamentals of functional programming languages – Programming with Scheme – Programming with ML – Introduction to logic and logic programming – Programming with Prolog – multi-paradigm languages

Total (45 L) =45 Periods

Text Books:

1	Robert W. Sebesta, “Concepts of Programming Languages”, Twelfth Edition (Global Edition), Pearson, 2022.
2	Michael L. Scott, “Programming Language Pragmatics”, Fourth Edition, Elsevier, 2018
	R. Kent Dybvig, “The Scheme programming language”, Fourth Edition, Prentice Hall, 2011.
	Jeffrey D. Ullman, “Elements of ML programming”, Second Edition, Pearson, 1997.
	W. F. Clocksin and C. S. Mellish, “Programming in Prolog: Using the ISO Standard”, Fifth Edition, Springer, 2003

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Describe syntax and semantics of programming languages	L1
CO2	Explain data, data types, and basic statements of programming languages	L2
CO3	Design and implement subprogram constructs	L3
CO4	Apply object-oriented, concurrency, and event handling programming constructs and Develop programs in Scheme, ML, and Prolog	L3
CO5	Understand and adopt new programming languages	L2

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	2	2	3	2	1	-	-	-	-	-	-	3	2	2
CO 2	3	3	3	2	2	-	-	-	-	-	-	3	2	2
CO 3	3	3	3	2	2	-	-	-	-	-	-	3	2	2
CO 4	3	3	3	3	2	2	-	-	-	-	-	-	2	2
CO 5	3	3	3	3	3	3	2	2	1	3	1	3	2	2
Avg	**2.8**	**2.8**	**3**	**2.4**	**2**	**2.5**	**2**	**2**	**1**	**3**	**1**	**3**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

18CSH301	CLOUD COMPUTING		Semester			
PREREQUISITES		Category	PE	Credit		3
		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives

1	To understand the principles of cloud architecture, models and infrastructure.
2	To understand the concepts of virtualization and virtual machines.
3	To gain knowledge about virtualization Infrastructure
4	To explore and experiment with various Cloud deployment environments.
5	To learn about the security issues in the cloud environment.

UNIT I	CLOUD ARCHITECTURE MODELS AND INFRASTRUCTURE	9	0	0	9

Cloud Architecture: System Models for Distributed and Cloud Computing – NIST Cloud Computing Reference Architecture – Cloud deployment models – Cloud service models; Cloud Infrastructure: Architectural Design of Compute and Storage Clouds – Design Challenges

UNIT II	VIRTUALIZATION BASICS	9	0	0	9

Virtual Machine Basics – Taxonomy of Virtual Machines – Hypervisor – Key Concepts – Virtualization structure – Implementation levels of virtualization – Virtualization Types: Full Virtualization – Para Virtualization – Hardware Virtualization – Virtualization of CPU, Memory and I/O devices.

UNIT III	VIRTUALIZATION INFRASTRUCTURE AND DOCKER	9	0	0	9

Desktop Virtualization – Network Virtualization – Storage Virtualization – System-level of Operating Virtualization – Application Virtualization – Virtual clusters and Resource Management – Containers vs. Virtual Machines – Introduction to Docker – Docker Components – Docker Container – Docker Images and Repositories.

UNIT IV	CLOUD DEPLOYMENT ENVIRONMENT	9	0	0	9

Google App Engine – Amazon AWS – Microsoft Azure; Cloud Software Environments – Eucalyptus – OpenStack.

UNIT V	CLOUD SECURITY	9	0	0	9

Virtualization System-Specific Attacks: Guest hopping – VM migration attack – hyperjacking. Data Security and Storage; Identity and Access Management (IAM) - IAM Challenges - IAM Architecture and Practice.

Total (45 L) =45 Periods

Text Books:

1	Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
2	James Turnbull, "The Docker Book", O'Reilly Publishers, 2014
3	Krutz, R. L., Vines, R. D, "Cloud security. A Comprehensive Guide to Secure Cloud Computing", Wiley Publishing, 2010.

Reference Books:

1	James E. Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.
2	Tim Mather, Subra Kumaraswamy, and Shahed Latif, "Cloud Security and Privacy: an enterprise perspective on risks and compliance", O'Reilly Media, Inc., 2009.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Understand the design challenges in the cloud.	L2
CO2	Apply the concept of virtualization and its types	L3
CO3	Experiment with virtualization of hardware resources and Docker	L3
CO4	Develop and deploy services on the cloud and set up a cloud environment.	L6
CO5	Explain security challenges in the cloud environment	L4

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	2	1	1	1	-	-	-	2	3	1	3	2	2
CO 2	3	1	2	2	1	-	-	-	1	2	1	3	2	2
CO 3	2	3	2	3	1	-	-	-	3	1	1	3	2	2
CO 4	1	2	3	3	3	-	-	-	3	3	1	2	2	2
CO 5	2	3	3	1	3	-	-	-	2	2	1	2	2	2
Avg	**2.2**	**2.2**	**2.2**	**2**	**1.8**	**-**	**-**	**-**	**2.2**	**2.2**	**1**	**2.6**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

18CSH302	VIRTUALIZATION	Semester			
PREREQUISITES	Category	PE	Credit		3
	Hours/Week	L	T	P	TH
		3	0	0	3

Course Learning Objectives

1	To Learn the basics and types of Virtualization
2	To understand the Hypervisors and its types.
3	To Explore the Virtualization Solutions
4	To Experiment the virtualization platforms

UNIT I	INTRODUCTION TO VIRTUALIZATION	9	0	0	9

Virtualization and cloud computing - Need of virtualization – cost, administration, fast deployment, reduce infrastructure cost – limitations- Types of hardware virtualization: Full virtualization - partial virtualization - Paravirtualization-Types of Hypervisor

UNIT II	SERVER AND DESKTOP VIRTUALIZATION	9	0	0	9

Virtual machine basics- Types of virtual machines- Understanding Server Virtualization- types of server virtualization- Business Cases for Server Virtualization – Uses of Virtual Server Consolidation – Selecting Server Virtualization Platform- Desktop Virtualization-Types of Desktop Virtualization

UNIT III	NETWORK VIRTUALIZATION	9	0	0	9

Introduction to Network Virtualization-Advantages- Functions-Tools for Network VirtualizationVLAN-WAN Architecture-WAN Virtualization

UNIT IV	STORAGE VIRTUALIZATION	9	0	0	9

Memory Virtualization-Types of Storage Virtualization-Block, File-Address space Remapping-Risks of Storage Virtualization-SAN-NAS-RAID.

UNIT V	VIRTUALIZATION TOOLS	9	0	0	9

VMWare-Amazon AWS-Microsoft HyperV- Oracle VM Virtual Box - IBM PowerVM- Google Virtualization- Case study.

Total (45 L) =45 Periods

Text Books:

1	Cloud computing a practical approach - Anthony T.Velte , Toby J. Velte Robert Elsenpeter, TATA McGraw- Hill , New Delhi – 2010
2	Cloud Computing (Principles and Paradigms), Edited by Rajkumar Buyya, James Broberg, Andrzej Goscinski, John Wiley & Sons, Inc. 2011
3	David Marshall, Wade A. Reynolds, Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center, Auerbach
4	Chris Wolf, Erick M. Halter, “Virtualization: From the Desktop to the Enterprise”, APress, 2005.
5	James E. Smith, Ravi Nair, “Virtual Machines: Versatile Platforms for Systems and Processes”, Elsevier/Morgan Kaufmann, 2005.
6	David Marshall, Wade A. Reynolds, “Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center”, Auerbach Publications, 2006.

Course Outcomes: Upon completion of this course, the students will be able to:		Bloom’s Taxonomy Level
CO1	Analyse the virtualization concepts and Hypervisor	L4

CO2	Apply the Virtualization for real-world applications	L3
CO3	Install & Configure the different VM platforms	L3
CO4	Experiment with the VM with various software	L3

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	1	3	1	3	2	-	-	-	1	1	3	1	2	2
CO 2	3	2	2	1	2	-	-	-	1	2	2	3	2	2
CO 3	3	2	1	3	1	-	-	-	2	2	1	3	2	2
CO 4	1	1	2	3	3	-	-	-	3	3	1	1	2	2
CO 5	1	3	2	3	1	-	-	-	2	1	3	3	2	2
Avg	**1.8**	**2.2**	**1.6**	**2.6**	**1.8**	**-**	**-**	**-**	**1.8**	**1.8**	**2**	**2.2**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

18CSH303	CLOUD SERVICES MANAGEMENT	Semester			
PREREQUISITES	Category	PE	Credit		3
	Hours/Week	L	T	P	TH
		3	0	0	3

Course Learning Objectives

1	Introduce Cloud Service Management terminology, definition & concepts
2	Compare and contrast cloud service management with traditional IT service management
3	Identify strategies to reduce risk and eliminate issues associated with adoption of cloud services
4	Select appropriate structures for designing, deploying and running cloud-based services in a business environment
5	Illustrate the benefits and drive the adoption of cloud-based services to solve real world problems

UNIT I	CLOUD SERVICE MANAGEMENT FUNDAMENTALS	9	0	0	9

Cloud Ecosystem, The Essential Characteristics, Basics of Information Technology Service Management and Cloud Service Management, Service Perspectives, Cloud Service Models, Cloud Service Deployment Models

UNIT II	CLOUD SERVICES STRATEGY	9	0	0	9

Cloud Strategy Fundamentals, Cloud Strategy Management Framework, Cloud Policy, Key Driver for Adoption, Risk Management, IT Capacity and Utilization, Demand and Capacity matching, Demand Queueing, Change Management, Cloud Service Architecture

UNIT III	CLOUD SERVICE MANAGEMENT	9	0	0	9

Cloud Service Reference Model, Cloud Service LifeCycle, Basics of Cloud Service Design, Dealing with Legacy Systems and Services, Benchmarking of Cloud Services, Cloud Service Capacity Planning, Cloud Service Deployment and Migration, Cloud Marketplace, Cloud Service Operations Management

UNIT IV	CLOUD SERVICE ECONOMICS	9	0	0	9

Pricing models for Cloud Services, Freemium, Pay Per Reservation, Pay per User, Subscription based Charging, Procurement of Cloud-based Services, Capex vs Opex Shift, Cloud service Charging, Cloud Cost Models.

UNIT V	CLOUD SERVICE GOVERNANCE & VALUE	9	0	0	9

IT Governance Definition, Cloud Governance Definition, Cloud Governance Framework, Cloud Governance Structure, Cloud Governance Considerations, Cloud Service Model Risk Matrix, Understanding Value of Cloud Services, Measuring the value of Cloud Services, Balanced Scorecard, Total Cost of Ownership.

Total (45 L) =45 Periods

Text Books:

1	Cloud Service Management and Governance: Smart Service Management in Cloud Era by Enamul Haque, Enel Publications
2	Cloud Computing: Concepts, Technology & Architecture by Thomas Erl, Ricardo Puttini, Zaigham Mohammad 2013
3	Cloud Computing Design Patterns by Thomas Erl, Robert Cope, Amin Naserpour

Reference Books:

1	Economics of Cloud Computing by Praveen Ayyappa, LAP Lambert Academic Publishing
2	Mastering Cloud Computing Foundations and Applications Programming Rajkumar Buyya, Christian Vechhiola, S. Thamarai Selvi

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Exhibit cloud-design skills to build and automate business solutions using cloud technologies.	L1
CO2	Possess Strong theoretical foundation leading to excellence and excitement towards adoption of cloud-based services	L2
CO3	Solve the real world problems using Cloud services and technologies	L3
CO4	Understand the pricing model of cloud.	L2
CO5	Understand the Cloud service Governance and value	L2

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	3	1	1	1	-	-	-	2	1	3	2	2	2
CO 2	3	1	2	3	2	-	-	-	1	2	3	1	2	2
CO 3	1	1	3	1	3	-	-	-	3	3	1	1	2	2
CO 4	1	1	1	2	3	-	-	-	2	3	3	1	2	2
CO 5	1	3	3	2	2	-	-	-	1	3	1	2	2	2
Avg	**1.8**	**1.8**	**2**	**1.8**	**2.2**	**-**	**-**	**-**	**1.8**	**2.4**	**2.2**	**1.4**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

18CSH304	DATA WAREHOUSING		Semester			
PREREQUISITES		Category	PE	Credit		3
		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives

1	To know the details of data warehouse Architecture
2	To understand the OLAP Technology
3	To understand the partitioning strategy
4	To differentiate various schema
5	To understand the roles of process manager & system manager

UNIT I	INTRODUCTION TO DATA WAREHOUSE	9	0	0	9

Data warehouse Introduction - Data warehouse components- operational database Vs data warehouse – Data warehouse Architecture – Three-tier Data Warehouse Architecture - Autonomous Data Warehouse- Autonomous Data Warehouse Vs Snowflake - Modern Data Warehouse

UNIT II	ETL AND OLAP TECHNOLOGY	9	0	0	9

What is ETL – ETL Vs ELT – Types of Data warehouses - Data warehouse Design and Modeling - Delivery Process - Online Analytical Processing (OLAP) - Characteristics of OLAP - Online Transaction Processing (OLTP) Vs OLAP - OLAP operations- Types of OLAP- ROLAP Vs MOLAP Vs HOLAP

UNIT III	META DATA, DATA MART AND PARTITION STRATEGY	9	0	0	9

Meta Data – Categories of Metadata – Role of Metadata – Metadata Repository – Challenges for Meta Management - Data Mart – Need of Data Mart- Cost Effective Data Mart- Designing Data Marts- Cost of Data Marts- Partitioning Strategy – Vertical partition – Normalization – Row Splitting – Horizontal Partition

UNIT IV	DIMENSIONAL MODELING AND SCHEMA	9	0	0	9

Dimensional Modeling- Multi-Dimensional Data Modeling – Data Cube- Star Schema- Snowflake schema- Star Vs Snowflake schema- Fact constellation Schema- Schema Definition - Process Architecture- Types of Data Base Parallelism – Datawarehouse Tools

UNIT V	SYSTEM & PROCESS MANAGERS	9	0	0	9

Data Warehousing System Managers: System Configuration Manager- System Scheduling Manager - System Event Manager - System Database Manager - System Backup Recovery Manager - Data Warehousing Process Managers: Load Manager – Warehouse Manager- Query Manager – Tuning – Testing

Total (45 L) =45 Periods

Text Books:

1	Alex Berson and Stephen J. Smith “Data Warehousing, Data Mining & OLAP”, Tata McGraw – Hill Edition, Thirteenth Reprint 2008.
2	Ralph Kimball, “The Data Warehouse Toolkit: The Complete Guide to Dimensional Modeling”, Third edition, 2013

Reference Books:

1	Paul Raj Ponniah, “Data warehousing fundamentals for IT Professionals”, 2012.
2	K.P. Soman, ShyamDiwakar and V. Ajay “Insight into Data mining Theory and Practice”, Easter Economy Edition, Prentice Hall of India, 2006.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Design data warehouse architecture for various Problems	L6
CO2	Apply the OLAP Technology	L3
CO3	Analyse the partitioning strategy	L4
CO4	Critically analyze the differentiation of various schema for given problem	L4
CO5	Frame roles of process manager & system manager	L2

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	3	3	2	2	-	-	-	3	-	-	3	2	2
CO 2	3	2	2	2	3	-	-	-	2	-	2	2	2	2
CO 3	3	3	3	3	-	-	-	-	-	-	-	3	2	2
CO 4	3	3	3	3	-	-	-	-	-	-	-	3	2	2
CO 5	3	2	2	2	-	2	-	-	-	-	2	2	2	2
Avg	**3**	**2.6**	**2.6**	**1.2**	**2.5**	**1**	**-**	**-**	**2.5**	**-**	**2**	**2.6**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

18CSH305	STORAGE TECHNOLOGIES	Semester			
PREREQUISITES	Category	PE	Credit		3
	Hours/Week	L	T	P	TH
		3	0	0	3

Course Learning Objectives

1	Characterize the functionalities of logical and physical components of storage
2	Describe various storage networking technologies
3	Identify different storage virtualization technologies
4	Discuss the different backup and recovery strategies
5	Understand common storage management activities and solutions

UNIT I	STORAGE SYSTEMS	9	0	0	9

Introduction to Information Storage: Digital data and its types, Information storage, Key characteristics of data center and Evolution of computing platforms. Information Lifecycle Management. Third Platform Technologies: Cloud computing and its essential characteristics, Cloud services and cloud deployment models, Big data analytics, Social networking and mobile computing, Characteristics of third platform infrastructure and Imperatives for third platform transformation. Data Center Environment: Building blocks of a data center, Compute systems and compute virtualization and Software-defined data center.

UNIT II	INTELLIGENT STORAGE SYSTEMS AND RAID	9	0	0	9

Components of an intelligent storage system, Components, addressing, and performance of hard disk drives and solid-state drives, RAID, Types of intelligent storage systems, Scale-up and scaleout storage Architecture.

UNIT III	STORAGE NETWORKING TECHNOLOGIES AND VIRTUALIZATION	9	0	0	9

Block-Based Storage System, File-Based Storage System, Object-Based and Unified Storage. Fibre Channel SAN: Software-defined networking, FC SAN components and architecture, FC SAN topologies, link aggregation, and zoning, Virtualization in FC SAN environment. Internet Protocol SAN: iSCSI protocol, network components, and connectivity, Link aggregation, switch aggregation, and VLAN, FCIP protocol, connectivity, and configuration. Fibre Channel over Ethernet SAN: Components of FCoE SAN, FCoE SAN connectivity, Converged Enhanced Ethernet, FCoE architecture.

UNIT IV	BACKUP, ARCHIVE AND REPLICATION	9	0	0	9

Introduction to Business Continuity, Backup architecture, Backup targets and methods, Data deduplication, Cloud-based and mobile device backup, Data archive, Uses of replication and its characteristics, Compute based, storage-based, and network-based replication, Data migration, Disaster Recovery as a Service (DRaaS).

UNIT V	SECURING STORAGE INFRASTRUCTURE	9	0	0	9

Information security goals, Storage security domains, Threats to a storage infrastructure, Security controls to protect a storage infrastructure, Governance, risk, and compliance, Storage infrastructure management functions, Storage infrastructure management processes.

Total (45 L) =45 Periods

Text Books:

1	EMC Corporation, Information Storage and Management, Wiley, India
2	Jon Tate, Pall Beck, Hector Hugo Ibarra, Shanmuganathan Kumaravel and Libor Miklas, Introduction to Storage Area Networks, Ninth Edition, IBM - Redbooks, December 2017
3	Ulf Troppens, Rainer Erkens, Wolfgang Mueller-Friedt, Rainer Wolafka, Nils Haustein ,Storage Networks Explained, Second Edition, Wiley, 2009

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Demonstrate the fundamentals of information storage management and various models of Cloud infrastructure services and deployment	L1
CO2	Illustrate the usage of advanced intelligent storage systems and RAID	L3
CO3	Interpret various storage networking architectures - SAN, including storage subsystems and virtualization	L4
CO4	Examine the different role in providing disaster recovery and remote replication technologies	L4
CO5	Infer the security needs and security measures to be employed in information storage management	L2

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	1	2	1	3	3	-	-	-	1	1	1	3	2	2
CO 2	3	1	2	3	3	-	-	-	3	2	3	2	2	2
CO 3	1	1	3	2	2	-	-	-	3	1	1	2	2	2
CO 4	3	2	1	2	2	-	-	-	1	1	3	1	2	2
CO 5	1	3	2	1	2	-	-	-	1	2	3	1	2	2
Avg	**1.8**	**1.8**	**1.8**	**2.2**	**2.4**	**-**	**-**	**-**	**1.8**	**1.4**	**2.2**	**1.8**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

18CSH306	SOFTWARE DEFINED NETWORKS		Semester			
PREREQUISITES		Category	PE	Credit		3
		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives

1	To understand the need for SDN and its data plane operations
2	To understand the functions of control plane
3	To comprehend the migration of networking functions to SDN environment
4	To explore various techniques of network function virtualization
5	To comprehend the concepts behind network virtualization

UNIT I	**SDN: INTRODUCTION**	**9**	**0**	**0**	**9**
Evolving Network Requirements – The SDN Approach – SDN architecture - SDN Data Plane , Control plane and Application Plane					
UNIT II	**SDN DATA PLANE AND CONTROL PLANE**	**9**	**0**	**0**	**9**
Data Plane functions and protocols - OpenFLow Protocol - Flow Table - Control Plane Functions - Southbound Interface, Northbound Interface – SDN Controllers - Ryu, OpenDaylight, ONOS - Distributed Controllers.					
UNIT III	**SDN APPLICATIONS**	**9**	**0**	**0**	**9**
SDN Application Plane Architecture – Network Services Abstraction Layer – Traffic Engineering – Measurement and Monitoring – Security – Data Center Networking					
UNIT IV	**NETWORK FUNCTION VIRTUALIZATION**	**9**	**0**	**0**	**9**
Network Virtualization - Virtual LANs – OpenFlow VLAN Support - NFV Concepts – Benefits and Requirements – Reference Architecture					
UNIT V	**NFV FUNCTIONALITY**	**9**	**0**	**0**	**9**
NFV Infrastructure – Virtualized Network Functions – NFV Management and Orchestration – NFV Use cases – SDN and NFV					
Total (45 L) =45 Periods					

Text Books:

1	William Stallings, "Foundations of Modern Networking: SDN, NFV, QoE, IoT and Cloud", Pearson Education, I Edition, 2015.

Reference Books:

1	Ken Gray, Thomas D. Nadeau, "Network Function Virtualization", Morgan Kauffman, 2016
2	Thomas D Nadeau, Ken Gray, "SDN: Software Defined Networks", O'Reilly Media, 2013.
3	Fei Hu, "Network Innovation through OpenFlow and SDN: Principles and Design", 1st Edition, CRC Press, 2014.
4	Paul Goransson, Chuck Black Timothy Culver, "Software Defined Networks: A Comprehensive Approach", 2nd Edition, Morgan Kaufmann Press, 2016
5	Oswald Coker, Siamak Azodolmolky, "Software-Defined Networking with OpenFlow", 2nd Edition, O'Reilly Media, 2017.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Describe the motivation behind SDN	L1
CO2	Identify the functions of the data plane and control plane	L3
CO3	Design and develop network applications using SDN	L6
CO4	Orchestrate network services using NFV	L4
CO5	Explain various use cases of SDN and NFV	L4

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	1	2	3	1	3	-	-	-	2	3	1	3	2	2
CO 2	2	1	2	2	3	-	-	-	2	2	2	2	2	2
CO 3	2	2	2	3	3	-	-	-	3	1	1	2	2	2
CO 4	2	2	2	3	1	-	-	-	1	3	1	2	2	2
CO 5	3	3	1	1	3	-	-	-	1	2	1	2	2	2
Avg	**2**	**2**	**2**	**2**	**2.6**	**-**	**-**	**-**	**1.8**	**2.2**	**1.2**	**2.2**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

18CSH307	STREAM PROCESSING	Semester			
PREREQUISITES	Category	PE	Credit		3
	Hours/Week	L	T	P	TH
		3	0	0	3

Course Learning Objectives

1	Introduce Data Processing terminology, definition & concepts
2	Define different types of Data Processing
3	Explain the concepts of Real-time Data processing
4	Select appropriate structures for designing and running real-time data services in a business environment
5	Illustrate the benefits and drive the adoption of real-time data services to solve real world problems

UNIT I	FOUNDATIONS OF DATA SYSTEMS	9	0	0	9

Introduction to Data Processing, Stages of Data processing, Data Analytics, Batch Processing, Stream processing, Data Migration, Transactional Data processing, Data Mining, Data Management Strategy, Storage, Processing, Integration, Analytics, Benefits of Data as a Service, Challenges

UNIT II	REAL-TIME DATA PROCESSING	9	0	0	9

Introduction to Big data, Big data infrastructure, Real-time Analytics, Near real-time solution, Lambda architecture, Kappa Architecture, Stream Processing,Understanding Data Streams, Message Broker, Stream Processor, Batch & Real-time ETL tools, Streaming Data Storage

UNIT III	DATA MODELS AND QUERY LANGUAGES	9	0	0	9

Relational Model, Document Model, Key-Value Pairs, NoSQL, Object-Relational Mismatch, Manyto-One and Many-to-Many Relationships, Network data models, Schema Flexibility, Structured Query Language, Data Locality for Queries, Declarative Queries, Graph Data models, Cypher Query Language, Graph Queries in SQL, The Semantic Web, CODASYL, SPARQL

UNIT IV	EVENT PROCESSING WITH APACHE KAFKA	9	0	0	9

Apache Kafka, Kafka as Event Streaming platform, Events, Producers, Consumers, Topics, Partitions, Brokers, Kafka APIs, Admin API, Producer API, Consumer API, Kafka Streams API, Kafka Connect API

UNIT V	REAL-TIME PROCESSING USING SPARK STREAMING	9	0	0	9

Structured Streaming, Basic Concepts, Handling Event-time and Late Data, Fault-tolerant Semantics, Exactly-once Semantics, Creating Streaming Datasets, Schema Inference, Partitioning of Streaming datasets, Operations on Streaming Data, Selection, Aggregation, Projection, Watermarking, Window operations, Types of Time windows, Join Operations, Deduplication

Total (45 L) =45 Periods

Text Books:

1	Streaming Systems: The What, Where, When and How of Large-Scale Data Processing by Tyler Akidau, Slava Chemyak, Reuven Lax, O'Reilly publication
2	Designing Data-Intensive Applications by Martin Kleppmann, O'Reilly Media
	Practical Real-time Data Processing and Analytics : Distributed Computing and Event Processing using Apache Spark, Flink, Storm and Kafka, Packt Publishing

Reference Books:

1	https://spark.apache.org/docs/latest/streaming-programming-guide.html
2	Kafka.apache.org

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Understand the applicability and utility of different streaming algorithms.	L2
CO2	Describe and apply current research trends in data-stream processing.	L1
CO3	Analyze the suitability of stream mining algorithms for data stream systems.	L4
CO4	Program and build stream processing systems, services and applications.	L6
CO5	Solve problems in real-world applications that process data streams.	L3

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	3	2	3	1	-	-	-	2	3	1	2	2	2
CO 2	2	1	1	2	2	-	-	-	3	2	2	3	2	2
CO 3	3	1	2	3	3	-	-	-	2	2	1	1	2	2
CO 4	2	1	3	3	3	-	-	-	3	3	1	1	2	2
CO 5	3	3	1	2	2	-	-	-	3	3	2	3	2	2
Avg	**2.6**	**1.8**	**1.8**	**2.6**	**2.2**	**-**	**-**	**-**	**2.6**	**2.6**	**1.4**	**2**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

18CSH308	SECURITY AND PRIVACY IN CLOUD		Semester			
PREREQUISITES		Category	PE	Credit		3
		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives

1	To Introduce Cloud Computing terminology, definition & concepts
2	To understand the security design and architectural considerations for Cloud
3	To understand the Identity, Access control in Cloud
4	To follow best practices for Cloud security using various design patterns
5	To be able to monitor and audit cloud applications for security

UNIT I	FUNDAMENTALS OF CLOUD SECURITY CONCEPTS	9	0	0	9

Overview of cloud security- Security Services - Confidentiality, Integrity, Authentication, Nonrepudiation, Access Control - Basic of cryptography - Conventional and public-key cryptography, hash functions, authentication, and digital signatures

UNIT II	SECURITY DESIGN AND ARCHITECTURE FOR CLOUD	9	0	0	9

Security design principles for Cloud Computing - Comprehensive data protection - End-to-end access control - Common attack vectors and threats - Network and Storage - Secure Isolation Strategies - Virtualization strategies - Inter-tenant network segmentation strategies - Data Protection strategies: Data retention, deletion and archiving procedures for tenant data, Encryption, Data Redaction, Tokenization, Obfuscation, PKI and Key

UNIT III	ACCESS CONTROL AND IDENTITY MANAGEMENT	9	0	0	9

Access control requirements for Cloud infrastructure - User Identification - Authentication and Authorization - Roles-based Access Control - Multi-factor authentication - Single Sign-on, Identity Federation - Identity providers and service consumers - Storage and network access control options - OS Hardening and minimization - Verified and measured boot - Intruder Detection and prevention

UNIT IV	CLOUD SECURITY DESIGN PATTERNS	9	0	0	9

Introduction to Design Patterns, Cloud bursting, Geo-tagging, Secure Cloud Interfaces, Cloud Resource Access Control, Secure On-Premise Internet Access, Secure External Cloud

UNIT V	MONITORING, AUDITING AND MANAGEMENT	9	0	0	9

Proactive activity monitoring - Incident Response, Monitoring for unauthorized access, malicious traffic, abuse of system privileges - Events and alerts - Auditing – Record generation, Reporting and Management, Tamper-proofing audit logs, Quality of Services, Secure Management, User management, Identity management, Security Information and Event Management

Total (45 L) =45 Periods

Text Books:

1	Raj Kumar Buyya , James Broberg, andrzejGoscinski, “Cloud Computing:‖, Wiley 2013
2	Dave shackleford, “Virtualization Security‖, SYBEX a wiley Brand 2013.
3	Mather, Kumaraswamy and Latif, “Cloud Security and Privacy‖, OREILLY 2011

Reference Books:

1	Mark C. Chu-Carroll “Code in the Cloud‖,CRC Press, 2011
2	Mastering Cloud Computing Foundations and Applications Programming RajkumarBuyya, Christian Vechhiola, S. ThamaraiSelvi

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Understand the cloud concepts and fundamentals.	L2
CO2	Explain the security challenges in the cloud.	L2
CO3	Define cloud policy and Identity and Access Management.	L1
CO4	Understand various risks and audit and monitoring mechanisms in the cloud.	L2
CO5	Define the various architectural and design considerations for security in the cloud.	L1

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	3	3	1	2	-	-	-	1	1	1	3	2	2
CO 2	1	3	2	3	1	-	-	-	2	2	3	2	2	2
CO 3	3	2	2	3	2	-	-	-	3	1	1	2	2	2
CO 4	2	1	2	3	3	-	-	-	3	2	3	3	2	2
CO 5	1	3	3	1	1	-	-	-	2	3	3	2	2	2
Avg	**2**	**2.4**	**2.4**	**2.2**	**1.8**	**-**	**-**	**-**	**2.2**	**1.8**	**2.2**	**2.4**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

18CSH401	CYBER PHYSICAL SYSTEMS		Semester			
PREREQUISITES		Category	PE	Credit		3
		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives

1	To provide introduction to Microcontroller and Embedded Systems.
2	To equip students with essential tools for Embedded systems.
3	To foster understanding through real-world applications related to embedded systems
4	To know logics towards solving a unknown problem
5	To Familiarize cyber physical systems applications.

UNIT I	INTRODUCTION	9	0	0	9

Cyber-Physical System, Key Features of CPS, Application Domains of CPS, Basic principles of design and validation of CPS, Challenges in CPS.

UNIT II	CPS PLATFORM COMPONENTS	9	0	0	9

CPS HW platforms, Processors, Sensors and Actuators, CPS Network - Wireless, CAN,Automotive Ethernet, Scheduling Real Time CPS tasks, Synchronous Model and Asynchronous Model.

UNIT III	SYNCHRONOUS AND ASYNCHRONOUS MODEL	9	0	0	9

Reactive Components, Components Properties, Components Composing, Synchronous Designs and Circuits, Asynchronous Processes and operations, Design Primitives in Asynchronous Process, Coordination Protocols in Asynchronous Process, Leader Election, Reliable Transmission..

UNIT IV	SECURITY OF CYBER-PHYSICAL SYSTEMS	9	0	0	9

Introduction to CPS Securities, Basic Techniques in CPS Securities, Cyber Security Requirements, Attack Model and Countermeasures, Advanced Techniques in CPS Securities.

UNIT V	CPS APPLICATION	9	0	0	9

Health care and Medical Cyber-Physical Systems, Smart grid and Energy Cyber Physical Systems, WSN based Cyber-Physical Systems, Smart Cities

Total (45 L) =45 Periods

Text Books:

1	E. A. Lee and S. A. Seshia, “Introduction to Embedded Systems: A Cyber-Physical Systems Approach”, 2011.
2	R. Alur, “Principles of Cyber-Physical Systems,” MIT Press, 2015.

Reference Books:

1	Raj Rajkumar, Dionisio de Niz and Mark Klein, “Cyber-Physical Systems”, Addison- Wesley, 2017
2	Rajeev Alur, “Principles of Cyber-Physical Systems”, MIT Press, 2015
3	Fei Hu, “Cyber-Physical Systems”, CRC Press 2013

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Apply Embedded system concepts to solve real word problems.	L1
CO2	Present solution to automated systems to make life easier.	L2
CO3	Apply concepts of embedded systems and microcontroller to enhance existing systems	L1
CO4	Ability to develop concepts, logics towards solving a unknown problem in research and industry..	L2
CO5	Describe cyber physical systems applications	L1

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	2	2	3	2	1	-	-	-	1	2	2	1	2	2
CO 2	1	2	1	2	1	-	-	-	2	2	1	1	2	2
CO 3	2	2	3	3	1	-	-	-	1	2	1	2	2	2
CO 4	2	1	1	2	1	-	-	-	1	3	3	3	2	2
CO 5	2	3	1	1	2	-	-	-	2	1	1	1	2	2
Avg	**1.8**	**2**	**1.8**	**2**	**1.2**	**-**	**-**	**-**	**1.4**	**2**	**1.6**	**1.6**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

18CSH402	ETHICAL HACKING	Semester			
PREREQUISITES	Category	PE	Credit		3
	Hours/Week	L	T	P	TH
		3	0	0	3

Course Learning Objectives

1	To understand the basics of computer based vulnerabilities.
2	To explore different foot printing, reconnaissance and scanning methods.
3	To expose the enumeration and vulnerability analysis methods.
4	To understand hacking options available in Web and wireless applications
5	To explore the options for network protection.
6	To practice tools to perform ethical hacking to expose the vulnerabilities.

UNIT I	INTRODUCTION	9	0	0	9

Ethical Hacking Overview - Role of Security and Penetration Testers .- Penetration-Testing Methodologies- Laws of the Land - Overview of TCP/IP- The Application Layer - The Transport Layer - The Internet Layer - IP Addressing .- Network and Computer Attacks - Malware – Protecting Against Malware Attacks.- Intruder Attacks - Addressing Physical Security

UNIT II	FOOT PRINTING, RECONNAISSANCE AND SCANNING NETWORKS	9	0	0	9

Footprinting Concepts - Footprinting through Search Engines, Web Services, Social Networking Sites, Website, Email - Competitive Intelligence - Footprinting through Social Engineering - Footprinting Tools - Network Scanning Concepts - Port-Scanning Tools - Scanning Techniques - Scanning Beyond IDS and Firewall

UNIT III	ENUMERATION AND VULNERABILITY ANALYSIS	9	0	0	9

Enumeration Concepts - NetBIOS Enumeration – SNMP, LDAP, NTP, SMTP and DNS Enumeration - Vulnerability Assessment Concepts - Desktop and Server OS Vulnerabilities - Windows OS Vulnerabilities - Tools for Identifying Vulnerabilities in Windows- Linux OS Vulnerabilities- Vulnerabilities of Embedded Oss

UNIT IV	SYSTEM HACKING	9	0	0	9

Hacking Web Servers - Web Application Components- Vulnerabilities - Tools for Web Attackers and Security Testers Hacking Wireless Networks - Components of a Wireless Network – Wardriving- Wireless Hacking - Tools of the Trade

UNIT V	NETWORK PROTECTION SYSTEMS	9	0	0	9

Access Control Lists. - Cisco Adaptive Security Appliance Firewall - Configuration and Risk Analysis Tools for Firewalls and Routers - Intrusion Detection and Prevention Systems - Network-Based and Host-Based IDSs and IPSs - Web Filtering - Security Incident Response Teams – Honeypots.

Total (45 L) =45 Periods

Text Books:

1	Michael T. Simpson, Kent Backman, and James E. Corley, Hands-On Ethical Hacking and Network Defense, Course Technology, Delmar Cengage Learning, 2010.
2	The Basics of Hacking and Penetration Testing - Patrick Engebretson, SYNGRESS, Elsevier, 2013.
3	The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws, Dafydd Stuttard and Marcus Pinto, 2011.

Reference Books:

1	Black Hat Python: Python Programming for Hackers and Pentesters, Justin Seitz , 2014

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	To express knowledge on basics of computer based vulnerabilities.	L1
CO2	To gain understanding on different foot printing, reconnaissance and scanning methods	L2
CO3	To demonstrate the enumeration and vulnerability analysis methods.	L1
CO4	To gain knowledge on hacking options available in Web and wireless applications.	L2
CO5	To acquire knowledge on the options for network protection	L1
	To use tools to perform ethical hacking to expose the vulnerabilities	L3

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	2	2	3	2	1	-	-	-	1	2	2	1	2	2
CO 2	1	2	1	2	1	-	-	-	2	2	1	1	2	2
CO 3	2	2	3	3	1	-	-	-	1	2	1	2	2	2
CO 4	2	1	1	2	1	-	-	-	1	3	3	3	2	2
CO 5	2	3	1	1	2	-	-	-	2	1	1	1	2	2
Avg	**1.8**	**2**	**1.8**	**2**	**1.2**	**-**	**-**	**-**	**1.4**	**2**	**1.6**	**1.6**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

18CSH403	DIGITAL AND MOBILE FORENSICS	Semester			
PREREQUISITES	Category	PE	Credit		3
	Hours/Week	L	T	P	TH
		3	0	0	3

Course Learning Objectives

1	To understand basic digital forensics and techniques..
2	To understand digital crime and investigation.
3	To understand how to be prepared for digital forensic readiness.
4	To understand and use forensics tools for iOS devices
5	To understand and use forensics tools for Android devices.

UNIT I	INTRODUCTION TO DIGITAL FORENSICS	9	0	0	9

Forensic Science - Digital Forensics - Digital Evidence - The Digital Forensics Process - Introduction - The Identification Phase - The Collection Phase - The Examination Phase - The Analysis Phase - The Presentation Phase

UNIT II	DIGITAL CRIME AND INVESTIGATION	9	0	0	9

Digital Crime – Substantive Criminal Law – General Conditions – Offenses – Investigation Methods for Collecting Digital Evidence – International Cooperation to Collect Digital Evidence

UNIT III	DIGITAL FORENSIC READINESS	9	0	0	9

Introduction - Law Enforcement versus Enterprise Digital Forensic Readiness - Rationale for Digital Forensic Readiness - Frameworks, Standards and Methodologies - Enterprise Digital Forensic Readiness - Challenges in Digital Forensics

UNIT IV	iOS FORENSICS	9	0	0	9

Mobile Hardware and Operating Systems - iOS Fundamentals - Jailbreaking - File System - Hardware - iPhone Security - iOS Forensics - Procedures and Processes - Tools - Oxygen Forensics - MobilEdit - iCloud

UNIT V	ANDROID FORENSICS	9	0	0	9

Android basics – Key Codes – ADB – Rooting Android – Boot Process – File Systems – Security – Tools – Android Forensics – Forensic Procedures – ADB – Android Only Tools – Dual Use Tools – Oxygen Forensics – MobilEdit – Android App Decompiling

Total (45+15) = 60 Periods

Text Books:

1	Andre Arnes, "Digital Forensics", Wiley, 2018.
2	Chuck Easttom, "An In-depth Guide to Mobile Device Forensics", First Edition, CRC Press, 2022.

Reference Books:

1	Vacca, J, Computer Forensics, Computer Crime Scene Investigation, 2nd Ed, Charles River Media, 2005, ISBN: 58450-389.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Have knowledge on digital forensics..	L1
CO2	Know about digital crime and investigations	L1
CO3	Be forensic ready.	L1
CO4	Investigate, identify and extract digital evidence from iOS devices	L4
CO5	Investigate, identify and extract digital evidence from Android devices	L4

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	1	3	2	1	-	-	-	1	1	3	3	2	2
CO 2	3	3	3	3	3	-	-	-	2	2	1	2	2	2
CO 3	3	3	2	3	1	-	-	-	3	2	1	1	2	2
CO 4	3	1	2	2	3	-	-	-	1	3	3	2	2	2
CO 5	1	3	2	3	2	-	-	-	2	3	2	3	2	2
Avg	**3**	**2**	**2**	**3**	**2**	**-**	**-**	**-**	**2**	**2**	**2**	**2**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

18CSH404	SOCIAL NETWORK SECURITY		Semester			
PREREQUISITES		Category	PE	Credit		3
		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives

1	To develop semantic web related simple applications
2	To explain Privacy and Security issues in Social Networking
3	To explain the data extraction and mining of social networks
4	To discuss the prediction of human behavior in social communities
5	To describe the Access Control, Privacy and Security management of social networks.

UNIT I	FUNDAMENTALS OF SOCIAL NETWORKING	9	0	0	9

Introduction to Semantic Web, Limitations of current Web, Development of Semantic Web, Emergence of the Social Web, Social Network analysis, Development of Social Network Analysis, Key concepts and measures in network analysis, Historical overview of privacy and security, Major paradigms, for understanding privacy and security

UNIT II	SECURITY ISSUES IN SOCIAL NETWORKS	9	0	0	9

The evolution of privacy and security concerns with networked technologies, Contextual influences on privacy attitudes and behaviors, Anonymity in a networked world

UNIT III	EXTRACTION AND MINING IN SOCIAL NETWORKING DATA	9	0	0	9

Extracting evolution of Web Community from a Series of Web Archive, Detecting communities in social networks, Definition of community, Evaluating communities, Methods for community detection and mining, Applications of community mining algorithms, Tools for detecting communities social network infrastructures and communities, Big data and Privacy

UNIT IV	PREDICTING HUMAN BEHAVIOR AND PRIVACY ISSUES	9	0	0	9

Understanding and predicting human behavior for social communities, User data Management, Inference and Distribution, Enabling new human experiences, Reality mining, Context, Awareness, Privacy in online social networks, Trust in online environment, What is Neo4j, Nodes, Relationships, Properties.

UNIT V	ACCESS CONTROL, PRIVACY AND IDENTITY MANAGEMENT	9	0	0	9

Understand the access control requirements for Social Network, Enforcing Access Control Strategies, Authentication and Authorization, Roles-based Access Control, Host, storage and network access control options, Firewalls, Authentication, and Authorization in Social Network,Identity & Access Management, Single Sign-on, Identity Federation, Identity providers and service consumers, The role of Identity provisioning

Total (45 L) =45 Periods

Text Books:

1	Peter Mika, Social Networks and the Semantic Web, First Edition, Springer 2007.
2	BorkoFurht, Handbook of Social Network Technologies and Application, First Edition, Springer, 2010.
3	Learning Neo4j 3.x Second Edition By Jérôme Baton, Rik Van Bruggen, Packt publishing
4	David Easley, Jon Kleinberg, Networks, Crowds, and Markets: Reasoning about a Highly Connected World, First Edition, Cambridge University Press, 2010.

Reference Books:	
1	Easley D. Kleinberg J., Networks, Crowds, and Markets - Reasoning about a Highly Connected World, Cambridge University Press, 2010
2	Jackson, Matthew O., Social and Economic Networks, Princeton University Press, 2008.
3	GuandongXu ,Yanchun Zhang and Lin Li, —Web Mining and Social Networking - Techniques and applications, First Edition, Springer, 2011.
4	Dion Goh and Schubert Foo, Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively, IGI Global Snippet, 2008.
5	Max Chevalier, Christine Julien and Chantal Soulé-Dupuy, Collaborative and Social Information Retrieval and Access: Techniques for Improved user Modeling, IGI Global Snippet, 2009
6	John G. Breslin, Alexander Passant and Stefan Decker, The Social Semantic Web, Springer, 2009.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Develop semantic web related simple applications	L5
CO2	Address Privacy and Security issues in Social Networking	L1
CO3	Explain the data extraction and mining of social networks	L2
CO4	Discuss the prediction of human behavior in social communities	L1
CO5	Describe the applications of social networks	L1

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	1	2	3	2	-	-	-	3	2	1	2	2	2
CO 2	2	2	2	3	3	-	-	-	1	2	2	3	2	2
CO 3	2	1	1	3	2	-	-	-	1	2	1	1	2	2
CO 4	3	3	3	3	3	-	-	-	1	1	1	1	2	2
CO 5	1	3	2	2	2	-	-	-	1	1	3	1	2	2
Avg	**2.2**	**2**	**2**	**2.8**	**2.2**	**-**	**-**	**-**	**1.4**	**1.6**	**1.6**	**1.6**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

18CSH405	MODERN CRYPTOGRAPHY		Semester			
PREREQUISITES		Category	PE	Credit		3
		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives

1	To learn about Modern Cryptography
2	To focus on how cryptographic algorithms and protocols work and how to use them.
3	To build a Pseudorandom permutation.
4	To construct Basic cryptanalytic techniques.
5	To provide instruction on how to use the concepts of block ciphers and message authentication codes.

UNIT I	INTRODUCTION	9	0	0	9

Basics of Symmetric Key Cryptography, Basics of Asymmetric Key Cryptography, Hardness of Functions. Notions of Semantic Security (SS) and Message Indistinguishability (MI): Proof of Equivalence of SS and MI, Hard Core Predicate, Trap-door permutation, Goldwasser-Micali Encryption. Goldreich-Levin Theorem: Relation between Hardcore Predicates and Trap-door permutations.

UNIT II	FORMAL NOTIONS OF ATTACKS	9	0	0	9

Attacks under Message Indistinguishability: Chosen Plaintext Attack (IND-CPA), Chosen Ciphertext Attacks (IND-CCA1 and IND-CCA2), Attacks under Message Non-malleability: NM-CPA and NMCCA2, Inter-relations among the attack model

UNIT III	RANDOM ORACLES	9	0	0	9

Provable Security and asymmetric cryptography, hash functions. One-way functions: Weak and Strong one-way functions. Pseudo-random Generators (PRG): Blum-Micali-Yao Construction, Construction of more powerful PRG, Relation between One-way functions and PRG, Pseudorandom Functions (PRF)

UNIT IV	BUILDING A PSEUDORANDOM PERMUTATION	9	0	0	9

The LubyRackoff Construction: Formal Definition, Application of the LubyRackoff Construction to the construction of Block Ciphers, The DES in the light of LubyRackoff Construction.

UNIT V	MESSAGE AUTHENTICATION CODES	9	0	0	9

Left or Right Security (LOR). Formal Definition of Weak and Strong MACs, Using a PRF as a MAC, Variable length MAC. Public Key Signature Schemes: Formal Definitions, Signing and Verification, Formal Proofs of Security of Full Domain Hashing. Assumptions for Public Key Signature Schemes: One-way functions Imply Secure One-time Signatures. Shamir's Secret Sharing Scheme. Formally Analyzing Cryptographic Protocols. Zero Knowledge Proofs and Protocols.

Total (45 L) =45 Periods

Text Books:

1	Hans Delfs and Helmut Knebl, Introduction to Cryptography: Principles and Applications, Springer Verlag.
2	Wenbo Mao, Modern Cryptography, Theory and Practice, Pearson Education (Low Priced Edition)

Reference Books:

1	ShaffiGoldwasser and MihirBellare, Lecture Notes on Cryptography, Available at http://citeseerx.ist.psu.edu/.
2	OdedGoldreich, Foundations of Cryptography, CRC Press (Low Priced Edition Available), Part 1 and Part 23
3	William Stallings, "Cryptography and Network Security: Principles and Practice", PHI 3rd Edition, 2006.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Interpret the basic principles of cryptography and general cryptanalysis.	L2
CO2	Determine the concepts of symmetric encryption and authentication.	L1
CO3	Identify the use of public key encryption, digital signatures, and key establishment.	L3
CO4	Articulate the cryptographic algorithms to compose, build and analyze simple cryptographic solutions.	L2
CO5	Express the use of Message Authentication Codes	L2

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	3	3	3	1	-	-	-	2	1	1	2	2	2
CO 2	1	3	2	1	2	-	-	-	3	2	2	2	2	2
CO 3	1	1	2	3	2	-	-	-	1	1	1	3	2	2
CO 4	3	1	2	1	3	-	-	-	3	2	1	2	2	2
CO 5	2	3	3	3	3	-	-	-	3	1	1	1	2	2
Avg	**2**	**2.2**	**2.4**	**2.2**	**2.2**	**-**	**-**	**-**	**2.4**	**1.4**	**1.2**	**2**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

18CSH406	ENGINEERING SECURE SOFTWARE SYSTEMS	Semester			
PREREQUISITES	Category	PE	Credit		3
	Hours/Week	L	T	P	TH
		3	0	0	3

Course Learning Objectives

1	Know the importance and need for software security.
2	Know about various attacks.
3	Learn about secure software design.
4	Understand risk management in secure software development.
5	Know the working of tools related to software security.

UNIT I	NEED OF SOFTWARE SECURITY AND LOW-LEVEL ATTACKS	9	0	0	9

Software Assurance and Software Security - Threats to software security - Sources of software insecurity - Benefits of Detecting Software Security - Properties of Secure Software – Memory- Based Attacks: Low-Level Attacks Against Heap and Stack - Defense Against Memory-Based Attacks

UNIT II	SECURE SOFTWARE DESIGN	9	0	0	9

Requirements Engineering for secure software - SQUARE process Model – Requirements elicitation and prioritization- Isolating The Effects of Untrusted Executable Content – Stack Inspection – Policy Specification Languages – Vulnerability Trends – Buffer Overflow – Code Injection - Session Hijacking. Secure Design - Threat Modeling and Security Design Principles

UNIT III	SECURITY RISK MANAGEMENT	9	0	0	9

Risk Management Life Cycle – Risk Profiling – Risk Exposure Factors – Risk Evaluation and Mitigation – Risk Assessment Techniques – Threat and Vulnerability Management

UNIT IV	SECURITY TESTING	9	0	0	9

Traditional Software Testing – Comparison - Secure Software Development Life Cycle – Risk Based Security Testing – Prioritizing Security Testing With Threat Modeling – Penetration Testing – Planning and Scoping - Enumeration – Remote Exploitation – Web Application Exploitation - Exploits and Client Side Attacks – Post Exploitation – Bypassing Firewalls and Avoiding Detection - Tools for Penetration Testing

UNIT V	SECURE PROJECT MANAGEMENT	9	0	0	9

Governance and security - Adopting an enterprise software security framework - Security and project management - Maturity of Practice

Total (45 L) =45 Periods

Text Books:

1	Julia H. Allen, "Software Security Engineering", Pearson Education, 2008.
2	Evan Wheeler, "Security Risk Management: Building an Information Security Risk Management Program from the Ground Up", First edition, Syngress Publishing, 2011
3	Chris Wysopal, Lucas Nelson, Dino Dai Zovi, and Elfriede Dustin, "The Art of Software Security Testing: Identifying Software Security Flaws (Symantec Press)", Addison-Wesley Professional, 2006

Reference Books:	
1	Robert C. Seacord, "Secure Coding in C and C++ (SEI Series in Software Engineering)", Addison-Wesley Professional, 2005.
2	Jon Erickson, "Hacking: The Art of Exploitation", 2nd Edition, No Starch Press, 2008.
3	Mike Shema, "Hacking Web Apps: Detecting and Preventing Web Application Security Problems", First edition, Syngress Publishing, 2012
4	Bryan Sullivan and Vincent Liu, "Web Application Security, A Beginner's Guide", Kindle Edition, McGraw Hill, 2012
5	Lee Allen, "Advanced Penetration Testing for Highly-Secured Environments: The Ultimate Security Guide (Open Source: Community Experience Distilled)", Kindle Edition, Packt Publishing,2012
6	Jason Grembi, "Developing Secure Software"

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Identify various vulnerabilities related to memory attacks	L3
CO2	Apply security principles in software development	L3
CO3	Evaluate the extent of risks. .	L5
CO4	Involve selection of testing techniques related to software security in the testing phase of software development. .	L2
CO5	Use tools for securing software.	L3

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	2	3	2	3	2	-	-	-	2	1	2	2	2	2
CO 2	2	2	2	3	3	-	-	-	2	1	2	2	2	2
CO 3	1	2	2	2	1	-	-	-	1	1	2	1	2	2
CO 4	2	3	2	2	2	-	-	-	2	1	2	2	2	2
CO 5	2	1	2	2	3	-	-	-	2	1	1	2	2	2
Avg	**1.8**	**2.2**	**2**	**2.4**	**2.2**	**-**	**-**	**-**	**1.8**	**1**	**1.8**	**1.8**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

18CSH407	CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES		Semester			
PREREQUISITES		Category	PE	Credit		3
		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives

1	To understand the basics of Blockchain
2	To learn Different protocols and consensus algorithms in Blockchain
3	To learn the Blockchain implementation frameworks.
4	To understand the Blockchain Applications
5	To experiment the Hyperledger Fabric, Ethereum networks

UNIT I	INTRODUCTION TO BLOCKCHAIN	9	0	0	9

Blockchain- Public Ledgers, Blockchain as Public Ledgers - Block in a Blockchain, Transactions- The Chain and the Longest Chain - Permissioned Model of Blockchain, Cryptographic –Hash Function, Properties of a hash function-Hash pointer and Merkle tree

UNIT II	BITCOIN AND CRYPTOCURRENCY	9	0	0	9

A basic crypto currency, Creation of coins, Payments and double spending, FORTH – the precursor for Bitcoin scripting, Bitcoin Scripts , Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay

UNIT III	BITCOIN CONSENSUS	9	0	0	9

Bitcoin Consensus, Proof of Work (PoW)- Hashcash PoW , Bitcoin PoW, Attacks on PoW ,monopoly problem- Proof of Stake- Proof of Burn - Proof of Elapsed Time - Bitcoin Miner, Mining Difficulty, Mining Pool-Permissioned model and use cases.

UNIT IV	HYPERLEDGER FABRIC & ETHEREUM	9	0	0	9

Architecture of Hyperledger fabric v1.1- chain code- Ethereum: Ethereum network, EVM, Transaction fee, Mist Browser, Ether, Gas, Solidity.

UNIT V	BLOCKCHAIN APPLICATIONS	9	0	0	9

Smart contracts, Truffle Design and issue- DApps- NFT. Blockchain Applications in Supply Chain Management, Logistics, Smart Cities, Finance and Banking, Insurance,etc- Case Study.

Total (45 L) =45 Periods

Text Books:

1	Bashir and Imran, Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks, 2017.
2	Andreas Antonopoulos, "Mastering Bitcoin: Unlocking Digital Cryptocurrencies", O'Reilly, 2014.

Reference Books:

1	Daniel Drescher, "Blockchain Basics", First Edition, Apress, 2017.
2	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 2016.
3	Melanie Swan, "Blockchain: Blueprint for a New Economy", O'Reilly, 2015
4	Ritesh Modi, "Solidity Programming Essentials: A Beginner's Guide to Build Smart Contracts for Ethereum and Blockchain", Packt Publishing

5	Handbook of Research on Blockchain Technology, published by Elsevier Inc. ISBN: 9780128198162, 2020.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Understand emerging abstract models for Blockchain Technology	L2
CO2	Identify major research challenges and technical gaps existing between theory and practice in the crypto currency domain.	L3
CO3	Provides conceptual understanding of the function of Blockchain as a method of securing distributed ledgers, how consensus on their contents is achieved, and the new applications that they enable.	L2
CO4	Apply hyper ledger Fabric and Ethereum platform to implement the Block chain Application.	L3

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	3	2	2	1	-	-	-	1	-	-	2	2	2
CO 2	3	3	3	3	1	-	-	-	2	-	-	2	2	2
CO 3	3	3	3	3	2	-	-	-	3	-	-	2	2	2
CO 4	3	2	3	2	3	-	-	-	3	-	-	2	2	2
Avg	**3**	**2.75**	**2.75**	**2.5**	**1.75**	**-**	**-**	**-**	**2.25**	**-**	**-**	**2**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

18CSH408	CYBER SECURITY		Semester			
PREREQUISITES		Category	PE	Credit		3
		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives

1	To Learn the basics of computer forensics
2	To be familiar with forensics tools
3	To Learn to analyze and validate forensics data.
4	To Expose how to evaluate the security and how to identify vulnerabilities in systems.
5	To learn how to detect a cyb er attack.

UNIT I	INTRODUCTION TO COMPUTER FORENSICS	9	0	0	9

Introduction to Traditional Computer Crime-Traditional problems associated with Computer Crime-Introduction to Identity Theft & Identity Fraud- Types of CF techniques - Incident and incident response methodology - Forensic duplication and investigation. Preparation for IR: Creating response tool kit and IR team. - Forensics Technology and Systems - Understanding Computer Investigation – Data Acquisition.

UNIT II	EVIDENCE COLLECTION AND FORENSICS TOOLS	9	0	0	9

Processing Crime and Incident Scenes – Working with Windows and DOS Systems. Current Computer Forensics Tools: Software/ Hardware Tools.

UNIT III	ANALYSIS AND VALIDATION	9	0	0	9

Validating Forensics Data – Data Hiding Techniques – Performing Remote Acquisition – Network Forensics – Email Investigations – Cell Phone and Mobile Devices Forensics

UNIT IV	ETHICAL HACKING	9	0	0	9

Introduction to Ethical Hacking - Footprinting and Reconnaissance - Scanning Networks - Enumeration - System Hacking - Malware Threats - Sniffing

UNIT V	INTRUSION DETECTION	9	0	0	9

Host -Based Intrusion Detection – Network -Based Intrusion Detection – Distributed or Hybrid Intrusion Detection – Intrusion Detection Exchange Format – Honeypots – Example System Snort.

Total (45+15) = 60 Periods

Text Books:

1	Bill Nelson, Amelia Phillips, Frank Enfinger, Christopher Steuart, ―Computer Forensics and Investigations‖, Cengage Learning, India Edition, 2016.
2	Anand Shinde, “Introduction to Cyber Security Guide to the World of Cyber Security”, Notion Press, 2021
3	CEH official Certified Ethical Hacking Review Guide, Wiley India Edition, 2015

Reference Books:

1	John R.Vacca, ―Computer Forensics‖, Cengage Learning, 2005
2	MarjieT.Britz, ―Computer Forensics and Cyber Crime‖: An Introduction‖, 3rd Edition, Prentice Hall, 2013.
3	William Stallings, Lawrie Brown, “Computer Security Principles and Practice”, Third Edition, Pearson Education, 2015
4	AnkitFadia ― Ethical Hacking‖ Second Edition, Macmillan India Ltd, 2006

5	Kenneth C.Brancik ―Insider Computer Fraud‖ Auerbach Publications Taylor & Francis Group– 2008.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Explain the basic concepts of computer forensics	L2
CO2	Apply a number of different computer forensic tools for various crime and incident scenes	L3
CO3	Choose appropriate technique to validate forensics data	L2
CO4	Identify the vulnerabilities in a given network infrastructure and the role of ethical hacking	L3
CO5	Apply intrusion techniques to detect intrusion.	L3

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	3	2	2	2	-	-	-	2	1	2	1	2	2
CO 2	1	1	3	2	2	-	-	-	2	2	1	1	2	2
CO 3	1	2	1	1	2	-	-	-	3	3	1	3	2	2
CO 4	2	2	3	2	3	-	-	-	3	3	2	1	2	2
CO 5	2	1	3	2	2	-	-	-	2	1	1	3	2	2
Avg	**1.8**	**1.8**	**2.4**	**1.8**	**2.2**	**-**	**-**	**-**	**2.4**	**2**	**1.4**	**1.8**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

GOVERNMENT COLLEGE OF ENGINEERING, SALEM

REGULATION 2018 A - VERTICALS FOR MINOR DEGREE

VERTICAL - I	VERTICAL - II	VERTICAL - III	VERTICAL - IV	VERTICAL - V	VERTICAL - VI
Civil Engineering	**Computer Science and Engineering**	**Electronics and Communication Engineering**	**Electrical and Electronics Engineering**	**Mechanical Engineering**	**Metallurgical Engineering**
18CEM01 Construction Materials	18CSM01 Programming in C++	18ECM01 Electron Devices	18EEM01 – Network Analysis and Synthesis	18MEM01 Engineering Thermodynamics	18MTM01 Advanced Physical Metallurgy
18CEM02 Building Construction & Equipment	18CSM02 Advanced Data Structures and Algorithms	18ECM02 Digital Electronics	18EEM02 – Signals and Systems	18MEM02 Fluid Mechanics and Machinery	18MTM02 Metallurgical Thermodynamics and kinetics
18CEM03 Concrete Technology	18CSM03 Computer Organization and Design	18ECM03 Electronic Circuits (EC-I & EC-II, LIC)	18EEM03 – Linear and Digital Electronics Circuits	18MEM03 Manufacturing Processes	18MTM03 Mechanical Behaviour of Materials
18CEM04 Environmental Engineering	18CSM04 Advanced Operating Systems	18ECM04 Signal Processing	18EEM04 – Microprocessor and Microcontrollers	18MEM04 Materials Engineering	18MTM04 Rate Processing in Metallurgy
18CEM05 Basics of Transportation Engineering	18CSM05 Data Communication and Computer Networks	18ECM05 Microprocessors and Microcontrollers	18EEM05 – Control Systems	18MEM05 Kinematics of Machinery	18MTM05 Corrosion and Surface Engineering
18CEM06 Repair and Rehabilitation Structures	18CSM06 Programming Essentials in Python	18ECM06 Analog and Digital Communication	18EEM06 – Measurement and Instrumentation	18MEM06 Hydraulics and Pneumatics	18MTM06 Characterization of Materials
18CEM07 Green Building Technology	18CSM07 Advanced Database System Concepts	18ECM07 Communication Networks (CN)	18EEM07 – Electrical Machines	18MEM07 Design of Machine Elements	18MTM07 Automotive, Aerospace and Defense Materials
-----	18CSM08 Virtualization and Cloud Computing	18ECM08 Fundamentals of IoT	18EEM08 – Electric Drives and Control	18MEM08 Heat and Mass Transfer	-----
-----	-----	18ECM09 Wireless Sensors and Networking (WSN)	18EEM09 – Electric Vehicle and Control	18MEM09 Metrology and Quality Control	-----
-----	-----	18ECM10 Basics of Embedded Systems	18EEM10 –Electric Energy Conservation and Auditing	18MEM10 Dynamics of Machinery	-----

LIST OF MINOR DEGREE - VERTICALS

S.No.	Course Code	Course	Cat	Hours/Week			Credits	Maximum Marks		
				L	T	P		CA	FE	Total
CIVIL ENGINEERING										
1	18CEM01	Construction Materials	OE	3	0	0	3	40	60	100
2	18CEM02	Building Construction & Equipment's	OE	3	0	0	3	40	60	100
3	18CEM03	Concrete Technology	OE	3	0	0	3	40	60	100
4	18CEM04	Environmental Engineering	OE	3	0	0	3	40	60	100
5	18CEM05	Basics of Transportation Engineering	OE	3	0	0	3	40	60	100
6	18CEM06	Repair and Rehabilitation of Structures	OE	3	0	0	3	40	60	100
7	18CEM07	Green Building Technology	OE	3	0	0	3	40	60	100
COMPUTER SCIENCE AND ENGINEERING										
1	18CSM01	Programming in C++	OE	3	0	0	3	40	60	100
2	18CSM02	Advanced Data Structures and Algorithms	OE	3	0	0	3	40	60	100
3	18CSM03	Computer Organization and Design	OE	3	0	0	3	40	60	100
4	18CSM04	Advanced Operating Systems	OE	3	0	0	3	40	60	100
5	18CSM05	Data Communication and Computer Networks	OE	3	0	0	3	40	60	100
6	18CSM06	Programming Essentials in Python	OE	3	0	0	3	40	60	100
7	18CSM07	Advanced Database System Concepts	OE	3	0	0	3	40	60	100
8	18CSM08	Virtualization and Cloud Computing	OE	3	0	0	3	40	60	100
ELECTRONICS AND COMMUNICATION ENGINEERING										
1	18ECM01	Electron Devices	OE	3	0	0	3	40	60	100
2	18ECM02	Digital Electronics	OE	3	0	0	3	40	60	100
3	18ECM03	Electronic Circuits	OE	3	0	0	3	40	60	100
4	18ECM04	Signal Processing	OE	3	0	0	3	40	60	100
5	18ECM05	Microprocessors and Microcontrollers	OE	3	0	0	3	40	60	100

6	18ECM06	Analog and Digital Communication	OE	3	0	0	3	40	60	100
7	18ECM07	Communication Networks	OE	3	0	0	3	40	60	100
8	18ECM08	Fundamentals of IoT	OE	3	0	0	3	40	60	100
9	18ECM09	Wireless sensors and networking	OE	3	0	0	3	40	60	100
10	18ECM10	Basics of Embedded systems	OE	3	0	0	3	40	60	100
ELECTRICAL AND ELECTRONICS ENGINEERING										
1	18EEM01	Linear and Digital Electronics Circuits	OE	3	0	0	3	40	60	100
2	18EEM02	Microprocessors and Microcontrollers	OE	3	0	0	3	40	60	100
3	18EEM03	Control Systems	OE	3	0	0	3	40	60	100
4	18EEM04	Measurements and Instrumentation	OE	3	0	0	3	40	60	100
5	18EEM05	Electrical Machines	OE	3	0	0	3	40	60	100
6	18EEM06	Electric Drives and Control	OE	3	0	0	3	40	60	100
7	18EEM07	Electric Vehicles and Control	OE	3	0	0	3	40	60	100
8	18EEM08	Electrical Energy Conservation and Auditing	OE	3	0	0	3	40	60	100
9	18EEM09	SMPS and UPS	OE	3	0	0	3	40	60	100
10	18EEM10	Utilization of Electrical Energy	OE	3	0	0	3	40	60	100
MECHANICAL ENGINEERING										
1	18MEM01	Engineering Thermodynamics	OE	3	0	0	3	40	60	100
2	18MEM02	Fluid Mechanics and Machinery	OE	3	0	0	3	40	60	100
3	18MEM03	Manufacturing Processes	OE	3	0	0	3	40	60	100
4	18MEM04	Materials Engineering	OE	3	0	0	3	40	60	100
5	18MEM05	Kinematics of Machinery	OE	3	0	0	3	40	60	100
6	18MEM06	Hydraulics and Pneumatics	OE	3	0	0	3	40	60	100
7	18MEM07	Design of Machine Elements	OE	3	0	0	3	40	60	100
8	18MEM08	Heat and Mass Transfer	OE	3	0	0	3	40	60	100
9	18MEM09	Metrology and Quality Control	OE	3	0	0	3	40	60	100

10.	18MEM10	Dynamics of Machinery	OE	3	0	0	3	40	60	100
METALLURGICAL ENGINEEING										
1	18MTM101	Advanced Physical Metallurgy	OE	3	0	0	3	40	60	100
2	18MTM102	Thermodynamics and Kinetics in Metallurgy	OE	3	0	0	3	40	60	100
3	18MTM103	Mechanical Behaviour of Materials	OE	3	0	0	3	40	60	100
4	18MTM104	Rate Processes in Metallurgy	OE	3	0	0	3	40	60	100
5	18MTM105	Corrosion and Surface Engineering	OE	3	0	0	3	40	60	100
6	18MTM106	Materials Characterization	OE	3	0	0	3	40	60	100
7	18MTM107	Automotive, Aerospace and Defence Materials	OE	3	0	0	3	40	60	100

B.E. – CIVIL ENGINEERING - MINOR DEGREE

18CEM01	CONSTRUCTION MATERIALS		Semester			
PREREQUISITES		**Category**	**OE**	**Credit**		**3**
NIL		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	To study the characteristics and Properties of Stones and Brick
2	To impart knowledge on Cement, Aggregate and Mortar
3	To understand the behaviour of concrete and seasoning timber
4	To study the Parts and types of flooring and roofing
5	To study carpentry, arches, lintels and finishing works.

Unit I	**STONES, BRICKS**	**9**	**0**	**0**	**9**

Building Stone –classification of rocks-characteristics of good building stone – deterioration and preservation of stone work – tests on stones - Bricks- manufacture of clay bricks -classification - tests on bricks- bricks for special use- refractory bricks.

Unit II	**CEMENT, AGGREGATES, MORTAR**	**9**	**0**	**0**	**9**

Cement- composition- manufacturing process-wet and dry processes. Aggregates –coarse and fine aggregates- characteristics and function. Mortar- properties- uses- types of mortars- selection of mortars for various Civil Engineering construction.

Unit III	**CONCRETE, TIMBER AND OTHER MATERIALS**	**9**	**0**	**0**	**9**

Concrete- ingredients - principles of hardened concrete- Special concrete- types.
Timber- characteristics- seasoning-preservation- Panels of laminates. Glass- properties- uses. Steel- Uses - market forms.

Aluminum and other metallic materials for construction.

Paints, Varnishes and Distempers-types-properties.

Unit IV	**FLOORING AND ROOFING**	**9**	**0**	**0**	**9**

Components of floor- selection of flooring materials- suitability of floors for various applications. damp proof course, causes of dampness- effect of dampness - requirements of good stairs - classification of stairs -Roofs - types of roofs- requirements - pitched roof - lean to roof-gable roof-hip roof-flat roof-RCC roof.

Unit V	**CARPENTARY, ARCHES, LINTELS AND FINISHING WORKS**	**9**	**0**	**0**	**9**

Location of doors and windows - size of doors - types of doors - fixture and fastenings for doors and windows - arches - classification - stability of an arch - lintels - classification of lintels - steel lintel. scaffolding - component parts - shoring - methods of plastering - defects in plastering - pointing - objectives- methods of pointing

Total= 45 Periods

Text Books:	
1	B.C. Punmia, Building Construction, Laxmi Publications; Eleventh edition -2021
2	S.C.Rangwala, Building Construction,CharotarPublishing House Pvt. Ltd, 34th Edition - 2022
3	P. Purushothama Raj., Building Construction Materials and Techniques, Pearson Education India, First Edition - 2017
Reference Books:	
1	Shetty M.S., Concrete Technology (Theory and Practice), S.Chand& Company Ltd.,2021.
2	Rangwala S.C., Engineering Materials (Material Science) revised and enlarged by Rangwala K.S. and Rangwala P.S., Charotar Publishing House, 2010.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Identify and characterize and properties of Stone and brick	Remember
CO2	Understand the manufacturing process of cement and functions of mortar	Understand
CO3	Identify the age of timber and preservation methods of timber	Remember
CO4	Differentiate the types of roofing and flooring	Understand
CO5	Understand the miscellaneous works such as carpentry, lintels, Arch, etc.	Understand

COURSE ARTICULATION MATRIX

COs/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**-**	**2**	**-**	**-**	**-**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**1**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	**1**	**-**	**2**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	**1**	**-**	**-**	**-**	**3**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Avg	**1**	**2**	**2**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**

18CEM02	BUILDING CONSTRUCTION & EQUIPMENT		Semester			
PREREQUISITES		**Category**	**OE**	**Credit**		**3**
NIL		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	Able to gain basic knowledge in construction methods.
2	Able to gain basic knowledge in equipment.
3	Able to gain basic knowledge in machineries.
4	Able to gain basic knowledge in fire safety principles.
5	Able to gain basic knowledge in green technology.

Unit I	**CLASSIFICATION OF BUILDINGS, FOUNDATIONS AND TYPES OF MASONRY**	**9**	**0**	**0**	**9**

Component parts of a building -Their functions. Classification of buildings according to National building code.
Site investigation for foundation as per N.B.C, Types of foundation and prevention of dampness at basement level,Classification of stone masonry

Unit II	**DOORS, WINDOWS, LINTELS, SCAFFOLDING AND STAIRCASES**	**9**	**0**	**0**	**9**

Doors and windows – parts of door and window – Types of Door and windows–Ventilators – fixed, swinging type and louvered. Lintels – Functions, Scaffolding – Purpose and types –Location of stairs.Types of stairs

Unit III	**ROOFS, FLOORINGS, PROTECTIVE AND DECORATIVE FINISHES**	**9**	**0**	**0**	**9**

Roof Beams and Roof Slabs – Types of Roofing Systems – Methods of Termite Proofing – Methods of Damp proofing.
Types of floors- Plastering (Interior and Exterior) – Pointing for Walls and Floors using Grouts – White Washing, Color Washing with different Color Shades available in the Markets – Painting – Types of Painting for Interior and Exterior application.

Unit IV	**CONSTRUCTION EQUIPMENTS**	**9**	**0**	**0**	**9**

Selection of equipment for earthwork excavation, drilling, blasting, tunnelling, erection and dewatering and pumping, concreting, material handling and erection of structures

Unit V	**GREEN BUILDING TECHNOLOGY**	**9**	**0**	**0**	**9**

Introduction to green technology – types and importance; zero waste and r concept, green materials – green concrete (purpose and limitations), green buildings, green engineering.

Total= 45 Periods

Text Books:	
1	Building Construction by S.C.Rangawala
2	Construction Technology by Sarkar Oxford University Press
3	Building Material & Construction by S.P. Arora& S. P. Bindra
Reference Books:	
1	Hopkinson And Kay J.D., The Lighting of Building, Faber and Faber, London.
2	Koerner, R.M, Construction & Geotechnical Methods in Foundations Engineering, McGraw Hill, 1984
3	Varna M., Construction Equipment and Its Planning & Applications, Metropolitan Books Co, 1979

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Organize the construction technique to be followed in brick and stone masonry, concreting, flooring, roofing and plastering etc.	Create
CO2	Select safe practices in building construction activities	Evaluate
CO3	Clarify the different types of roofs, floor and productive materials of buildings	understand
CO4	Select the relevant equipment for building construction	Evaluate
CO5	Apply the Principles of green building technology.	Apply

COURSE ARTICULATION MATRIX

COs/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-	-	**3**	**2**	**2**	**2**	**1**	**1**	-	-	-	-	**1**
CO2	-	-	-	-	**3**	**2**	**2**	**2**	**2**	**2**	-	-	-	-	**1**
CO3	-	-	-	-	**2**	**3**	**2**	**2**	**2**	**1**	-	-	-	-	**1**
CO4	-	-	-	-	**2**	**2**	**3**	**1**	**1**	**2**	-	-	-	-	**1**
CO5	-	-	-	-	**2**	**3**	**2**	**2**	**2**	**2**	-	-	-	-	**1**
Avg	-	-	-	-	**2.4**	**2.4**	**2.2**	**1.8**	**1.6**	**1.6**	-	-	-	-	**1**

3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**

18CEM03	CONCRETE TECHNOLOGY		Semester			
PREREQUISITES		Category	OE	Credit		3
NIL		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives

1	To understand the properties of ingredients of concrete.
2	To study the behavior of concrete at its fresh and hardened state.
3	To study about the concrete design mix.
4	To know about the procedures in concrete at different stage.
5	To understand special concrete and their uses.

Unit I	INTRODUCTION	9	0	0	9

Concrete materials, Cement: Field and laboratory tests on cement, Types of cement and their uses, different tests for aggregates. Methods for manufacturing of cement- Wet and dry process. Hydration of cement, Bogue's compound.

Unit II	ADMIXTURES	9	0	0	9

Accelerating admixtures, Retarding admixtures, water reducing admixtures, Air entraining admixtures, coloring agent, Plasticizers. Batching, Mixing, Transportation, placing of concrete, curing of Concrete

Unit III	MIX DESIGN	9	0	0	9

Factors influencing mix proportion, Mix design by ACI method and I.S. code method, Design of high strength concrete.

Unit IV	BEHAVIOUR OF CONCRETE	9	0	0	9

Strength of concrete, Shrinkage and temperature effects, creep of concrete, permeability of concrete, durability of concrete, Corrosion, Causes and effects, remedial measures, Thermal properties of concrete, Micro cracking of concrete.

Unit V	SPECIAL CONCRETE	9	0	0	9

Light-weight concrete, Fibre reinforced concrete, Polymer modified concrete, Ferro cement, Mass concrete, Ready-mix concrete, Self-compacting concrete, Quality control, Sampling and testing, Acceptance criteria.

Total= 45 Periods

Text Books:

1	Neville A.M Properties of Concrete, Pearson publication, 2012.
2	Shetty M.S Concrete technology, S.Chand and Company Ltd, New Delhi 2022.
3	Santha Kumar A.R Concrete Technology, Oxford university Press, NewDelhi, 2022.
4	Mehta K.P Concrete Technology, Chand & Co, NewDelhi, 2006.
5	Robert RatayForensic Structural Engineering Handbook, McGraw Hill LLC, 2009

Reference Books:	
1	Indian Standard Recommended Guide lines for Concrete Mix Design, IS:10262 – 2019, Bureau of Indian Standards, NewDelhi.
2	Indian Standard Specification for Coarse and Fine Aggregates from Natural Sources for Concrete IS:383-1970 R2011, Bureau of Indian Standards, NewDelhi.
3	Gambhir.M.L,Concrete Technology, Volume I & II, Tata McGraw-HillBookCompany,Third print, 2003
4	Krishna Raju N. Design of Concrete Mixes, CBS publishers. NewDelhi, 2002.
5	Stephen E. Petty,Forensic Engineering: Damage Assessments for Residential and Commercial Structures,CRCpress,Taylor& Francis,2013.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	To identify suitable materials to be used in the cement concrete by conducting various tests as per BIS code.	Evaluate
CO2	To know about the specific applications and uses of admixtures.	Understand
CO3	Design the concrete mix using ACI and BIS code methods.	Create
CO4	Determine the properties of fresh and hardened of concrete.	Evaluate
CO5	Design special concretes and to Ensure quality control while testing/ sampling and acceptance criteria for pre and post construction work.	Apply

COURSE ARTICULATION MATRIX

COs/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-	-	3	-	1	1	1	2	1	1	1	-	1
CO2	-	-	-	-	3	-	3	-	1	1	-	-	2	-	1
CO3	-	-	-	-	3	-	3	-	-	1	-	-	1	-	1
CO4	-	-	-	-	3	2	1	-	-	-	-	-	-	-	1
CO5	-	-	-	-	3	3	3	1	1	3	1		3	-	1
Avg	-	-	-	-	3	2.5	2.2	1	1	1.75	1	1	1.75	-	1
3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**															

18CEM04	ENVIRONMENTAL ENGINEERING		Semester			
PREREQUISITES		Category	OE	Credit		3
NIL		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives

1	To evaluate the sources of water and analyse its characteristics and processes in water treatment, express the analysis of distribution network
2	To design sewer system, basic design of the biological treatment processes, gain knowledge on sludge treatment and its disposal
3	To predict the sources, effects, dispersion of air pollutants air quality management and its control measures
4	To identify the characteristics and sources of municipal solid wastes, its collection methods, off-site processing of municipal solid wastes and its recovery, disposal methods
5	To assess the sources, effects and control measures of noise pollution

Unit I	WATER TREATMENT	9	0	0	9

Water Quality and its Treatment: Basics of water quality standards – Physical, chemical and biological parameters; Water quality index; Unit processes and operations; Water requirement; Water distribution system; Drinking water treatment.

Unit II	WASTEWATER TREATMENT	9	0	0	9

Sewerage system design, quantity and quality of domestic wastewater, primary and secondary treatment. Effluent discharge standards; Sludge disposal; Reuse of treated sewage for different applications.

Unit III	AIR POLLUTION	9	0	0	9

Air Pollution: Types of pollutants, their sources and impacts, air pollution control, air quality standards, Air quality Index and limits.

Unit IV	SOLID WASTE MANAGEMENT	9	0	0	9

Municipal Solid Wastes: Characteristics, generation, collection and transportation of solid wastes, engineered systems for solid waste management (reuse/ recycle, energy recovery, treatment and disposal).

Unit V	NOISE POLLUTION	9	0	0	9

Noise pollution: Sources; Health effects; Standards; Measurement and control methods

Total= 45 Periods

Text Books:

1	Garg, S.K. Water supply Engineering, Khanna Publishers, New Delhi, 2010.
2	Garg, S.K. Sewage water disposal and Air pollution, Khanna Publishers, New Delhi, 2010.
3	George Tchobanoglous et.al., Integrated Solid Waste Management, McGraw-Hill, Publishers, 1993.
4	Rao, C.S., Environmental Pollution Control Engineering, Wiley Eastern Ltd., New Delhi, 1996.

Reference Books:	
1	Manual on Water Supply and Treatment, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2013.
2	Peavy S.W., Rowe D.R. and Tchobanoglous G. Environmental Engineering, McGraw Hill, NewDelhi, 1985.
3	Metcalf and Eddy,M.C., Wastewater Engineering – Treatment &Reuse,TataMcGraw-Hill Publications, New Delhi,2003.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Identify the sources of water supply, analyze the characteristics of water with its standards and various unit operations and processes in water treatment, express the analysis of distribution network	Remember
CO2	Expertise design sewer system, basic design of the biological treatment processes, gain knowledge on sludge treatment and disposal and justify the methods for disposal of sewage	Analyze
CO3	Predict the sources, effects, dispersion of air pollutants air quality management and its control measures	Apply
CO4	Aware about the characteristics, types and sources of municipal solid wastes, Learn the collection methods, Know about off-site processing of municipal solid wastes and its recovery, disposal methods	Remember
CO5	Understand the sources, effects and control methods of noise pollution	Understand

COURSE ARTICULATION MATRIX

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	3	2	1	3	2	1	1	2	1	1	3	-	2
CO2	2	1	3	1	1	3	1	-	1	2	2	1	3	-	2
CO3	2	1	3	1	1	3	1	-	1	2	2	1	3	-	2
CO4	2	1	3	1	1	3	1	-	-	2	2	1	3	-	2
CO5	2	-	3	-	-	3	-	-	-	2	1	1	3	-	2
Avg	2	1	3	1.3	1	3	1.3	1	1	2	1.6	1	3	-	2

3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**

18CEM05	BASICS OF TRANSPORTATION ENGINEERING		Semester			
PREREQUISITES		Category	OE	Credit		3
NIL		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives

1	The objective of the course is to educate the students on various components of highway engineering.
2	To educate the geometric design concepts of highway engineering
3	To develop skills on construction and maintenance of highway.
4	Ability to plan various civil engineering aspects of railways and educate various components of railways
5	The course enables the students to develop skill on evaluation and maintenance of railway track.

Unit I	**CROSS SECTIONAL ELEMENTS OF HIGHWAYS**	**9**	**0**	**0**	**9**

Classification of Highways - Classification and Cross Section of Urban and Rural Roads (IRC), Highway Cross Sectional Elements- Right of Way, Carriage Way, Camber, Kerbs, Shoulders and Footpaths (IRC Standards), Sight Distances - Stopping Sight Distance (SSD), Overtaking Sight Distance (OSD), Sight Distance at Intersections, Intermediate Sight Distance and Illumination Sight Distance - Cross Sections of Different Class of Roads -

Unit II	**GEOMETRIC DESIGN OF HIGHWAYS**	**9**	**0**	**0**	**9**

Horizontal Alignments – Superelevation, Widening of Pavements on Horizontal Curves, Vertical Alignments - Rolling. Limiting, Exceptional and Minimum Gradients, Summit and Valley Curves -Geometric Design of Hill Roads (IRC Standards Only)

Unit III	**CONSTRUCTION AND MAINTENANCE OF HIGHWAY**	**9**	**0**	**0**	**9**

Construction of Flexible and Rigid Pavements – Defects in Flexible and Rigid Pavements -Highway Drainage – Evaluation and Maintenance of Pavements.

Unit IV	**RAILWAY PLANNING AND DESIGN**	**9**	**0**	**0**	**9**

Permanent Way, its Components and Functions of Each Component: Rails - Types of Rails, Rail Fastenings, Concept of Gauges, Coning of Wheels, Creeps Sleepers - Functions, Materials, Density. Ballasts - Functions, Materials, Ballast less Tracks Geometric Design of Railway Tracks Gradients and Grade Compensation, Super-Elevation, Widening of Gauges in Curves, Transition Curves, Horizontal and Vertical Curves.

Unit V	**RAILWAY TRACK CONSTRUCTION MAINTENANCE AND OPERATION**	**9**	**0**	**0**	**9**

Points and Crossings – Turnouts, Track circuiting, Signaling, Interlocking, Lay Outs of Railway Stations and Yards, Rolling Stock, Tractive Power, Track Resistance, Level Crossings.

Total= 45 Periods

Text Books:

1	Khanna K., Justo C.E.G., Highway Engineering Revised 10th Edition Khanna Publishers, Roorkee, 2014
2	Kadiyalil. R, Engineering Traffic and Transport Planning, Khanna Publishers, New Delhi, 2019.
3	Chandola S.P. Transportation Engineering-2019

Reference Books:	
1	Sharma S.K., Principles Practice and Design of Highway Engineering, S. Chand & Co Ltd. New Delhi, 2006
2	Guidelines Of Ministry of Road Transport and Highways, Government of India.
3	Agarwal M.M., Indian Railway Track, 14th Edition, Prabha and Co., New Delhi, 2002.
4	Saxena S.C. Highway & Traffic Engineering, 2014.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Classify roads as per Indian Road Congress and describe the principles of highway alignment	Understand
CO2	Determine the highway geometric elements	Analyse
CO3	Differentiate between types of pavements, their construction and design principles	Analyse
CO4	Explain the functions of components of Railways	Understand
CO5	Carry out the various methods for track alignment & procedure for construction of railway & maintenance of track	Apply

COURSE ARTICULATION MATRIX

COs/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-	-	**2**	**2**	**3**	**1**	**2**	-	-	-	**1**	-	-
CO2	**2**	**3**	**2**	**2**	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	**2**	**2**	**3**	**1**	**3**	-	-	-	**1**	-	-
CO4	-	-	-	-	**2**	**2**	**3**	**1**	**2**	-	-	-	-	-	-
CO5	-	-	-	-	**2**	**2**	**3**	**1**	**2**	-	-	-	**1**	-	-
Avg	**2**	**3**	**2**	**2**	**2**	**2**	**3**	**1**	**2.25**	-	-	-	**1**	-	-

3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**

18CEM06	REPAIR AND REHABILITATION OF STRUCTURES	Semester			
PREREQUISITES	Category	OE	Credit		3
NIL	Hours/Week	L	T	P	TH
		3	0	0	3

Course Learning Objectives

1	Study the various types and properties of repair materials
2	Learn various distress and damages to concrete structures
3	Understand the importance of maintenance of structures
4	Assess the damage to structures using various tests
5	Learn various repair techniques of damaged structures, corroded structures

Unit I	MAINTENANCE AND REPAIR STRATEGIES	9	0	0	9

Maintenance, repair and rehabilitation, Facts of Maintenance, importance of Maintenance various aspects of inspection, assessment procedure for evaluating a damaged structure, causes of deterioration.

Unit II	SERVICEABILITY AND DURABILITY OF CONCRETE	9	0	0	9

Quality assurance for concrete construction, concrete properties- strength, permeability, thermal properties and cracking- effects due to climate, temperature, chemical, corrosion- Design and construction errors-effects of cover thickness and cracking.

Unit III	MATERIALS AND TECHNIQUES FOR REPAIR	9	0	0	9

Special concretes and mortar, concrete chemical, special elements for accelerated strength gain, expansive cement, polymer concrete, Sulphur infiltrated concrete, ferro cement, fibre reinforced concrete, rust eliminators and polymers coating for rebars during repair, foamed concrete, mortar and dry pack, vacuum concrete, gunite and shotcrete, epoxy injection, mortar repair for cracks, shoring and underpinning. Methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coatings and cathodic protection.

Unit IV	REPAIRS, REHABILITATION AND RETROFITTING OF STRUCTURES	9	0	0	9

Strengthening of Structural elements, deflection, cracking, chemical disruption, weathering corrosion, wear, fire, leakage and marine exposure.

Unit V	DEMOLITION TECHNIQUES	9	0	0	9

Demolition methods by machines, explosives, Advanced techniques-Demolition sequences, dismantling techniques, safety precautions in dismantling and demolition, Engineered demolition techniques for dilapidated structures- case studies

Total= 45 Periods

Text Books:

1	Shetty, M.S, Concrete Technology- Theory and Practice, S. Chand and company, New Delhi,2019
2	Repair and protection of concrete structures by Noel P. Mailvaganam, CRC Press,1991.
3	CPWD: Handbook on Repair & Rehabilitation of R.C.C. Buildings, CPWD, Govt. of India, 2002, updated reprint 2011

Reference Books:	
1	Santhakumar A.R, Training Course notes on Damage Assessment and Repair in Low-cost housing, "RHDC.NBO" Anna University, July 1992.
2	Raikar R.N.,Learning from failures- deficiencies in design, construction and services – R&D Centre (SDCPL), Raikar bhavan, Bombay,1987
3	Palaniyappan, N., Estate management, Anna Institute of Management, Chennai,1992.
4	Lakshmipathy, M. etal., Lecture notes of workshop on Repairs and Rehabilitation of structures, 29-30th October 1999.
5	https://nptel.ac.in/courses/114106035/38

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Demonstrate the condition of structures	Understand
CO2	Inspect and evaluate the damaged structure	Analyze
CO3	Implement the repairing techniques of a structure	Analyze
CO4	Identify and Use different materials for repairing works	Apply
CO5	Demonstrate the dismantling and demolishing structures	Apply

COURSE ARTICULATION MATRIX

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**1**	**-**	**2**	**2**	**2**	**2**	**3**	**2**	**-**	**-**	**-**	**1**	**2**	**-**	**-**
CO2	**1**	**-**	**2**	**2**	**2**	**2**	**3**	**2**	**-**	**-**	**-**	**1**	**2**	**-**	**-**
CO3	**1**	**-**	**2**	**2**	**2**	**2**	**3**	**2**	**-**	**-**	**-**	**1**	**2**	**-**	**-**
CO4	**1**	**-**	**2**	**2**	**2**	**2**	**3**	**2**	**-**	**-**	**-**	**1**	**2**	**-**	**-**
CO5	**1**	**-**	**2**	**2**	**2**	**2**	**3**	**2**	**-**	**-**	**-**	**1**	**2**	**-**	**-**
Avg	**1**	**-**	**2**	**2**	**2**	**2**	**3**	**2**	**-**	**-**	**-**	**1**	**2**	**-**	**-**

3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**

18CEM07	GREEN BUILDING TECHNOLOGY		Semester			
PREREQUISITES		Category	OE	Credit		3
NIL		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives

1	To Know various aspects of green buildings
2	To Learn the principles of planning and orientation of buildings.
3	To Relate the construction of green building with prevailing energy conservation policy and regulations.
4	To Know and identify different green building construction materials.
5	To Learn different rating systems and their criteria

Unit I	INTRODUCTION TO GREEN BUILDING	9	0	0	9

Introduction, Necessity, Definition & concept of Green Building, Issues and strategies of Green Building, Principles and Benefits of Green Building, Components/ features of Green Building, Energy Efficiency, Water efficiency, Material Efficiency, Indoor Air Quality.

Unit II	SITE SELECTION AND PLANNING	9	0	0	9

Site selection, Site selection strategies, Landscaping, building form, orientation, building envelope and fenestration, material and construction techniques, roofs, walls, fenestration and shaded finishes, Environmental design (ED) strategies for building construction, Rainwater harvesting methods for roof & non-roof, reducing landscape water demand by proper irrigation systems, recycle and reuse systems, Waste Management.

Unit III	ENERGY AND ENERGY CONSERVATION	9	0	0	9

Introduction, Environmental impact of building constructions, present scenario, Need of energy conservation, Concepts of embodied energy,

operational energy and life cycle energy, Methods to reduce operational energy, Energy efficient building, zero ozone depleting potential (ODP) materials, wind and solar energy harvesting, energy metering and monitoring, concept of net zero buildings.

Unit IV	BUILDING MATERIALS	9	0	0	9

Green building materials and products- Bamboo, Rice husk ash concrete, plastic bricks, Bagasse particle board, Insulated concrete forms. use of materials with recycled content such as blended cements, pozzolana cements, flyash bricks, vitrified tiles, materials from agro and industrial waste, reuse of waste material-Plastic, rubber, Newspaper wood, Nontoxic paint, green roofing.

Unit V	RATING SYSTEM	9	0	0	9

Introduction to Leadership in Energy and Environmental Design (LEED) criteria, Indian Green Building council (IGBC) Green rating, Green Rating for Integrated Habitat Assessment. (GRIHA) criteria, National Productivity council (NPC) Ministry of New and Renewable Energy (MNRE) Bureau of Energy efficiency (BEE) -BER (Building Energy Rating) – Certificates.

Total= 45 Periods

Text Books:

1	Kibert, C.J., Sustainable construction: Green Building design and Delivery, John Wiley Hobouken, NewJersey, 3rd Edition, 2012.
2	Chauhan, D S Sreevasthava, S K., Non-conventional Energy Resources, New Age International Publishers, NewDelhi, 4th Edition, 2021

Reference Books:	
1	O.P. Gupta, Energy Technology, Khanna Publishing House, NewDelhi
2	Jagadeesh, K S, Reddy Venkatta Rama &Nanjunda Rao, K S., Alternative Building Materials and Technologies, New Age International Publishers,Delhi.
3	Sam Kubba., Handbook of Green Building Design and Construction, Butterworth- Heinemann.
4	Means R S, Green Building - Project Planning and Cost Estimating, John Wiley &Sons
5	Sharma K V, Venkataseshaiah P., Energy Management and Conservation, IK International.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand the concepts of Green Building	Understand
CO2	Discuss the Planning of Green Building.	Understand
CO3	Explain the concept of Energy and Energy Conservation.	Understand
CO4	Select appropriate green building material and technique.	Understand
CO5	Summarize the Green Building Functions in various organizations.	Understand

COURSE ARTICULATION MATRIX

COs/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-	**1**	-	**2**	**3**	-	-	-	**2**	**1**	**2**	-	-
CO2	**1**	**1**	**1**	**2**	**1**	-	-	-	-	-	-	-	**2**	-	-
CO3	-	**1**	**3**	-	**2**	-	-	-	-	-	-	-	**2**	-	-
CO4	-	**1**	**2**	-	**3**	-	-	-	-	-	**2**	-	**2**	-	-
CO5	**1**	**1**	**2**	**3**	**2**	-	-	-	-	-	**2**	-	**2**	-	-
Avg	**1**	**1**	**2**	**2**	**2**	**2**	**3**	-	-	-	**2**	**1**	**2**	-	-

3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**

B.E. – COMPUTER SCIENCE ENGINEERING - MINOR DEGREE

18CSM01	PROGRAMMING IN C++				
PREREQUISITES	**Category**	**OE**	**Credit**		**3**
	Hours/Week	**L**	**T**	**P**	**TH**
		3	**0**	**0**	**3**

Course Learning Objectives

1	To understand and develop the object oriented programming concepts.
2	To familiarize and design the template functions and classes
3	To disseminate and apply exception handling mechanisms.
4	To learn and exploit stream classes.

Unit I	**INTRODUCTION**	**9**	**0**	**0**	**9**

Procedure oriented programming paradigm - Object oriented programming paradigm - Basic concepts of object oriented programming, benefits of OOP, application of OOP - C++ fundamentals –structure of C++ program, tokens, data types - Operators and expressions - Control structures - Functions.

Unit II	**INHERITANCE AND VIRTUAL FUNCTIONS**	**9**	**0**	**0**	**9**

Classes and objects - friend functions- constructors and destructors- Operator overloading – binary and unary operator overloading using member function and friend function - Type conversions.

Unit III	**INHERITANCE AND VIRTUAL FUNCTIONS**	**9**	**0**	**0**	**9**

Inheritance – defining derived classes, types, virtual base classes, abstract classes, constructor in derived classes - Pointers-pointers to objects, this pointer, pointer to derived classes - Virtual functions.

Unit IV	**TEMPLATES AND EXCEPTION HANDLING**	**9**	**0**	**0**	**9**

Generic Classes – class template, class templates with multiple parameters - Generic Functions - function templates, function templates with multiple parameters, member function templates - Exception handling – basics, exception handling mechanism, rethrowing an exception – Exception handling options – understanding terminate() and unexpected() – the uncaught_exception() function – bad_exception().

Unit V	**CONSOLE I/O AND FILE HANDLING**	**9**	**0**	**0**	**9**

C++ Stream Classes – unformatted I/O operations, formatted console I/O operations, manipulators - Files-classes for file operation, opening and closing a file, detecting end of file, files modes, sequential file operations, random file operations.

Total (45 L) =45 Periods

Text Books:

1	E. Balagurusamy “Object –Oriented Programming with C++” Sixth Edition Tata McGraw-Hill

Reference Books:

1	Herbert Schildt, "The Complete Reference C++", Fifth Edition, Tata McGraw Hill
2	Bjarne Stroustrup, “The C++ programming language”, Fourth Edition Addison Wesley
3	K.R.Venugopal, Rajkumar Buyya, T.Ravishankar , Mastering in C++, Second Edition, Tata McGraw Hill

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Build the object oriented programming concepts.	Apply
CO2	Familiarize and build the template functions and classes	Understand
CO3	Disseminate and apply exception handling mechanisms.	Apply
CO4	Depict and exploit steam classes.	Understand

18CSM02	ADVANCED DATA STRUCTURES AND ALGORITHMS				
PREREQUISITES		**Category**	**OE**	**Credit**	**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	To understand the concepts of ADTs
2	To Learn linear data structures – lists, stacks, and queues
3	To have knowledge about non-linear data structures like trees and graphs
4	To understand concepts about searching and sorting and hashing techniques

Unit I	**LINEAR DATA STRUCTURES – LIST**	**9**	**0**	**0**	**9**

Abstract Data Types (ADTs) – List ADT - Array based Implementation - Linked List Implementation – Singly Linked Lists - Circularly Linked Lists - Doubly-Linked Lists - Applications of Lists – Polynomial Manipulation – All operations (Insertion, Deletion, Merge, Traversal).

Unit II	**LINEAR DATA STRUCTURES –STACKS AND QUEUES**	**9**	**0**	**0**	**9**

Stack ADT - Operations - Applications of Stacks - Evaluating Arithmetic Expression - Conversion of infix to postfix Expression - Queue ADT - Operations - Circular Queue - DeQueue - Applications of Queue

Unit III	**NON LINEAR DATA STRUCTURES – TREES**	**9**	**0**	**0**	**9**

Tree ADT – Tree traversals – Binary Tree ADT – Expression Trees – Applications of Trees – Binary Search Tree ADT – Threaded Binary Trees- AVL Trees – B-Tree – Heaps - Operations of Heaps - Priority Queues - Binary Heap - Max Heap - Min Heap - Applications of Heap.

Unit IV	**NON LINEAR DATA STRUCTURES – GRAPHS**	**9**	**0**	**0**	**9**

Definition – Representation of Graphs –Types of Graphs - Graph Traversals - Breadth First Search - Depth First Search - Application of Graph Structures: Shortest Path Problem: Dijkstra's Algorithm - Minimum Spanning Trees: Prim's Algorithm - Kruskal's Algorithms

Unit V	**SEARCHING, SORTING AND HASHING TECHNIQUES**	**9**	**0**	**0**	**9**

Searching: Linear Search - Binary Search - Sorting Algorithms - Insertion Sort - Selection Sort - Shell Sort - Bubble Sort - Quick Sort - Merge Sort - Radix Sort - Hashing: Hash Functions – Separate Chaining – Open Addressing – Rehashing – Extendible Hashing.

Total (45 L) =45 Periods

Text Books:

1	Mark Allen Weiss, " Data Structures and Algorithm Analysis in C ", 4/E Pearson Education, 2013.

Reference Books:

1	Seymour Lipschutz, "Data Structures With C ",(Schaum`s Outline Series) Published by Tata McGraw-Hill Education Pvt. Ltd., 2015
2	Ellis Horowitz, Sartaj Sahni, Dinesh Mehta, "Fundamentals of Data Structures In C", Second Edition, Silicon Press, 2008.
3	Richard F.Gilberg & Behrouz A.Forouzan, "Data Structures: A Pseudo code Approach With C", Second Edition, Cengage Learning Publishers,2005.
4	Classic Data Structures", Second Edition by Debasis Samanta, PHI Learning, 2009.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Implement various abstract data types to solve real time problems by using Linear Data Structures	Apply
CO2	Apply the different Non-Linear Data Structures to solve problems	Apply
CO3	Analyze and implement graph data structures to solve various computing problems.	Analyze
CO4	Critically analyze the various sorting and searching algorithms	Analyze

18CSM03	COMPUTER ORGANIZATION AND DESIGN				
PREREQUISITES		**Category**	**OE**	**Credit**	**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	To understand the basic structure and operations of digital computer
2	To learn the working of different arithmetic operations
3	To understand the different types of control and the concept of pipelining
4	To study the hierarchical memory system including cache memory and virtual memory
5	To understand the different ways of communication with I/O devices and standard I/O interfaces

UNIT I	**INTRODUCTION**	**9**	**0**	**0**	**9**

Functional units ,Basic Operational Concepts, Bus Structure ,Memory Locations and Addresses, MemoryOperations, Instruction and Instruction Sequencing, Addressing modes.

UNIT II	**ARITHMETIC UNIT**	**9**	**0**	**0**	**9**

Addition and Subtraction of Signed Numbers, Design of Fast Adders, Multiplication of Positive Numbers, BoothAlgorithm, Fast Multiplication, Integer Division, Floating point number operations.

UNIT III	**PROCESSOR UNIT AND PIPELINING**	**9**	**0**	**0**	**9**

Fundamental Concepts, Execution of Instruction, Multi Bus Organization, Hardwired control, Micro programmed control, Basic Concepts of pipelining, Data Hazards, Instruction Hazards ,Data path & Control Considerations.

UNIT IV	**MEMORY SYSTEMS**	**9**	**0**	**0**	**9**

Basic Concepts, Semiconductor RAM, ROM, Cache memory, Improving Cache Performance, Virtual memory,Memory Management requirements, Secondary Storage Device.

UNIT V	**INPUT AND OUTPUT ORGANIZATION**	**9**	**0**	**0**	**9**

Accessing I/O devices, Programmed I/O, Interrupts, Direct Memory Access, Interface circuits, Standard I/O Interfaces (PCI, SCSI, USB).

Total (45 L) =45 Periods

Text Books:

1	Carl Hamacher V.,Zvonko G.Vranesic, Safwat G. Zaky, " Computer organization ", Tata McGraw Hill,5th Edition, 200

Reference Books:

1	Patterson and Hennessey, “Computer Organization and Design ". The Hardware/Software interface,Harcourt Asia Morgan Kaufmann, 3rd Edition, 2007
2	Hayes, “Computer Architecture and Organization ", 3rd edition,Tata McGraw Hill, 2006
3	Heuring V.P., Jordan H.F., " Computer System Design and Architecture ", 6th edition ,Addison Wesley,2008

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Understand the working principles of computer componets	Understand
CO2	Design the arithmetic and processing units	Create
CO3	Analyze the various computer components	Analyze

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18CSM04	ADVANCED OPERATING SYSTEMS	Semester			
PREREQUISITES	Category	OE	Credit		3
	Hours/Week	L	T	P	TH
		3	0	0	3

Course Learning Objectives

1	To understand the structure and functions of Operating systems
2	To understand the process concepts and scheduling algorithms
3	To understand the concept of process synchronization and deadlocks
4	To learn various memory management schemes
5	To illustrate various file systems and disk management strategies

UNIT I	INTRODUCTION AND OPERATING SYSTEM STRUCTURES	9	0	0	9

Main frame Systems, Desktop Systems, Multiprocessor Systems, Distributed Systems, Clustered Systems, Real Time systems, Hand held Systems; Operating Systems Structures - System Components, Operating System Services, System calls, System Programs, System Design and Implementation.

UNIT II	PROCESS MANAGEMENT	9	0	0	9

Processes-Process Concepts, Process Scheduling, Operation on Processes, Co-Operating Processes, InterProcess Communication; Threads- Multithreading Models, Threading Issues; CPU Scheduling-Basic Concepts, Scheduling Criteria, Scheduling Algorithms.

UNIT III	PROCESS SYNCHRONIZATION AND DEADLOCKS	9	0	0	9

Process Synchronization- The Critical Section Problem, Synchronization Hardware, Semaphores, Classical Problem of Synchronization, Monitors; Deadlocks- Deadlock Characterization, Methods for handling Deadlocks, Deadlock Prevention, Deadlock Avoidance ,Deadlock Detection, Recovery from Deadlock.

UNIT IV	MEMORY MANAGEMENT AND VIRTUAL MEMORY	9	0	0	9

Memory Management- Background, Swapping, Contiguous Memory Allocation, Paging, Segmentation, Segmentation with paging; Virtual Memory - Demand paging, Page Replacement, Thrashing.

UNIT V	FILE SYSTEM AND MASS-STORAGE STRUCTURE	9	0	0	9

File System Interface - File Concepts, Access methods, Directory Structure, File Sharing, File Protection; File System Implementation- File System Structure and Implementation, Directory Implementation, Allocation Methods, Free Space Management; Mass-Storage Structure - Disk Structure, Disk scheduling, Disk Management, RAID Structure; Case study: Linux system.

Total (45 L) =45 Periods

Text Books:

1	Abraham Silberschatz, P.B.Galvin, G.Gagne ―Operating System Concepts 6th edition, John Wiley & Sons, 2003.

Reference Books:

1	Andrew S. Tanenbaum, ―Modern Operating Systems, PHI , 2nd edition, 2001
2	D.M.Dhamdhere, "Systems Programming and Operating Systems ", 2nd edition, Tata McGraw Hill Company, 1999.
3	Maurice J. Bach, ―The Design of the Unix Operating System, 1st edition, PHI, 2004.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Identify the components and their functionalities in the operating system	Apply
CO2	Apply various CPU scheduling algorithms to solve problems	Apply
CO3	Analyze the needs and applications of process synchronization and deadlocks	Analyze
CO4	Apply the concepts of memory management including virtual memory and page replacement to the issues that occur in real time applications	Apply
CO5	Solve issues related to file system implementation and disk management	Apply

18CSM05	DATA COMMUNICATION AND COMPUTER NETWORKS	Semester	

PREREQUISITES	Category	OE	Credit		3
	Hours/Week	L	T	P	TH
		3	0	0	3

Course Learning Objectives

1	To study the concepts of data communications and functions of different ISO/OSI reference architecture
2	To understand the error detection and correction methods and also the types of LAN
3	To study the concepts of subnetting and routing mechanisms
4	To understand the different types of protocols and congestion control
5	To study the application protocols and network security

UNIT I	DATA COMMUNICATIONS AND PHYSICAL LAYER	9	0	0	9

Data Communication; Networks- Physical Structures (Types of Connections, Physical Topology),Categories of Networks, Interconnection of Networks: Internetwork; Protocols and Standards; Network Models-The OSI Model, Layers in the OSI Model, Addressing; Transmission media-Guided Media, Unguided Media.

UNIT II	DATA LINK LAYER	9	0	0	9

Introduction-Types of errors, Redundancy, Detection versus Correction, Modular Arithmetic; Block Coding-Error Detection and Correction (VRC,LRC,CRC, Checksum, Hamming Code);Data link Control- Flow Control (Stop- and-Wait, Sliding Window),Error Control (Automatic Repeat Request, Stop-and-wait ARQ, Sliding Window ARQ), HDLC; Local Area Networks-Ethernet, Token Bus, Token Ring, FDDI.

UNIT III	NETWORK LAYER	9	0	0	9

Network Layer services-Packet Switching-Network Layer Performance-IPv4 addresses-IPv6 addressing- Subnetting-Bridges-Gateways- Routers-Routing Algorithm-Distance Vector Routing, Link State Routing.

UNIT IV	TRANSPORT LAYER	9	0	0	9

Duties of the Transport layer-User Datagram Protocol-Transmission Control Protocol- Congestion Control and Quality of Service-Congestion, Congestion Control, Quality of Service, Techniques to improve QoS, Integrated Services.

UNIT V	PRESENTATION LAYER AND APPLICATION LAYER	9	0	0	9

Domain Name System - Domain Name Space, DNS in the Internet; Electronic Mail-FTP- HTTP- World Wide Web.

Total (45 L) =45 Periods

Text Books:

1	Behrouz A.Ferouzan, "Data Communications and Networking", 4th Edition, Tata McGraw-Hill, 2007.

Reference Books:

1	Andrew S. Tanenbaum, "Computer networks "PHI, 4th edition 2008
2	William Stallings," Data and computer communications", 10th edition,PHI, 2012
3	Douglas E. comer," Internetworking with TCP/IP-Volume-I", 6th edition,PHI, 2008

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Classify the fundamentals of data communications and functions of layered architecture	Understand
CO2	Apply the error detection and correction methods and also identify the different network technologies	Apply
CO3	Analyze the requirements for a given organizational structure and select the most appropriate networking architecture and routing technologies	Analyze
CO4	Illustrate the transport layer principles and reliable data transfer using protocols	Apply
CO5	Analyze the application layer protocols and also the use of network security	Analyze

18CSM06	PROGRAMMING ESSENTIALS IN PYTHON	Semester			
PREREQUISITES	Category	OE	Credit		3
	Hours/Week	L	T	P	TH
		3	0	0	3

Course Learning Objectives

1	To learn Python data structures, conditional and control structures and files
2	To study Python Modules, packages, Functions and Exceptions.
3	To describe Object oriented programming features and Regular Expressions.
4	To learn about Web programming, GUI Programming and Database programming

UNIT I	INTRODUCTION	9	0	0	9

Python: Features - The Basics-Python Objects-Numbers-Sequences-Mapping and set types- Conditionals and loops-if statement-else statement-elif-Conditional Expressions-while statement-for statement-break-continue.

UNIT II	FUNCTIONS, MODULES AND PACKAGES	9	0	0	9

Functions-Calling functions-Creating functions-Passing Functions-Formal Arguments-Variable length arguments-variable scope-Recursion, Modules-Packages.

UNIT III	FILES AND EXCEPTIONS	9	0	0	9

Files and Input/ Output –Errors and Exceptions-Introduction-Detecting and handling Exceptions-Context Management-Raising Exceptions-Assertions-Standard Exceptions.

UNIT IV	OBJECT ORIENTED PROGRAMMING AND REGULAR EXPRESSIONS	9	0	0	9

Object Oriented Programming Introduction-Classes-class Attributes-Instances-Instances attributes-Building and Method Invocation-Static methods and class Methods-Inheritance-Operator overloading - Regular Expressions-Network Programming – Multithreaded Programming

UNIT V	ADVANCED TOPICS	9	0	0	9

GUI Programming- Web Programming-Database Programming

Total (45 L) =45 Periods

Text Books:

1	Wesley J.Chun-"Core Python Programming" –Prentice Hall, Second Edition, 2006.

Reference Books:

1	Swaroop C N, " A Byte of Python ", ebshelf Inc., 1st Edition, 2013
2	"A Practical Introduction to python programming", Brian Heinold,Mount St.Mary's University,2012
3	Learning to Program with Python," Richard L. Halterman"., Southern Adventist University

Course Outcomes: Upon completion of this course, the students will be able to:		Bloom's Taxonomy Level
CO1	Develop programs using control structures and files.	Create
CO2	Create own Python Modules, packages, functions and Exceptions.	Create
CO3	Illustrate Object oriented Programming features and Regular Expressions.	Apply
CO4	Create own Web programs, GUI and database programs.	Create

22CSM07	ADVANCED DATABASE SYSTEM CONCEPTS	Semester			
PREREQUISITES	Category	OE	Credit		3
	Hours/Week	L	T	P	TH
		3	0	0	3

Course Learning Objectives

1	To understand the fundamentals of data models ,SQL queries and relational databases
2	To make a study of database design using ER Diagram and normalize
3	To impart knowledge in transaction processing.
4	To make the students to understand the file operations and indexing
5	To familiarize the students with advanced databases

UNIT I	RELATIONAL DATABASES	9	0	0	9

Purpose of Database System – Views of data – Data Models – Database System Architecture – Introduction to relational databases – Relational Model – Keys – Relational Algebra – SQL fundamentals – Advanced SQL features – Embedded SQL– Dynamic SQL.

UNIT II	DATABASE DESIGN	9	0	0	9

Entity-Relationship model – E-R Diagrams – Enhanced-ER Model – ER-to-Relational Mapping – Functional Dependencies – Non-loss Decomposition – First, Second, Third Normal Forms, Dependency Preservation – Boyce/Codd Normal Form – Multi-valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form.

UNIT III	TRANSACTION	9	0	0	9

Transaction Concepts – ACID Properties – Schedules – Serializability – Concurrency Control – Need for Concurrency – Locking Protocols – Two Phase Locking – Deadlock – Transaction Recovery – Save Points – Isolation Levels – SQL Facilities for Concurrency and Recovery.

UNIT IV	IMPLEMENTATION TECHNIQUES	9	0	0	9

RAID – File Organization – Organization of Records in Files – Indexing and Hashing –Ordered Indices – B+ tree Index Files – B tree Index Files – Static Hashing – Dynamic Hashing – Query Processing Overview – Algorithms for SELECT and JOIN operations – Query optimization using Heuristics and Cost Estimation.

UNIT V	ADVANCED TOPICS	9	0	0	9

Distributed Databases: Architecture, Data Storage, Transaction Processing – Object-based Databases: Object Database Concepts, Object-Relational features, ODMG Object Model, ODL, OQL – XML Databases: XML Hierarchical Model, DTD, XML Schema, XQuery – Data Warehousing and Data Mining - information Retrieval: IR Concepts, Retrieval Models, Queries in IR systems.

Total (45 L) =45 Periods

Text Books:

1	Abraham Silberschatz, Henry F.Korth and S.Sundarshan “Database System Concepts”, Sixth Edition,Tata McGraw Hi 2011.

Reference Books:

1	Ramez Elamassri and Shankant B-Navathe, “Fundamentals of Database Systems”, Sixth Edition,Pearson Education, 2011.
2	C.J. Date, “An Introduction to Database Systems”, Eighth Edition, Pearson Education Delhi, 2008.
3	Raghu Ramakrishnan, ―Database Management Systems, Fourth Edition, McGraw-Hill CollegePublications, 2015.
4	G.K.Gupta,”Database Management Systems”, Tata McGraw Hill, 2011.

E-References:

1.	Lecture Series on Database Management System by Dr.S.Srinath, IIIT Bangalore, nptl

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Understand the basic concepts of the database and data models.	Understand
CO2	Design a database using ER diagrams and map ER into Relations and normalize the relations.	Create
CO3	Develop a simple database for applications	Create

18CSM08	VIRTUALIZATION AND CLOUD COMPUTING	Semester	

PREREQUISITES	Category	OE	Credit		3
	Hours/Week	L	T	P	TH
		3	0	0	3

Course Learning Objectives

1	To introduce the broad perceptive of Parallel Computing, Distributed Computing and Cloud Computing.
2	To understand the concept of Virtualization
3	To identify the approaches of SLA and programming model in Cloud
4	To understand the Cloud Platforms in Industry and Software Environments.
5	To learn to design the trusted Cloud Computing system

UNIT I	INTRODUCTION	9	0	0	9

Principles of Parallel and Distributed Computing – Elements of Parallel and Distributed Computing, Technologies for Distributed Computing; Vision of Cloud, Defining a Cloud, characteristics and benefits; Cloud Computing Architecture- Cloud Reference Model, Types of Clouds, Open Challenges.

UNIT II	VIRTUALIZATION	9	0	0	9

Introduction, Characteristics of Virtualized environments, Virtualization techniques-Machine Reference Model, Hardware-Level Virtualization, Programming Language-Level Virtualization, Application-Level Virtualization ,Other types of Virtualization, Virtualization and Cloud computing, Pros and cons of Virtualization, Technology examples-Xen: Para virtualization, VMware: Full Virtualization.

UNIT III	SLA MANAGEMENT IN CLOUD COMPUTING AND PROGRAMMING MODEL	9	0	0	9

Traditional Approaches to SLA Management, Types of SLA, Life Cycle of SLA, SLA Management in Cloud; Data Intensive Computing - Technologies for Data Intensive Computing, MapReduce Programming Model.

UNIT IV	CLOUD INDUSTRIAL PLATFORMS AND SOFTWARE ENVIRONMENTS	9	0	0	9

Cloud Platforms in Industry - Amazon Web Service, Google App Engine; Cloud Software Environments –Eucalyptus, OpenNebula; Aneka Cloud Application Platform-Aneka Framework Overview, Anatomy of Aneka Container.

UNIT V	CLOUD SECURITY AND APPLICATIONS	9	0	0	9

An Introduction to the Idea of Data Security, The Current State of Data Security in the Cloud, Cloud Computing and Data Security Risk, Cloud Computing and Identity; The Cloud, Digital Identity, and Data Security, Content Level Security, Pros and Cons; Cloud Scientific Applications.

Total (45L) = 45 Periods

Text Books:

1	Rajkumar Buyya, Christian Vecchiola, S.Tamarai Selvi, 'Mastering Cloud Computing-Foundations and Applications Programming", TMGH,2013.(Unit- I,II & IV)
2	RajKumar Buyya, James Broberg, Andrezei M.Goscinski, "Cloud Computing: Principles and paradigms",2011(Unit-III & V)

Reference Books:

1	Kai Hwang.GeoffreyC.Fox.JackJ.Dongarra, " Distributed and Cloud Computing ,From Parallel Processing to The Internet of Things", 2012 Elsevier
2	Barrie Sosinsky, "Cloud Computing Bible", Wiley Publisher, 2011

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Explain the main concepts and architecture of Parallel computing, Distributed Computing and Cloud Computing.	Understand
CO2	Analyze the concept of Virtualization	Analyze
CO3	Identify the approaches of SLA and programming model in Cloud	Apply
CO4	Analyze the Cloud Platforms in Industry and Software Environments.	Analyze
CO5	Identify the security issues in scientific and real time applications.	Apply

B.E. – ELECTRONICS AND COMMUNICATION ENGINEERING - MINOR DEGREE

18ECM01	ELECTRON DEVICES				
PREREQUISITES	**CATEGORY**	**OE**	**Credit**		**3**
	Hours/Week	**L**	**T**	**P**	**TH**
		3	**0**	**0**	**3**

Course Objectives:

1. To introduce components such as diodes, BJTs and FETs, their characteristics and applications
2. To understand, analyse and design of simple diode and transistor circuits.
3. To know the switching characteristics of components and the concept of rectifiers and power supplies

Unit I	**EXTRINSIC SEMICONDUCTOR AND PN JUCTIONS**	**9**	**0**	**0**	**9**

N and P type semiconductor and their energy band structures- Law of electrical neutrality-calculation of location of Fermi level and free electron and hole densities in extrinsic semiconductors-Mobility, drift current and conductivity-diffusion current-continuity equation- Hall effect and its applications. Band structure of PN junction – current component in a PN junction- derivation of diode equation-temperature dependence of diode characteristics and equivalent models.

Unit II	**SWITCHING CHARACTERISTICS OF PN JUNTION AND SPECIAL DIODES**	**9**	**0**	**0**	**9**

Calculation of transition and diffusion capacitance- varactor diode-charge control description of diode-switching characteristics of diode- mechanism of avalanche and Zener breakdown-temperature dependence of breakdown voltages-backward diode-tunneling effect in thin barriers - tunnel diode-photo diode-light emitting diodes.

Unit III	**BIPOLAR JUNCTION TRANSISTORS**	**9**	**0**	**0**	**9**

Construction of PNP and NPN transistors- BJT current components-emitter to collector and base to collector current gains-base width modulation CB, CE and CC characteristics- breakdown characteristics- Ebers-Moll model - transistor switching times- Photo translator.

Unit IV	**FIELD EFFECT TRANSISTORS**	**9**	**0**	**0**	**9**

Construction and characteristics of JFET-relation between pinch off voltage and drain current derivation. MOSFETS - enhancement and depletion types. CMOS circuits. MOS capacitance, BICMOS, SOI CMOS.

Unit V	**RECTIFIERS AND POWER SUPPLIES**	**9**	**0**	**0**	**9**

Half-wave, full-wave and bridge rectifiers with resistive load. Analysis for Vdc and ripple voltage with C, CL, L-C and C-L-C filters. Voltage multipliers Zener diode regulator. Electronically regulated d.c power supplies. Line regulation, output resistance and temperature coefficient.

Total (45L)= 45 Periods

Text Books:

1. JaconMillman& Christos C. Halkias, " Electronic Devices and Circuits" Tata McGraw-Hill, 1991.

2.	Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory 8th edition.", PHI, 2002
Reference Books:	
1.	Donald A. Neaman. " Semiconductor Physics and Devices" 3rd Ed., Tata McGraw-Hill 2002
2.	S. Salivahanan, N. Suresh kumar and A. Vallavaraj, Electronic Devices and Circuits, TMH, 1998.
3.	Ben, G. Streetman and Sanjay Banerjee, Solid State Electronic Devices, Pearson Education 2000
4.	Floyd, "Electronic Devices", Sixth edition, Pearson Education, 2003.
E-References:	
1.	https://archive.nptel.ac.in/courses/108/108/108108122/
2.	https://www.youtube.com/watch?v=qqQ8wO-lNmI
3.	https://slideplayer.com/slide/12438044/

Course Outcomes: Upon completion of this course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Interpret various applications of diode.	Applying
CO2	Classify various configurations and biasing technique of BJT	Applying
CO3	Apply the knowledge of using special devices for various applications	Understanding
CO4	Discuss operation, biasing and applications of JFET.	Analysing
CO5	Design power supplies and rectifiers	Applying

COURSE ARTICULATION MATRIX															
COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	2	2	1	-	-	-	-	-	-	-	-	-	1	-	-
CO2	2	2	1	-	-	-	-	-	-	-	-	-	2	-	-
CO3	2	2	1	-	-	-	-	-	-	-	-	-	3	-	-
CO4	2	2	1	-	-	-	-	-	-	-	-	-	2	2	1
CO5	2	2	1	-	-	-	-	-	-	-	-	-	3	2	2
Avg	2	2	1	-	-	-	-	-	-	-	-	-	2.2	2	1.5
3/2/1 - indicates strength of correlation (3-High,2- Medium,1- Low)															

18ECM02	DIGITAL ELECTRONICS				
PREREQUISITES	**CATEGORY**	**OE**	**Credit**		**3**
	Hours/Week	**L**	**T**	**P**	**TH**
		3	**0**	**0**	**3**

Course Objectives

1	To introduce basic postulates of boolean algebra and show the correlation between expressions
2	To Introduce the methods for Simplifying Boolean expressions
3	To Outline the formal procedures for the analysis and design of combinational circuits and sequential circuits
4	To introduce the Concept of Memories and programmable logic devices
5	To illustrate the concept of synchronous and Asynchronous sequential circuits

Unit I	**NUMBER SYSTEMS AND LOGIC GATES**	**9**	**0**	**0**	**9**

Number Systems - signed Binary numbers - Binary Arithmetic - Binary codes -conversion from one code to another - Boolean Algebra and Minimization Techniques - Canonical forms – Conversion between canonical forms – Simplifications of Boolean expressions using Karnaugh map - LOGIC GATES - Implementations of Logic Functions using gates.

Unit II	**COMBINATIONAL CIRCUITS**	**9**	**0**	**0**	**9**

Design procedure – Adders/Subtractor – Serial adder/ Subtractor - Parallel adder/ Subtractor- BCD adder- Multiplexer/ Demultiplexer - encoder / decoder – code converters.

Unit III	**SEQUENTIAL CIRCUITS**	**9**	**0**	**0**	**9**

Design Procedure - Flip flops: SR, JK, T, D and JKMS – Triggering of Flip-flop - Realization of flip flops – Moore and Mealy – Counters: Asynchronous / Ripple counters – Synchronous counters – Modulo n counter. Register: shift registers- Universal shift register.

Unit IV	**ASYNCHRONOUS SEQUENTIAL CIRCUITS**	**9**	**0**	**0**	**9**

Design of fundamental mode circuits – primitive state / flow table – Minimization of primitive state table –state assignment. Problems in Asynchronous Circuits: Cycles – Races – Hazards. Design of Hazard Free Circuits: Static, Dynamic Hazards elimination

Unit V	**PLD AND MEMORY DEVICES**	**9**	**0**	**0**	**9**

Classification of memories –RAM organization –ROM organization. Programmable Logic Devices: Programmable Logic Array (PLA) - Programmable Array Logic (PAL). Implementation of combinational logic using MUX, ROM, PAL and PLA.

Total (45 L) = 45 Periods

Text Books:

1	M. Morris Mano, Digital Design, 4.ed.,Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2008
2	R.P.Jain, Modern Digital Electronics, 4th edition, TMH, 2010.

Reference Books:

1	S. Salivahanan and S. Arivazhagan, Digital Circuits and Design, 2nd ed., Vikas Publishing House Pvt. Ltd, New Delhi, 2004
2	Charles H.Roth. “Fundamentals of Logic Design”, Thomson Publication Company, 2003.
3	Donald P.Leach and Albert Paul Malvino, Digital Principles and Applications, 5 ed., Tata McGraw Hill Publishing Company Limited, New Delhi, 2003.
4	John F.Wakerly, Digital Design: Principles and practices, PHI, 2006

E-Reference:

1	http://nptel.ac.in/noc/individual_course.php?id=noc15-ec01

2	https://nptel.ac.in/courses/117105080/6
3	https://nptel.ac.in/courses/117105080/12

Course Outcomes: Upon completion of this course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Minimize Boolean expressions and implement using logic gates	Applying
CO2	Design and analyse combinational logic circuits.	Analysing
CO3	Design and analyse synchronous and asynchronous sequential logic circuits	Analysing
CO4	Understand the concepts of memories and PLDs	Understanding
CO5	Implement circuits using memory and PLDs.	Applying

COURSE ARTICULATION MATRIX

COs/POs	PO 1	PO 2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	2	3	2	3	2	-	-	-	-	2	1	-
CO2	3	3	2	2	3	3	2	1	1	-	-	-	3	2	-
CO3	2	2	3	3	2	1	2	1	1	-	-	-	2	2	-
CO4	2	1	2	1	2	2	3	1	-	-	-	-	2	1	-
CO5	2	1	2	1	3	2	1	2	-	-	-	-	3	2	-
Avg	2.4	1.8	2.2	1.8	2.6	2	2.2	1.4	1	-	-	-	2.4	1.6	-

3/2/1 - indicates strength of correlation (3-High,2- Medium,1- Low)

18ECM03	ELECTRONIC CIRCUITS				
PREREQUISITES	**CATEGORY**	**OE**	**Credit**		**3**
Electron Devices	**Hours/Week**	**L**	**T**	**P**	**TH**
		3	**0**	**0**	**3**

Course Objectives

1	To perform analysis on Small signal amplifiers and large signal amplifiers.
2	To give a comprehensive exposure to all types of discrete amplifiers and oscillators.
3	To understand the various linear and non-linear applications of op-amp

Unit I	**MIDBAND ANALYSIS OF SMALL SIGNAL AMPLIFIERS**	**9**	**0**	**0**	**9**

BJT – Need for biasing - Fixed bias circuit - Load line and quiescent point. Different types of biasing circuits. Use of Self bias circuit as a constant current circuit. CE, CB and CC amplifiers. Method of drawing small-signal equivalent circuit. Mid-band analysis of various types of single stage amplifiers to obtain gain - input impedance and output impedance. Miller's theorem. Darlington connection using similar and Complementary transistors. Methods of increasing input impedance using Darlington connection and bootstrapping. CS, CG and CD (FET) amplifiers. Multistage amplifiers-Basic emitter coupled differential amplifier circuit. Differential gain - CMRR. Use of constant current circuit to improve CMRR.

Unit II	**LARGE SIGNAL AMPLIFIERS**	**9**	**0**	**0**	**9**

Low frequency & High frequency analysis of amplifiers -Hybrid – pi equivalent circuit of BJTs.-High frequency equivalent circuit of FETs. Gain-bandwidth product of FETs. General expression for frequency response of multistage amplifiers. Calculation of overall upper and lower cut off frequencies of multistage amplifiers. Amplifier rise time and sag time and their relation to cut off frequencies. Classification of amplifiers (Class A, B, AB, C&D), Efficiency of class A, RC coupled and transformer-coupled power amplifiers. Class B complementary-symmetry, push-pull power amplifiers. Calculation of power output, efficiency and power dissipation. Crossover distortion and methods of eliminating it. Calculation of actual power handling capacity of transistors with and without heat sink. Heat sink design.

Unit III	**OSCILLATORS**	**9**	**0**	**0**	**9**

Feedback Amplifier: Block diagram - Gain with feedback - Barkhausen Criterion - Mechanism for start of oscillation and stabilization of amplitude - Analysis of Oscillator using Cascade connection of RC and LC filters - RC phase shift Oscillator - Wien bridge Oscillator and Twin-T Oscillators - Analysis of LC Oscillators: Colpitts – Hartley – Clapp - Miller and Pierce oscillators - Frequency range of RC Oscillators - Electrical equivalent circuit of Crystal.

Unit IV	**TUNED AMPLIFIERS AND MULTIVIBRATORS**	**9**	**0**	**0**	**9**

Analysis of single tuned and synchronously tuned amplifiers - Class C tuned amplifiers and their applications - Efficiency of Class C tuned Amplifier- Collector coupled and Emitter coupled Astable Multi vibrator – Mono stable Multi vibrator – Bistable Multi vibrator - Triggering methods – Mono stable and Astable Blocking Oscillators using Emitter and base timing.

Unit V	**OPERATIONAL AMPLIFIERS AND ITS APPLICATIONS**	**9**	**0**	**0**	**9**

Basic structure and principle of operation - Calculation of differential gain - Common Mode gain, CMRR - OP-AMP design - DC and AC characteristics of OP-AMP. Applications: Inverting and non-inverting amplifiers - Integrator and Differentiator - Summing amplifier - Precision rectifier - Schmitt trigger and its applications - Active filters: Low pass, high pass, band pass and band stop filters - Sine wave oscillators – Comparator – Multi vibrator.

Total (45 L) = 45 Periods

Text Books:

1	B.Visvesvara Rao, K.Raja Rajeswari, P.Chalam Raju Pantulu, K.Bhaskara Rama Murthy, "Electronic Circuits-II", Pearson Education,2012
2	D.Roy Choudhry, Shail Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd., 2011.

Reference Books:

1	Millman J. and Taub H., "Pulse Digital and Switching waveform", 3rd Edition, McGraw-Hill International , 2011.

2	Sedera& Smith, “Micro Electronic Circuits”, 4 th Edition, Oxford University Press, Chennai.
3	Michael Jacob, ‘Applications and Design with Analog Integrated Circuits’, Prentice Hall of India, 1996.
4	K.R.Botkar, ‘Integrated Circuits’, 10th edition, Khanna Publishers, 2010.
e-Reference:	
1	http://nptel.ac.in/courses/117105080/40
2	http://nptel.ac.in/courses/117108038/1
3	https://freevideolectures.com/course/2915/linear-integrated-circuits

Course Outcomes: Upon completion of this course, the students will be able to:		Bloom’s Taxonomy Mapped
CO1	To analyze small signal amplifiers and Large signal Amplifiers.	Applying
CO2	Analyze the frequency response characteristics of amplifiers	Applying
CO3	Develop insight of on oscillator design.	Applying
CO4	Construct and analyse tuned amplifiers and multivibrators.	Applying
CO5	Develop competence in linear and nonlinear Op amp circuit analysis.	Applying

COURSE ARTICULATION MATRIX															
COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	1	2	-	-	-	-	-	-	-	-	1	2	1
CO2	3	2	1	2	-	-	-	-	-	-	-	-	1	2	1
CO3	3	2	1	2	-	-	-	-	-	-	-	-	1	2	1
CO4	3	2	1	2	-	-	-	-	-	-	-	-	1	2	1
CO5	1	2	1	2	-	-	-	-	-	-	-	-	1	2	1
Avg	2.4	2	1	2	-	-	-	-	-	-	-	-	1	2	1
3/2/1 - indicates strength of correlation (3-High,2- Medium,1- Low)															

18ECM04	SIGNAL PROCESSING				
PREREQUISITES	**CATEGORY**	**OE**	**Credit**		**3**
	Hours/Week	**L**	**T**	**P**	**TH**
		3	**0**	**0**	**3**

Course Objectives:

1.	To understand and perform Fourier and Laplace analysis on signals and systems respectively.
2.	To analyse the Discrete Fourier Transform, Fast Fourier Transform algorithms.
3.	To design and realize IIR, FIR filters.

Unit I	**INTRODUCTION TO SIGNALS AND SYSTEMS**	**9**	**0**	**0**	**9**

Classification of Signals: Even and Odd Signal - Energy and power signals - Continuous time (CT) and Discrete time (DT) signals - Continuous and Discrete amplitude signal -. System properties and representation: linearity - Tme-invariance – Causality – Stability - Realizability. - Linear Time-Invariant (LTI) systems: Impulse response and step response – Convolution – Correlation - System representation through differential equations and difference equations.

Unit II	**ANALYSIS OF SIGNAL AND SYSTEMS**	**9**	**0**	**0**	**9**

Introduction to Fourier Transform, Fourier Series, Relating the Laplace Transform to Fourier Transform, Frequency response of continuous time systems. Introduction to z- Transform.

Unit III	**DISCRETE FOURIER TRANSFORM**	**9**	**0**	**0**	**9**

Introduction to DFT – Properties of DFT - Circular convolution - FFT algorithms – Radix-2 FFT algorithms – Decimation in Time and Decimation in Frequency algorithms.

Unit IV	**INFINITE IMPULSE RESPONSE FILTER DESIGN**	**9**	**0**	**0**	**9**

Characteristics of Analog Butterworth filter - Chebyshev filter - Low pass filter, High pass filter, Band pass filter and Band stop filter - Transformation of analog filters in to equivalent digital filters using bilinear transformation method - Realization structure for IIR filters-Direct form - Cascade form - Parallel form.

Unit V	**FINITE IMPULSE RESPONSE FILTER DESIGN**	**9**	**0**	**0**	**9**

Linear phase response of FIR filter - FIR design using window method: Rectangular, Hamming, Hanning and Blackmann Windows - Park-McClellan's method - Realization structures for FIR filters - Linear phase structures and Direct form structure - Comparison of FIR and IIR filters.

Total (45L)= 45 Periods

Text Books:

1.	A.Anand Kumar, “Signals and Systems” , 3rd Edition, PHI, 2013.
2.	John G Proakis and Manolakis, “Digital Signal Processing Principles, Algorithms and Applications”, 4th Edition, Pearson Education, 2009.

Reference Books:	
1.	Alan V Oppenheim, Alan S Willsky and S Hamid Nawab, “Signals and Systems”, 2nd edition, PHI Learning Private Limited, New Delhi, 2010.
2.	B.P. Lathi, "Principles of Signal Processing and Linear Systems", Oxford University Press, 2009.
3.	Emmanuel C. Ifeacher, Barry W. Jervis, “Digital Signal Processing: A Practical Approach”, 2nd Edition, Pearson Education, 2004.
4.	S.K. Mitra, “Digital Signal Processing, A Computer Based approach”, 4th Edition, McGraw-Hill, 2010.
E-References:	
1.	http://nptel.ac.in/courses/117104074/
2.	https://www.coursera.org/learn/dsp
3.	https://ocw.mit.edu/resources/res-6-008-digital-signal-processing-spring-2011/

Course Outcomes: Upon completion of this course, the students will be able to:		Bloom’s Taxonomy Mapped
CO1	Analyse and understands different types of signals.	Analysing
CO2	Represent continuous signals and systems in time and frequency domain using different transforms.	Analysing
CO3	Analyse the need for Discrete Fourier Transform, Fast Fourier Transform algorithms in digital signals & systems.	Analysing
CO4	Design and realize IIR filters.	Applying
CO5	Design and realize FIR filters.	Applying

COURSE ARTICULATION MATRIX															
COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	2	3	3	3	-	-	-	-	-	-	-	2	2	2
CO2	3	2	2	3	3	2	-	-	-	-	-	-	2	2	2
CO3	3	2	2	2	1	-	1	-	-	-	-	-	1	1	1
CO4	3	2	2	2	1	-	1	-	-	-	-	-	1	1	1
CO5	1	1	1	1	1	-	-	-	-	-	-	-	2	2	1
Avg	2.6	1.8	2	2.2	1.8	2	1						1.6	1.6	1.4
3/2/1 - indicates strength of correlation (3-High,2- Medium,1- Low)															

18ECM05	MICROPROCESSORS AND MICROCONTROLLERS				
PREREQUISITES		**CATEGORY**	**OE**	**Credit**	**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	To familiarise with 8086 and 8051 architectures.
2.	To interface 8086 microprocessor and 8051 microcontrollers with peripherals by programming.
3.	To gain basic knowledge of PIC microcontrollers.

Unit I	**8086 MICROPROCESSOR ARCHITECTURE**	9	0	9
Overview of Microcomputer systems-8086 Architecture – Pin Assignments – Internal Architecture – Addressing modes-Instruction Formats- Directives and Operators-Assembly process.				
Unit II	**PROGRAMMING AND INTERFACING OF 8086**	9	0	9
Fundamental I/O considerations- Programmed I/O- Interrupt I/O- Basic 8086 Configurations- Minimum Mode-Maximum Mode-System Bus timing- I/O Interfaces-Peripheral Interfacing using 8255 PPI - 8279 Keyboard/Display controller - 8251 USART.				
Unit III	**8051 ARCHITECTURE**	9	0	9
8051 architecture - Registers in 8051 - Pin description - 8051 parallel I/O ports - memory organization - Instruction set — Addressing modes				
Unit IV	**PROGRAMMING AND INTERFACING OF 8051**	9	0	9
Assembly language programming.8051Timers - Serial Port Programming - Interrupts Programming - LCD and Keyboard Interfacing - ADC, DAC and Sensor Interfacing - Motor Control.				
Unit V	**PIC MICROCONTROLLERS**	9	0	9
Main characteristics of PIC microcontrollers – PIC microcontroller families-Memory-Program Memory – RAM Data Memory - Instruction set and timers in PIC				
Total (L+T) = 45 periods				

Text Books:

1.	Yu-Cheng Liu, Glenn A. Gibson," Microcomputer Systems, The 8086/8088 Family", Pearson, 2e, 2019.
2.	Muhammad Ali Mazidi, Janice GillispieMazidi, RolinD.McKinlay, "The 8051 Microcontroller and Embedded Systems using Assembly and C", 2e, 2022.

Reference Books:

1.	Mohamed Ali Mazidi, Janice GillispieMazidi, RolinMcKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", 2nd Edition, Pearson education, 2011.
2.	Martin Bates,"PIC Microcontrollers-An Introduction to Microelectronics", 3e, Elsevier, 2011.
3.	Mathur Sunil,"Microprocessor 8086: Architecture, Programming and Interfacing" PHI Learning Pvt. Ltd. 2011.
4.	Salvador PinillosGimenez," 8051 Microcontrollers Fundamental Concepts, Hardware, Software and Applications in Electronics", Springer 2019.

E-References:

1.	Ashraf Almadhoun,"A Detailed Look Into PIC Microcontroller and Its Architecture", Amazon 2020.
2.	https://nptel.ac.in/courses/108105102
3.	http://www.satishkashyap.com/2012/02/video-lectures-on-microprocessors-and.html

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Describe and analyse the architecture of 8086 microprocessor and 8051 architectures.	Remembering
CO2	Develop assembly language programs and Interface peripherals with 8086.	Applying
CO3	Develop assembly language programs and Interface peripherals with 8051.	Applying
CO4	Determine application specific circuit for real-time applications.	Understanding
CO5	Associate appropriate PIC microcontroller for a given application.	Understanding

COURSE ARTICULATION MATRIX

COs/POs	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	PSO3
CO1	2	2	-	-	-	-	-	-	-	-	2	-	1	-	-
CO2	2	2	2	2	-	-	-	-	-	-	-	-	2	2	-
CO3	2	2	2	2	-	-	-	-	-	-	-	-	2	2	-
CO4	2	2	2	2	-	-	-	-	-	-	-	-	2	2	2
CO5	2	2	-	2	-	-	-	-	-	-	-	-	2	2	-
Avg	2	2	2	2	-	-	-	-	-	-	2	-	1.8	2	2

18ECM06	ANALOG AND DIGITAL COMMUNICATION				
PREREQUISITES	**CATEGORY**	**OE**	**Credit**		**3**
	Hours/Week	**L**	**T**	**P**	**TH**
		3	**0**	**0**	**3**

Course Objectives:

1.	Understand analog and digital communication techniques.
2.	Learn data and pulse communication techniques.
3.	Be familiarized with source and Error control coding.

Unit I	**INFORMATION THEORY**	**9**	**0**	**0**	**9**

Uncertainty, information and entropy – Source coding theorem – Shannon Fano coding – Huffman coding – Discrete memoryless channels – Mutual information – Channel capacity – Channel coding theorem.

Unit II	**ANALOG COMMUNICATION**	**9**	**0**	**0**	**9**

Noise: Source of Noise – External Noise- Internal Noise- Noise Calculation. Introduction to Communication Systems: Modulation – Types – Need for Modulation. Theory of Amplitude Modulation – Evolution and Description of SSB Techniques – Theory of Frequency and Phase Modulation – Comparison of various Analog Communication System (AM – FM – PM).

Unit III	**DIGITAL COMMUNICATION**	**9**	**0**	**0**	**9**

Amplitude Shift Keying (ASK) – Frequency Shift Keying (FSK) Minimum Shift Keying (MSK) –Phase Shift Keying (PSK) – BPSK – QPSK – 8 PSK – 16 PSK – Quadrature Amplitude Modulation (QAM) – 8 QAM – 16 QAM – Bandwidth Efficiency– Comparison of various Digital Communication System (ASK – FSK – PSK – QAM).

Unit IV	**PULSE COMMUNICATION AND MULTIPLE ACCESS TECHNIQUES**	**9**	**0**	**0**	**9**

Pulse Communication: Pulse Amplitude Modulation (PAM) – Pulse Time Modulation (PTM) – Pulse code Modulation (PCM) – Comparison of various Pulse Communication System (PAM – PTM – PCM). Multiple access techniques: FDMA, CDMA, TDMA, SDMA.

Unit V	**ERROR CONTROL CODING**	**9**	**0**	**0**	**9**

Linear block codes - Cyclic codes - Convolution codes – Maximum likelihood decoding of convolutional codes – Sequential decoding of convolutional codes – Trellis codes – Applications.

Total (45L)= 45 Periods

Text Books:

1.	Simon Haykin, "Communication Systems", 4th Edition, John Wiley & Sons, 2014.
2.	J.G.Proakis, M.Salehi, ―Fundamentals of Communication Systems‖, Pearson Education 2014.

Reference Books:

1.	B.P.Lathi, ―Modern Digital and Analog Communication Systems‖, 4th Edition, Oxford University Press, 2013.
2.	D.Roody, J.Coolen, ―Electronic Communications, 4th edition PHI 2015.
3.	B.Sklar, ―Digital Communications Fundamentals and Applications‖, 5th Edition Pearson Education 2017
4.	H P Hsu, Schaum Outline Series - ―Analog and Digital Communications‖ TMH, 5th edition 2006

E-References:

1.	https://onlinecourses.nptel.ac.in/noc21_ee74/preview
2.	https://nptel.ac.in/courses/117101051
3.	https://www.digimat.in/nptel/courses/video/117105143/L51.html

Course Outcomes: Upon completion of this course, the students will be able to:			Bloom's Taxonomy Mapped
CO	:	Apply the concepts of Random Process to the design of Communication	Applying
CO	:	Apply analog and digital communication techniques.	Applying
CO	:	Understand the use of data and pulse communication techniques.	Understanding
CO	:	Analyze Source and Error control coding.	Analysing
CO	:	Design AM communication systems and Angle modulated communication	Applying

COURSE ARTICULATION MATRIX															
COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO1 2	PSO 1	PSO 2	PSO 3
CO1	2	3	2	1	1	-	-	-	-	-	-	-	3	-	-
CO2	3	2	2	1	1	-	-	-	-	-	-	-	3	2	1
CO3	2	2	2	3	1	-	-	-	-	-	-	-	3	2	-
CO4	1	1	2	1	2	-	-	-	-	-	-	-	2	3	-
CO5	1	1	2	2	2	-	-	-	-	-	-	-	2	3	1
Avg	1.8	1.8	2	1.6	1.4	-	-	-	-	-	-	-	2.6	2.5	1
3/2/1 - indicates strength of correlation (3-High,2- Medium,1- Low)															

18ECM07	COMMUNICATION NETWORKS				
PREREQUISITES	**CATEGORY**	**OE**	**Credit**		**3**
	Hours/Week	**L**	**T**	**P**	**TH**
		3	**0**	**0**	**3**

Course Objectives:

1.	Understand the division of network functionalities into layers.
2.	Be familiar with the components required to build different types of networks
3.	Be exposed to the required functionality at each layer
4.	Learn the flow control and congestion control algorithms

Unit I	**FUNDAMENTALS & LINK LAYER**	9	0	0	9

Overview of Data Communications- Networks – Building Network and its types– Overview of Internet - Protocol Layering - OSI Mode – Physical Layer – Overview of Data and Signals - introduction to Data Link Layer - Link layer Addressing- Error Detection and Correction

Unit II	**MEDIA ACCESS & INTERNETWORKING**	9	0	0	9

Overview of Data link Control and Media access control - Ethernet (802.3) - Wireless LANs – Available Protocols – Bluetooth – Bluetooth Low Energy – WiFi – 6LowPAN–Zigbee - Network layer services – Packet Switching – IPV4 Address – Network layer protocols (IP, ICMP, Mobile IP)

Unit III	**ROUTING**	9	0	0	9

Routing - Unicast Routing – Algorithms – Protocols – Multicast Routing and its basics – Overview of Intradomain and interdomain protocols – Overview of IPv6 Addressing – Transition from IPv4 to IPv6

Unit IV	**TRANSPORT LAYER**	9	0	0	9

Introduction to Transport layer –Protocols- User Datagram Protocols (UDP) and Transmiision Control Protocols (TCP) –Services – Features – TCP Connection – State Transition Diagram – Flow, Error and Congestion Control - Congestion avoidance (DECbit, RED) – QoS – Application requirements

Unit V	**APPLICATION LAYER**	9	0	0	9

Application Layer Paradigms – Client Server Programming – World Wide Web and HTTP - DNS- Electronic Mail (SMTP, POP3, IMAP, MIME) – Introduction to Peer to Peer Networks – Need forCryptography and Network Security – Firewalls.

Total (45L)= 45 Periods

Text Books:

1. Behrouz A Forouzan, Data Communications and Networking, 4th Edition, 2020

2.	James F. Kurose, Keith W. Ross, Computer Networking - A Top-Down Approach Featuring the Internet, Seventh Edition, Pearson Education, 2016.
Reference Books:	
1.	Nader. F. Mir," Computer and Communication Networks", Pearson Prentice Hall Publishers, 2nd Edition, 2014.
2.	Alberto Leon-Garcia, IndraWidjajaCommunication Networks 2nd Edition McGraw-Hill Education, 2003
3.	Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, "Computer Networks: An Open Source Approach", McGraw Hill Publisher, 2011.
4.	Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", Fifth Edition, Morgan Kaufmann Publishers, 2011.
E-References:	
1.	https://onlinecourses.nptel.ac.in/noc22_ee61/preview
2.	https://www.ee.iitb.ac.in/~sarva/courses/EE706/2012/EE706LecNotes.pdf
3.	http://www.cs.kent.edu/~farrell/net01/lectures/

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the basic concept in modern data communication and different level of layers in the protocol	Understanding
CO2	Analyse the functions and services of data link layer	Analysing
CO3	Categorize the functions and services of network layer	Understanding
CO4	Examine the basic functions of transport layer and congestion in networks	Understanding
CO5	Analyse the concepts of various network applications and data security	Analysing

COURSE ARTICULATION MATRIX															
COs/POs	PO 1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	2	1	1	-	1	-	-	-	-	-	-	-	2	-	1
CO2	2	1	2	-	1	-	-	-	-	-	-	-	2	1	1
CO3	2	1	1	-	-	-	-	-	-	-	-	-	3	1	2
CO4	3	2	1	-	2	-	-	-	-	-	-	-	2	-	2
CO5	2	1	1	-	1	-	-	-	-	-	-	-	1	1	1
Avg	2.2	1.2	1.2	-	1.25	-	-	-	-	-	-	-	2	1	1.4
3/2/1 - indicates strength of correlation (3-High,2- Medium,1- Low)															

18ECM08	INTERNET OF THINGS				
PREREQUISITES	**CATEGORY**	**OE**	**Credit**		**3**
	Hours/Week	**L**	**T**	**P**	**TH**
		3	**0**	**0**	**3**

Course Objectives

1	To understand Smart Objects and IoT Architectures
2	To learn about various IOT-related protocols
3	To build simple IoT Systems using Arduino and Raspberry Pi
4	To understand data analytics and cloud in the context of IoT
5	To develop IoT infrastructure for popular applications

Unit I	**FUNDAMENTALS OF IOT**	**9**	**0**	**0**	**9**

Evolution of Internet of Things - Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT models – Simplified IoT Architecture and Core IoT Functional Stack -– Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects

Unit II	**IoT PROTOCOLS**	**9**	**0**	**0**	**9**

IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks – Application Transport Methods: Supervisory Control and Data Acquisition – Application Layer Protocols: CoAP and MQTT

Unit III	**DESIGN AND DEVELOPMENT**	**9**	**0**	**0**	**9**

Design Methodology - Embedded computing logic - Microcontroller, System on Chips - IoT system building blocks - Arduino - Board details, IDE programming - Raspberry Pi - Interfaces and Raspberry Pi with Python Programming.

Unit IV	**DATA ANALYTICS AND SUPPORTING SERVICES**	**9**	**0**	**0**	**9**

Structured Vs Unstructured Data and Data in Motion Vs Data in Rest – Role of Machine Learning – No SQL Databases – Hadoop Ecosystem – Apache Kafka, Apache Spark – Edge Streaming Analytics and Network Analytics – Xively Cloud for IoT, Python Web Application Framework – Django – AWS for IoT – System Management with NETCONF-YANG

Unit V	**CASE STUDIES/INDUSTRIAL APPLICATIONS**	**9**	**0**	**0**	**9**

Cisco IoT system - IBM Watson IoT platform – Manufacturing - Converged Plantwide Ethernet Model (CPwE) – Power Utility Industry – Grid Blocks Reference Model - Smart and Connected Cities: Layered architecture, Smart Lighting, Smart Parking Architecture and Smart Traffic Control

Total (45 L) = 45 Periods

Text Books:

1	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, ―IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017
2	ArshdeepBahga, Vijay Madisetti, ―Internet of Things – A hands-on approach‖, Universities Press, 2015

Reference Books:

1	Olivier Hersent, David Boswarthick, Omar Elloumi , ―The Internet of Things – Key applications and Protocols, Wiley, 2012 (for Unit 2).

2	Jan Ho¨ ller, VlasiosTsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.
3	Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), ―Architecting the Internet of Things‖, Springer, 2011.
4	Michael Margolis, Arduino Cookbook, Recipes to Begin, Expand, and Enhance Your Projects, 2nd Edition, O'Reilly Media, 2011.
E-References:	
1	https://online.stanford.edu/courses/xee100-introduction-internet-things
2	https://www.udemy.com/topic/internet-of-things/
3	https://www.netacad.com/courses/iot

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the concept of IoT.	Understanding
CO2	Analyze various protocols for IoT.	Applying
CO3	Design a PoC of an IoT system using Rasperry Pi/Arduino	Applying
CO4	Apply data analytics and use cloud offerings related to IoT.	Applying
CO5	Analyze applications of IoT in real time scenario	Analysing

COURSE ARTICULATION MATRIX															
COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	1	2	1	1	-	-	-	-	-	1	-	2	2	2
CO2	2	1	2	1	1	-	-	-	-	-	1	-	2	2	2
CO3	2	2	3	2	1	-	-	-	-	-	2	-	2	2	2
CO4	2	2	2	1	1	-	-	-	-	-	1	-	2	2	2
CO5	2	2	3	2	1	-	-	-	-	-	2	-	2	2	2
Avg	2	1.6	2.4	1.4	1	-	-	-	-	-	1.4	-	2	2	2
3/2/1 - indicates strength of correlation (3-High,2- Medium,1- Low)															

18ECM09	WIRELESS SENSORS AND NETWORKING					
PREREQUISITE:		**CATEGORY**	**OE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	Learn fundamental of Ad hoc network and architecture
2.	Understand the MAC and routing protocols.
3.	Have an in-depth knowledge on QoS, security and sensor network platforms

Unit I	**ROUTING PROTOCOLS**	9	0	0	9

Elements of Ad hoc Wireless Networks, Issues in Ad hoc wireless networks, Example commercial applications of Ad hoc networking, Ad hoc wireless Internet, Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classifications of Routing Protocols, Table Driven Routing Protocols – Destination Sequenced Distance Vector (DSDV), On–Demand Routing protocols –Ad hoc On–Demand Distance Vector Routing (AODV).

Unit II	**ARCHITECTURES OF WSN**	9	0	0	9

WSN application examples, Types of applications, Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks, Single-Node Architecture: Hardware Components, Energy Consumption of Sensor Nodes, Operating systems and execution environments

Network Architecture: Sensor Network Scenarios, Optimization goals and figures of merit, Design principles of WSN, Service interfaces of WSNs, gateway concepts.

Unit III	**MAC PROTOCOLS AND ROUTING PROTOCOLS**	9	0	0	9

Image compression: Predictive techniques – PCM – DPCM - DM - Transform coding - Introduction to JPEG - JPEG-2000 - JBIG standards - Study of EZW. Video compression: Video signal representation – ITU-T Recommendation H.261 – Model based coding – The MPEG-1 Video Standard - The MPEG-2 Video Standard: H.262 - ITU-T Recommendation H.263.

Unit IV	**QUALITY OF SERVICE AND ADVANCED APPLICATION SUPPORT**	9	0	0	9

Quality of Service: Coverage and deployment, Reliable data transport, Single packet delivery, Block delivery, Congestion control and rate control - Advanced application support: Advanced in-network processing, Security and Application-specific support.

Unit V	**SENSOR NETWORK PLATFORMS AND TOOLS**	9	0	0	9

Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms – TinyOS, nesC, CONTIKIOS, Node-level Simulators – NS2 and its extension to sensor networks, COOJA, TOSSIM, Programming beyond individual nodes – State centric programming.

Total (45L) = 45 Periods

Text Books:	
1.	C. Siva Ram Murthy, and B. S. Manoj, "AdHoc Wireless networks ", Pearson Education – 2008
2.	Holger Karl and Andreas Willig, "Protocols And Architectures for Wireless Sensor Networks", John Wiley, 2007.
Reference Books:	
1.	Feng Zhao and LeonidesGuibas, "Wireless sensor networks ", Elsevier publication - 2004.
2.	Charles E. Perkins, ―Ad Hoc Networking‖, Addison Wesley, 2000.
3.	William Stallings, "Wireless Communications and Networks ", Pearson Education – 2004
4.	I.F. Akyildiz, W. Su, Sankarasubramaniam, E. Cayirci, "Wireless sensor networks: a survey", Computer Networks, Elsevier, 2002, 394 - 422.
E-References:	
1.	https://nptel.ac.in/courses/106105183
2.	https://nptel.ac.in/courses/106105183
3.	https://archive.nptel.ac.in/courses/106/105/106105160/

Course Outcomes: Upon completion of this course, the students will be able to		**Bloom's Taxonomy Mapped**
CO1	Know the basics of Ad hoc networks and Wireless Sensor Networks	Understanding
CO2	Have a knowledge on architecture of Wireless Sensor Networks	Applying
CO3	Apply the knowledge to identify MAC and routing protocols	Applying
CO4	Understand the transport layer and security issues possible in Ad hoc and sensor networks	Understanding
CO5	Be familiar with the OS used in Wireless Sensor Networks and build basic modules	Remembering

COURSE ARTICULATION MATRIX															
COs/POs	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	PSO2	PSO3
CO1	3	3	1	3	3	3	2	-	-	-	3	3	3	-	2
CO2	3	3	2	3	3	3	2	-	-	-	3	3	3	-	2
CO3	3	3	3	3	3	3	2	-	-	-	3	3	3	-	2
CO4	3	3	2	3	3	3	2	-	-	-	2	3	3	-	2
CO5	3	3	2	3	3	3	2	-	-	-	3	3	3	-	2
Avg	3	3	2	3	3	3	2	-	-	-	2.8	3	3	-	2
3/2/1 - indicates strength of correlation (3-High,2- Medium,1- Low)															

18ECM10	BASICS OF EMBEDDED SYSTEMS					
PREREQUISITES		**CATEGORY**	**OE**	**Credit**		**3**
Microprocessors and Mmicrocontrollers		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives	
1	To impart knowledge on embedded system architecture and embedded development Strategies
2	To understand the bus Communication in processors and peripheral interfacing
3	To understand basics of Real Time Operating System

UNIT I	**BASICS OF EMBEDDED SYSTEMS**	9	0	0	9

Introduction - Fundamental Components of Embedded Systems - Challenges for Embedded Systems - Examples - Programming Languages - Recent Trends in Embedded Systems - Architecture of Embedded Systems - Embedded Design Life Cycle - Selection Process - Hardware Software Partitioning - Development Environment.

UNIT II	**MEMORY MANAGEMENT AND INTERRUPTS**	9	0	0	9

Memory Access Procedure - Types of Memory - Memory Management Methods - DMA – Memory Interfacing - Polling Vs Interrupts - Types of Interrupts - Interrupt Latency - Interrupt Priority – Programmable Interrupt Controllers - Interrupt Service Routines

UNIT III	**COMMUNICATION INTERFACES**	9	0	0	9

Interfacing Buses - Serial Interfaces - RS232/UART - RS422/RS485 - I2C Interface - SPI Interface - USB – CAN - IRDA - Ethernet - IEEE 802.11 – Bluetooth

UNIT IV	**REAL TIME OPERATING SYSTEMS**	9	0	0	9

Real-Time Concepts - Task Management - Task Scheduling - Classification of Scheduling Algorithms - Clock Driven Scheduling - Event Driven Scheduling - Resource Sharing - Priority Inheritance Protocol - Priority Ceiling Protocol - Inter Task Communication - Mutex - Semaphores - Message Queues - Timers - Commercial RTOS.

UNIT V	**VALIDATION AND DEBUGGING**	9	0	0	9

Host and Target Machines - Validation Types and Methods - Host Testing - Host-Based Testing Setup - Target Testing - Remote Debuggers and Debug Kernels - ROM Emulator - Logical Analyzer – Background Debug Mode - InCircuit Emulator CASE STUDY: RFID Systems - GPS Navigation System – Development of Protocol Converter.

Total (45 L) = 45 Periods

Text Books:	
1	Sriram V Iyer and Pankaj Gupta, ―Embedded Real-time Systems Programming‖, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2006.
2	Arnold S Berger, ―Embedded Systems Design - An Introduction to Processes, Tools and Techniques, Elsevier, New Delhi, 2011.
Reference Books:	
1	Prasad K V K K, ―Embedded/Real-Time Systems: Concepts, Design and Programming – The Ultimate Reference, Himal Impressions, New Delhi, 2003
2	Heath, "Embedded Systems Design‖", Newnes an Imprint of Elsevier, Massachusetts, 2003.
3	Tammy Noergaard, "Embedded Systems Architecture‖, Newnes an Imprint of Elsevier, Massachusetts, 2006.
4	Raj Kamal, 'Embedded System-Architecture, Programming, Design', McGraw Hill, 2013
E-References:	
1	https://lecturenotes.in/subject/225/embedded-system-es
2	https://nptel.ac.in/courses/108102045/19

3	https://www.coursera.org/learn/introduction-embedded-systems.

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Course Outcomes: Upon completion of this course, the students will be able to		**Bloom's Taxonomy Mapped**
CO1	Outline the concepts of embedded systems	Understanding
CO2	Understand the concept of memory management system and interrupts.	Understanding
CO3	Know the importance of interfaces.	Understanding
CO4	Understand real time operating system concepts.	Understanding
CO5	To realize the applications of validation and debugging.	Applying

COURSE ARTICULATION MATRIX															
COs/POs	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	PSO2	PSO3
CO1	3	3	1	3	-	-	-	-	-	-	3	3	3	-	2
CO2	3	3	2	3	-	-	-	-	-	-	3	3	3	-	2
CO3	3	3	3	3	-	-	-	-	-	-	3	3	3	-	2
CO4	3	3	2	3	-	-	-	-	-	-	2	3	3	-	2
CO5	3	3	2	3	-	-	-	-	-	-	3	3	3	-	2
Avg	3	3	2	3	-	-	-	-	-	-	2.8	3	3	-	2
3/2/1 - indicates strength of correlation (3-High,2- Medium,1- Low)															

B.E. - ELECTRICAL AND ELECTRONICS ENGINEERING - MINOR DEGREE

18EEM01	LINEAR AND DIGITAL ELECTRONICS CIRCUITS	SEMESTER			
PREREQUISITES	CATEGORY	PE	Credit		3
Electron Devices and Circuits	Hours/Week	L	T	P	TH
		3	0	0	3

Course Objectives:

1. To impart knowledge on the characteristics& applications of Operation Amplifier, functional diagram and applications of linear ICs.
2. To simplify the switching functions
3. To design the combinational logic circuits and sequential logic circuits

Unit I	OPERATIONAL AMPLIFIERS	9	0	0	9

Operational amplifiers - Equivalent circuit, voltage transfer curve - Open loop Op-amp configurations –Voltage series, Voltage shunt feedback amplifiers configurations, closed loop differential amplifiers for single and differential outputs.

Output offset voltage, minimizing output offset voltage due to input bias current and input offset current, factors affecting off set parameters, CMRR - Open loop and closed loop frequency response of op-amps, circuit stability, slew rate and its effects in applications.

Unit II	APPLICATION OF OPERATIONAL AMPLIFIER AND LINEAR ICS	9	0	0	9

DC & AC amplifiers- Summing, Scaling and Averaging amplifiers-Instrumentation amplifier- Voltage to Current converter for floating and grounded loads - Current to voltage converter - Integrator, Differentiator. Voltage comparators - Zero Crossing Detector - Schmitt trigger with voltage limiter- Precision Rectifier Circuits-Peak Detector-Sample and Hold circuit, Active Filters - Frequency response characteristics of major active filters, first and higher order low pass and high pass filters, all pass filters.

Functional block diagram and Applications of Linear ICs: IC 555 Timer -IC 566 Voltage controlled oscillator- IC 565 Phase-locked loops - IC LM317 voltage regulators.

Unit III	COMBINATIONAL LOGIC CIRCUITS	9	0	0	9

Representation of logic functions: SOP and POS forms - Simplification of switching functions: K-maps method and QuineMcCluskey (Tabulation) method.

Design:Adders -Subtractors– 2 bit Magnitude Comparator-Multiplexer- Demultiplexer- Encoder - Priority Encoder - Decoder – Code Converters. Implementation of combinational logic circuits using multiplexers and Decoder.

Unit IV	SYNCHRONOUS SEQUENTIAL LOGIC CIRCUITS	9	0	0	9

Flip-flops: SR, D, JK and T- Conversion of flip-flops; Classification of sequential circuits: Moore and Mealy models - Analysis and design of synchronous sequential circuits - Design of synchronous counters- Universal shift register.

Unit V	ASYNCHRONOUS SEQUENTIAL LOGIC CIRCUITS	9	0	0	9

Fundamental mode and pulse mode circuits , Analysis procedure of asynchronous circuits with /without using of SR latches-primitive state / flow table – Reduction of state and flow table - state assignment –Design Procedure of asynchronous circuits with /without using of SR latches-Problems in asynchronous sequential circuits: cycles -Races –Hazards.

Total (45L+0T) = 45 Periods

Text Books:

1. Ramakant A Gayakward, “Op-Amps and Linear Integrated Circuits”, Fourth Edition, Pearson Education, 2003.
2. Donald.E.Neaman, “Electronic Circuit, Analysis and Design”, Tata McGraw Hill Publishing Company Limited, Second Edition, 2002.
3. D.Roy Chowdhury and Shail B. Jain, “Linear Integrated Circuits”, Fourth Edition, New Age International (P) Ltd Publishers, 2014.
4. M. Morris Mano, “Digital Design” , Third Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2003 / Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2010 .
5. S. Salivahanan and S. Arivazhagan, “Digital Circuits and Design”, Third Edition, Vikas Publishing House Pvt. Ltd, New Delhi, 201

Reference Books:

1.	Jacob Millman, Christos C.Halkias, “Integrated Electronics - Analog and Digital circuits system”, Tata McGraw Hill 2003.
2.	R.P.Jain, “Modern Digital Electronics”, Third Edition, Tata McGraw–Hill Publishing company limited, New Delhi, 2011.
3.	Thomas L. Floyd, “Digital Fundamentals”, Pearson Education, Inc, New Delhi, 2015
4.	Donald P.Leach and Albert Paul Malvino, “Digital Principles and Applications”, Fifth Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2012.

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom’s Taxonomy Mapped**
CO1	:	Understand the Op-amp characteristics	L2: Understanding
CO2	:	Understand the applications of Op-amp and other linear ICs.	L2: Understanding
CO3	:	Apply K-map and Tadulation methods to simplify the switching functions	L3: Applying
CO4	:	Design and implement of combinational logic circuits	L6: Creating
CO5	:	Analyse and design of synchronous & asynchronous sequential logic circuits	L4: Analyzing

COURSE ARTICULATION MATRIX

CO/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	2	1											2		
CO2	3	2	1	1									3		
CO3	3	2		2	2								3	3	
CO4	3	2	3	1	2							2	3	3	1
CO5	3	2	3	1	2							2	3	3	1
Avg.	**2.8**	**1.8**	**2.3**	**1.25**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2.8**	**3**	**1**

3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)

18EEM02	MICROPROCESSOR AND MICROCONTROLLER	SEMESTER			
PREREQUISTIES	**CATEGORY**	**PE**	**Credit**		**3**
C Programming	**Hours/Week**	**L**	**T**	**P**	**TH**
		3	**0**	**0**	**3**

Course Objectives:

1.	To study the architecture of μP8085 and μC 8051.
2.	To study the Interrupt structure of 8085 and 8051.
3.	To do simple applications development with programming 8085 and 8051.

UNIT I	**8085 8 BIT MICROPROCESSOR**	**9**	**0**	**0**	**9**

Fundamentals of microprocessors – Architecture of 8085 – Groups of Instructions - Addressing modes – Basic timing diagram – Organization and addressing of Memory and I/O systems –Interrupt structure – Stack and sub-routines - Simple 8085 based system design and programming.

UNIT II	**8051 8 BIT MICROCONTROLLER**	**9**	**0**	**0**	**9**

Fundamentals of microcontrollers – Architecture of 8051 – Groups of Instructions - Addressing modes – Organization of Memory systems – I/O Ports – Timers/Counters – Serial Port - Interrupt structure – Simple programming concepts using Assemblers and Compliers.

UNIT III	**INTERFACING WITH 8051 MICROCONTROLLER**	**9**	**0**	**0**	**9**

Need and requirements of interfacing – Interfacing – LED, 7 segment and LCD Displays – Tactile switches, Matrix keyboard – Parallel ADC – DAC – Interfacing of Current, Voltage, RTD and Hall Sensors.

UNIT IV	**EXTERNAL COMMUNICATION INTERFACE**	**9**	**0**	**0**	**9**

Synchronous and Asynchronous Communication. RS232, RS 485, SPI, I2C. Introduction and interfacing to protocols like Blue-tooth and Zig-bee.

UNIT V	**APPLICATIONS OF MICROCONTROLLERS**	**9**	**0**	**0**	**9**

Simple programming exercises- key board and display interface –Control of servo motor stepper motor control- Application to automation systems.

Total (45L+0T)= 45 Periods

Text Books:

1.	R.S. Gaonkar, 'Microprocessor Architecture Programming and Application', with 8085, Wiley Eastern Ltd., New Delhi, 2013.
2.	K. J. Ayala, "8051 Microcontroller", Delmar Cengage Learning, 2004.
3.	Muhammad Ali Mazidi & Janice Gilli Mazidi, R.D.Kinely 'The 8051 Micro Controller and Embedded Systems', PHI Pearson Education, 5th Indian reprint, 2003.

Reference Books:

1.	R. Kamal, "Embedded System", McGraw Hill Education, 2009.
2.	D. V. Hall, "Microprocessors & Interfacing", McGraw Hill Higher Education, 1991.

E-References;

1.	www.onlinecourses.nptel.ac.in/noc18_ee41
2.	www.class-central.com
3.	www.mooc-list.com

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom's Taxonomy Mapped**
CO1	:	Understand basics of microprocessor and microcontroller	L2: Understanding
CO2	:	Understand the architecture of Microprocessor and Microcontroller	L1: Remembering
CO3	:	Apply the digital concepts to measure and control simple electrical systems	L3: Applying
CO4	:	Design and interface communications between digital systems	L2: Understanding
CO5	:	Design a microcontroller based electrical control system.	L5: Evaluating

COURSE ARTICULATION MATRIX															
COs/ POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	2	1	1	1								1	1	1	
CO2	2	1	1	1								1	1	1	
CO3	2	3	2	3	2							1	1	1	2
CO4	2	3	3	3	2							2	2	2	2
CO5	2	3	3	3	2							2	2	2	2
Avg.	**2**	**2.2**	**2**	**2.2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1.4**	**1.4**	**1.4**	**2**
3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)															

18EEM03	CONTROL SYSTEMS		SEMESTER			
PREREQUISTIES		**CATEGORY**	**PE**	**Credit**		**3**
Electrical Machines and Electric circuit analysis		**Hours/Week**	**L**	**T**	**P**	**TH**
			1	**1**	**0**	**3**

Course Objectives:

1.	To understand the methods of representation of physical systems and getting their transfer function models.
2.	To provide adequate knowledge in the time response of systems and steady state error analysis.
3.	To give basic knowledge in obtaining the open loop and closed loop frequency response of systems.
4.	To understand the concept of stability of control system and methods of stability analysis.
5.	To study the designing compensators for a feedback control system.

UNIT I	**MODELLING OF LINEAR TIME INVARIANT SYSTEMS**	**6**	**9**	**0**	**9**

Basic elements in control systems – Open and closed loop systems – Feedback control system characteristics - Mathematical model and Electrical analogy of mechanical systems – Transfer function Representation– Synchro – AC and DC servo-motors – Block diagram reduction techniques – Signal flow graphs.

UNIT II	**TIME RESPONSE ANALYSIS**	**6**	**3**	**0**	**9**

Standard test signals – Time response of first order and second order systems –time domain specifications - Steady-state errors and error constants – Type and order of control systems – Effect of adding poles and zeros to transfer functions – Response with P, PI, PD and PID controllers.

UNIT III	**FREQUENCY RESPONSE ANALYSIS**	**6**	**3**	**0**	**9**

Correlation between time and frequency response: Second order systems – Frequency domain specifications - Polar plots – Bode plots – Computation of Gain Margin and Phase Margin — Constant M and N-circles – Nichols chart.

UNIT IV	**STABILITY OF CONTROL SYSTEM**	**6**	**3**	**0**	**9**

BIBO stability – Necessary conditions for stability – Routh-Hurwitz stability criterion – Root locus concepts – Rules for the construction of Root loci – Nyquist stability criterion – Assessment of relative stability using Nyquist criterion.

UNIT V	**COMPENSATOR AND CONTROLLER DESIGN**	**6**	**3**	**0**	**9**

Need for compensation – Types of compensators – Electric network realization and frequency characteristics of basic compensators: Lag, lead and lag-lead compensators – Design of compensators using root locus and Bode plot techniques- PID controller: Design using reaction curve and Ziegler - Nichols technique.

Total (30L+15T) = 45 Periods

Text Books:

1.	A. Anand Kumar, "Control Systems", PHI Learning Pvt. Ltd., New Delhi, 2nd Edition, 2017.
2.	I.J. Nagrath, and M. Gopal, "Control Systems Engineering", New Age International Publishers, Delhi, 7th Edition, 2021.

Reference Books:

1.	K. Ogata, "Modern Control Engineering", Pearson Education, New Delhi, 5th Edition, 2021.
2.	M. Gopal, "Control Systems: Principles and Design", TMH, New Delhi, 4th Edition, 2018.

E-Reference

1.	https://nptel.ac.in/courses/107106081
2.	https://nptel.ac.in/courses/108106098

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom's Taxonomy Mapped**
CO1	:	Develop the transfer function models of any electrical and electro-mechanical systems.	L2: Understanding
CO2	:	Obtain the time responses of the systems and construct root locus plot.	L3: Applying
CO3	:	Analyze the frequency response of the system	L3: Applying
CO4	:	Analyze the absolute / relative stability of a control system.	L4: Analyzing
CO5	:	Design the compensators and PID controller of a feedback control system.	L3: Applying

COURSE ARTICULATION MATRIX															
COs/ POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	3	3	2	2	2							1	3	2	1
CO2	3	3	3	2	2							1	3	2	1
CO3	3	3	3	2	2							1	3	2	1
CO4	3	3	3	2	2							1	3	2	1
CO5	3	3	3	2	2							1	3	2	1
Avg	**3**	**3**	**2.8**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**2**	**1**
3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)															

18EEM04	MEASUREMENTS AND INSTRUMENTATION		SEMESTER			
PREREQUISTIES		**CATEGORY**	**PE**	**Credit**		**3**
Electric Circuit Analysis		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	To educate the fundamental concepts and characteristics of measurement System
2.	To introduce the fundamentals of electrical and electronic instruments for measurement of Electrical and Non-electrical quantities
3.	To familiarize Oscilloscope and the bridge circuits for electrical parameters measurement

UNIT I	**INTRODUCTION**	**9**	**0**	**0**	**9**
Elements of a generalized measurement system - Static and dynamic characteristics - Errors in measurement. Measurement of voltage and current - permanent magnet moving coil and moving iron type meters					
UNIT II	**MEASUREMENT OF POWER , ENERGY AND FREQUENCY**	**9**	**0**	**0**	**9**
Measurement of power - single and three phase- electrodynamometer type watt meters – Construction, operation – torque equation for deflection – errors. Measurement of energy-Single phase induction type energy meters, Instrument transformers – Current and Potential transformers, Power factor meters- Single phase electrodynamometer type power factor meter, frequency meter-Electrical resonance type frequency meter					
UNIT III	**DC AND AC BRIDGES**	**9**	**0**	**0**	**9**
Balance equations - Wheatstone bridge – Kelvin double Bridge –Maxwell's inductance capacitance bridge – Hay's bridge – Anderson's bridge – Schering bridge and De Sauty's bridge					
UNIT IV	**POTENTIOMETERS, OSCILLOSCOPES AND DIGITAL INSTRUMENTS**	**9**	**0**	**0**	**9**
DC Potentiometer- Crompton's Potentiometer, AC potentiometer– Drysdale polar potentiometer- Gall Tinsley co-ordinate type potentiometer, Cathode Ray Oscilloscope and Digital storage Oscilloscope-Construction, operation and Applications, Digital multi-meters, Digital voltmeters.					
UNIT V	**MEASUREMENT OF NON-ELECTRICAL QUANTITIES**	**9**	**0**	**0**	**9**
Classification of transducers –Position transducers, Piezo-electric transducers and Hall effect transducers. Measurement of pressure, temperature and displacement– Introduction to Smart Sensors					
					Total (45L+0T)= 45 Periods

Text Books:

1.	A.K. Sawhney, 'A Course in Electrical & Electronics Measurement & Instrumentation', Dhanpat Rai and Co, 2015
2.	E.O. Doebelin, 'Measurements Systems- Application and Design', Tata McGraw Hill publishing company, 2015.

Reference Books:

1.	D.V.S. Moorthy, 'Transducers and Instrumentation', Prentice Hall of India Pvt. Ltd, 2010.
2.	H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw Hill, 2015.
3.	Martin Reissland, ' Electrical Measurements', New Age International(P) Ltd., Delhi, 2011.

E-Reference:

1	https://archive.nptel.ac.in/courses/108/105/108105153/

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom's Taxonomy Mapped**
CO1	:	Recall the fundamentals of measurement system in electrical engineering.	L1: Remembering
CO2	:	Describe the working principle of different measuring instruments	L2: Understanding
CO3	:	Choose appropriate instrument for measuring the electrical parameters	L3: Applying
CO4	:	Employ the digital instruments in real time measurements.	L3: Applying
CO5	:	Select an appropriate transducer for measurement of non-electrical quantities	L4: Analysing

COURSE ARTICULATION MATRIX															
COs/ POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	2	2	2	3				1		2		2	2	1	1
CO2	1	3			3					2		1	2	1	
CO3	1	1		2	1	1	2		1				1	2	1
CO4	1	1		1	1		2	2	1		2	2	1	3	1
CO5	2	2	3	1	2	2	1			1	3		1	2	
Avg	**1.4**	**1.8**	**2.5**	**1.75**	**1.75**	**1.5**	**1.67**	**1.5**	**1**	**1.67**	**2.5**	**1.67**	**1.4**	**1.8**	**1**
3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)															

18EEM05	ELECTRICAL MACHINES	SEMESTER			
PREREQUISTIES	CATEGORY	PE	Credit		3
	Hours/Week	L	T	P	TH
		3	0	0	3

Course Objectives:

1.	To impart knowledge on construction, working and performance of DC generators and motors.
2.	To deliberate the construction, working and performance of single phase and three phase transformers.
3.	To impart knowledge on construction, working and performance of synchronous generators and motors.
4.	To impart knowledge on construction, principle of operation and performance of single and three-phase induction motors.

UNIT I	DC GENERATORS	9	0	0	9

Principle of operation, constructional details, types - EMF equation, armature reaction, demagnetizing and cross magnetizing Ampere turns, compensating winding, commutation, methods of improving commutation, interpoles, Open circuit and load characteristics of different types of DC Generators. Parallel operation of DC Generators, applications of DC Generators.

UNIT II	DC MOTORS	9	0	0	9

Principle of operation, significance of back emf, torque equation and power developed by armature, load characteristics of shunt, series and compound type motors, starting methods, speed control methods - losses and efficiency calculation, condition for maximum efficiency. Testing of DC Machines: Brake test, Swinburne's test, Hopkinson's test, Retardation test, Separation of core losses - applications of DC motors**.**

UNIT III	TRANSFORMER	9	0	0	9

Single phase transformer: Construction and principle of operation, working of practical transformer - equivalent circuit, voltage regulation, losses and efficiency- testing : polarity test, open circuit and short circuit tests, back-to back test, all day efficiency, parallel operation, applications.

Autotransformer: Construction and working, saving of copper - applications, **Three phase transformer**: construction, types of connections and their comparative features.

UNIT IV	SYNCHRONOUS GENERATOR AND MOTOR	9	0	0	9

Synchronous Generator: Constructional and working details – Types of rotors – EMF equation – Phasor diagrams of non-salient pole synchronous generator connected to infinite bus - Synchronizing and parallel operation – Synchronizing torque - Voltage regulation – EMF, MMF and ZPF method – steady state power angle characteristics – Two reaction theory – slip test.

Synchronous Motor: Principle of operation – Torque equation – Operation on infinite bus bars - V and Inverted V curves – Power input and power developed equations – Starting methods – Current loci for constant power input, constant excitation and constant power Developed -Hunting – natural frequency of oscillations – damper windings- synchronous condenser.

UNIT V	THREE PHASE AND SINGLE PHASE INDUCTION MOTOR	9	0	0	9

Three phase induction motor: Constructional details – Types of rotors –- Principle of operation – Equivalent circuit – Torque-Slip characteristics - Condition for maximum torque – Losses and efficiency – load test - No load and blocked rotor tests - Circle diagram – Separation of losses – Starters: DOL, Autotransformer and Star delta starters – Speed control methods: Voltage control, Frequency control and pole changing – V/f control – Slip power recovery Scheme.

Single phase induction motor: Constructional details – Double field revolving theory and operation – Equivalent circuit – No load and blocked rotor test – Performance analysis – Starting methods of single-phase induction motors – split phase, Capacitor-start, capacitor start and capacitor run Induction motor.

Total (45L+0T)= 45 Periods

Text Books:

1.	I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 5th Edition, 2017.
2.	P. S. Bimbhra, "Electric Machinery", Khanna Publishers, 2nd Edition, 2021.
3.	B.L.Theraja and A.K.Theraja," A text book of Electrical Technology - Volume-II", S.Chand & Company Ltd., New Delhi, 23rd Edition, 2009.

Reference Books:

1.	B.R.Gupta, 'Fundamental of Electric Machines' New age International Publishers,3rd Edition, Reprint 2015.

2.	Murugesh Kumar, 'Electric Machines', Vikas Publishing House Pvt. Ltd, First edition, 2010.
3.	A.E. Fitzgerald, Charles Kingsley, Stephen. D. Umans, 'Electric Machinery', Mc Graw Hill publishing Company Ltd, 6th Education, 2017.
4.	Stephen J. Chapman, 'Electric Machinery Fundamentals'4th edition, McGraw Hill Education Pvt. Ltd, 4th Edition 2017.

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom's Taxonomy Mapped**
CO1	:	Explain the construction and working principle of DC machines, and Interpret various characteristics of DC machines.	L2: Understanding
CO2	:	Compute various performance parameters of the machine, by conducting suitable tests.	L5: Evaluating
CO3	:	Describe the working principle of transformer, auto transformer, three phase transformer connection, and determine the efficiency and regulation.	L3: Applying
CO4	:	Understand the construction and working principle of Synchronous Machines.	L3: Applying
CO5	:	Understand the construction and working principle, speed control of three phase and single phase induction motor.	L5: Evaluating

COURSE ARTICULATION MATRIX

COs/ POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	3	3	1	1	1			1				1	3	2	1
CO2	3	3	1	1	1			1				1	3	2	1
CO3	3	3	1	1	1			1				1	3	2	1
CO4	3	3	1	1	1			1				1	3	2	1
CO5	3	3	1	1	1			1				1	3	2	1
Avg.	**3**	**3**	**1**	**1**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**1**	**3**	**2**	**1**

3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)

18EEM06	ELECTRICAL DRIVES AND CONTROL		SEMESTER			
PREREQUISTIES		**CATEGORY**	**PE**	**Credit**		**3**
DC Machines and Transformers, Synchronous and Induction Machines, and Power Electronics		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	To know about the operation analyse of chopper fed DC drive, both qualitatively and quantitatively.
2.	To understand the operation and performance of AC motor drives.

UNIT I	**DC MOTOR CHARACTERISTICS & CHOPPER FED DC DRIVES**	**9**	**0**	**0**	**9**

Review of torque-speed characteristics of separately excited dc motor, change in torque-speed curve with armature voltage, example load torque-speed characteristics, operating point, armature voltage control for varying motor speed. Review of dc chopper and duty ratio control, chopper fed dc motor for speed control, steady state operation of a chopper fed drive, armature current waveform and ripple, calculation of losses in dc motor and chopper.

UNIT II	**MULTI-QUADRANT & CLOSED-LOOP CONTROL OF DC DRIVE**	**9**	**0**	**0**	**9**

Review of Four quadrant operation of dc machine; single-quadrant, two-quadrant and four-quadrant choppers; Control structure of DC drive, inner current loop and outer speed loop, dynamic model of dc motor – dynamic equations and transfer functions, modeling of chopper as gain with switching delay, plant transfer function, current controller specification and design, speed controller specification and design.

UNIT III	**INDUCTION MOTOR CHARACTERISTICS**	**9**	**0**	**0**	**9**

Review of induction motor equivalent circuit and torque-speed characteristic, variation of torque-speed curve with (i) applied voltage, (ii) applied frequency and (iii) applied voltage and frequency. Review of three-phase voltage source inverter, generation of three-phase PWM signals, constant V/f control of induction motor

UNIT IV	**CONTROL OF SLIP RING INDUCTION MOTOR**	**9**	**0**	**0**	**9**

Impact of rotor resistance of the induction motor torque-speed curve, operation of slip-ring induction motor with external rotor resistance, starting torque, power electronic based rotor side control of slip ring motor, slip power recovery. .

UNIT V	**CONTROL OF SRM AND BLDC MOTOR DRIVES.**	**9**	**0**	**0**	**9**

SRM construction - Principle of operation - SRM drive design factors-Torque controlled SRM- Block diagram of Instantaneous Torque control using current controllers and flux controllers. Construction and Principle of operation of BLDC Machine - Sensing and logic switching scheme,-Sinusoidal and trapezoidal type of Brushless dc motors – Block diagram of current controlledd Brushless dc motor drive

Total (45L+0T)= 45 Periods

Text Books:

1.	G. K. Dubey, “Power Semiconductor Controlled Drives”, Prentice Hall, 1989.
2.	R. Krishnan, “Electric Motor Drives: Modeling, Analysis and Control”, Prentice Hall,2010
3.	Bose B K, "Modern Power Electronics and AC Drives", Pearson Education New Delhi, 2010.

Reference Books:

1.	G. K. Dubey, “Fundamentals of Electrical Drives”, CRC Press, 2012.
2.	W. Leonhard, “Control of Electric Drives”, Springer Science & Business Media, 2001.

E-Reference

1	https://www.iith.ac.in/~ketan/drives.htmL

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom’s Taxonomy Mapped**
CO1	:	Understand the characteristics of dc motors and induction motors.	L2: Understanding
CO2	:	Summarize the operation of chopper fed DC drives.	L4: Analyzing
CO3	:	Understand the principles of speed-control of dc motors and induction motors.	L2: Understanding
CO4	:	Identify suitable power electronic converters used for dc motor and induction motor speed control.	L3: Applying

CO5	:	Analyze the SRM and BLDC motor drive control	L4: Analyzing

COURSE ARTICULATION MATRIX

COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	1	3			1	1					1	3	2	
CO2	3	3	1	3		1	1					1	3	2	
CO3	3	3	3	3	1	1	1					1	3	2	
CO4	1	3	3	2	1	1	1					1	3	2	
CO5	3	3	3	3	1	1	1					1	3	2	
Avg.	**2.6**	**2.6**	**2.6**	**2.75**	**1**	**1**	**1**	-	-	-	-	**1**	**3**	**2**	-

3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)

18EEM07	ELECTRIC VEHICLES AND CONTROL		SEMESTER			
PREREQUISTIES		CATEGORY	PE	Credit		3
Electrical drives and control		Hours/Week	L	T	P	TH
			3	0	0	3

Course Objectives:

1.	To provide knowledge on electric vehicle architecture and its configurations
2.	To impart knowledge on vehicle control, use of energy storage systems and energy management in Electric Vehicle

UNIT I	**ELECTRIC VEHICLES**	**9**	**0**	**0**	**9**

Configurations of Electric Vehicles (EV), Performance of Electric Vehicles, Tractive Effort in Normal Driving and Energy Consumption, Hybrid Electric Vehicles (HEV): Classification, Series Hybrid Electric Drive Trains, Parallel Hybrid Electric Drive Trains

UNIT II	**PLUG-IN HYBRID ELECTRICVEHICLES (PHEV) AND FUEL CELL ELECTRIC VEHICLES**	**9**	**0**	**0**	**9**

Functions and Benefits of PHEV, Components of PHEVs, Operating Principles of Plug-in Hybrid Vehicle, Control Strategy of PHEV, Fuel Cell: Operation and Types, Fuel Cell Electric Vehicle: Configuration and Control Strategy

UNIT III	**ELECTRIC PROPULSION SYSTEMS**	**9**	**0**	**0**	**9**

Typical electric propulsion system, Classification of electric motor drives for EV and HEV, Multiquadrant Control of Chopper-Fed DC Motor Drives, Vector Control of Induction Motor drives, Permanent Magnetic Brush-Less DC Motor Drives, Switched Reluctance Motor Drives for Electric Vehicles

UNIT IV	**ENERGY STORAGE SYSTEM**	**9**	**0**	**0**	**9**

Status of Battery Systems for Automotive Applications, Battery Technologies: Nickel–Metal Hydride (Ni–MH) Battery, Lithium–Polymer (Li–P) Battery, Lithium-Ion (Li-Ion) Battery, Ultracapacitors: Features, operation and performance, Ultrahigh-Speed Flywheels, Hybridization of Energy Storages

UNIT V	**ENERGY MANAGEMENT SYSTEM**	**9**	**0**	**0**	**9**

Energy Management System(EMS) in Electric Vehicle, Rule-based control strategy: Deterministic rule-based control, Fuzzy logic-based control, and Neural network-based control. Optimization based control strategy: Dynamic Programming, Metaheuristic optimization methods and Model predictive control, Semi-active type Hybrid Energy Storage System-based EMS, Fully-active type Hybrid Energy Storage System-based EMS

Total (45L+0T)= 45 Periods

Text Books:

1.	Iqbal Hussain, "Electric and Hybrid Vehicles: Design Fundamentals", CRC Press, Taylor & Francis Group, Second Edition ,2011.
2.	Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay, AliEmadi,, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles" CRC Press, 2016

Reference Books:

1.	Ali Emadi, Mehrdad Ehsani, John M.Miller ,"Vehicular Electric Power Systems", Ali Emadi, Mehrdad Ehsani, John M.Miller, Special Indian Edition, Marcel dekker, Inc 2010

E-Reference:

1	https://archive.nptel.ac.in/courses/108/106/108106170/

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom's Taxonomy Mapped**
CO1	:	Recall the fundamentals of electric vehicle and its mechanics	L1: Remembering
CO2	:	Explain the architecture of different forms of hybrid electric vehicles.	L2: Understanding
CO3	:	Illustrate the four-quadrant operation of DC drive, induction motor drive and SRM drive for Electric Vehicles.	L4: Analyzing
CO4	:	Select an appropriate energy storage system for Electric vehicle	L4: Analyzing
CO5	:	Use the suitable energy management control strategy for hybrid electric vehicle	L3: Applying

COURSE ARTICULATION MATRIX

COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	1		1	3	1		1					1	1	2	1
CO2	1	2	3	1			2					2	1	2	
CO3	1	1			2		3						1	1	1
CO4	3	1	2	1	2		1					2	1	2	1
CO5	1	2	1	2	1							1	1	2	1
Avg	**1.4**	**1.5**	**1.75**	**1.75**	**1.5**	**-**	**1.75**	**-**	**-**	**-**	**-**	**1.5**	**1**	**1.8**	**1**

3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)

18EEM08	ELECTRICAL ENERGY CONSERVATION AND AUDITING		SEMESTER			
PREREQUISITES		CATEGORY	PE	Credit		3
Power Generation, Transmission and Distribution System		Hours/Week	L	T	P	TH
			3	0	0	3

Course Objectives:

1.	To get knowledge about basics of energy and energy scenario of India.
2.	To familiarise the energy conservation methods.
3.	To acquire knowledge on energy auditing, energy efficiency and modern energy efficient devices.

UNIT I	ENERGY SCENARIO	9	0	0	9

Commercial and non-commercial energy -Primary energy resources - Commercial energy production - Final energy consumption - Energy needs of growing economy - Long term energy scenario - Energy pricing - Energy sector reforms - Energy and environment - Energy security - Energy conservation and its importance - Restructuring of the energy supply sector - Energy strategy for the future, air pollution, climate change. Energy Conservation Act-2001 and its features.

UNIT II	BASICS OF ENERGY	9	0	0	9

Electricity tariff - Load management and maximum demand control - Thermal Basics-fuels - Thermal energy contents of fuel, temperature and pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity & heat transfer, units and conversion.

UNIT III	ENERGY MANAGEMENT AND AUDIT	9	0	0	9

Definition - Energy audit – Need and types of energy audit. Energy management (audit) approach understanding energy costs - Bench marking - Energy performance - Matching energy use to requirement - Maximizing system efficiencies - Optimizing the input energy requirements, fuel and energy substitution - Energy audit instruments. Material and energy balance: Facility as an energy system - Methods for preparing process flow, material and energy balance diagrams.

UNIT IV	ENERGY EFFICIENCY	9	0	0	9

Electrical system: Electricity billing - Electrical load management and maximum demand control -Power factor improvement and its benefit - Selection and location of capacitors - Performance assessment of PF capacitors, distribution and transformer losses. Electric motors: Types - Losses in induction motors - Motor efficiency - Factors affecting motor performance - Rewinding and motor replacement issues - Energy saving opportunities with energy efficient motors.

UNIT V	ENERGY EFFICIENT TECHNOLOGIES	9	0	0	9

Maximum demand controllers - Automatic power factor controllers - Energy efficient motors –Soft starters with energy saver - Variable speed drives - Energy efficient transformers - Electronic ballast - Occupancy sensors - Energy efficient lighting controls - Energy saving potential of each technology.

Total (45 L+ 0 T) = 45 Periods

Text Books:

1.	Sonal Desai, “Handbook of Energy Audit”, McGraw Hill, 2015.
2,	Tripathy, S. C, “Utilization of Electrical Energy and Conservation”, McGraw Hill, 1991.
3.	Hossam A Gabbar, “Energy Conservation in Infrastructure Systems”, Wiley-IEEE Press, New Jersey, 2018

Reference Books:

1.	General Aspects of Energy Management and Energy Audit, Bureau of Energy Efficiency, New Delhi, 2015.
2,	Energy Efficiency in Electrical Utilities, Bureau of Energy Efficiency, New Delhi, 2015.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom’s Taxonomy Mapped**
CO1	Identify the present energy scenario and future energy strategy.	L1: Understanding
CO2	Recognize the various forms of energy.	L1: Understanding
CO3	Interpret energy management methods and energy auditing.	L3: Applying
CO4	Familiar in energy efficiency of electrical systems.	L4: Analysing
CO5	Familiar with the advanced energy efficient technologies.	L4: Analysing

COURSE ARTICULATION MATRIX															
COs/ POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	1	2	3	2	2		3					1	2	2	1
CO2	1	2	2	2	2		3					1	2	2	1
CO3	2	2	2	3	2		3					1	1	3	1
CO4	2	3	2	2	3		3					1	3	3	1
CO5	2	2	3	1	2		3					1	3	2	1
Avg	**1.6**	**2.2**	**2.4**	**2**	**2.2**	**-**	**3**	**-**	**-**	**-**	**-**	**1**	**2.2**	**2.4**	**1**
3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)															

18EEM09	SMPS AND UPS		SEMESTER			
PREREQUISITES		**CATEGORY**	**PE**	**Credit**		**3**
Power Electronics		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	To impart knowledge about modern power electronic converters and their applications in power utility.
2.	To impart knowledge about Resonant converters and UPS.

UNIT I	**DC-DC CONVERTERS**	**9**	**0**	**0**	**9**

Introduction to SMPS – Non-isolated DC-DC converters: Cuk, SEPIC topologies, Z-source converter – Zeta converter - Analysis and state space modeling –- Concept of volt-second and charge balance – High gain input-parallel output-series DC-DC converter.

UNIT II	**SWITCHED MODE POWER CONVERTERS**	**9**	**0**	**0**	**9**

Isolated DC-DC converters: Analysis and state space modelling of fly back, Forward, Push pull, Luo, Half bridge and full bridge converters- control circuits and PWM techniques – Bidirectional DC-DC converters.

UNIT III	**RESONANT CONVERTERS**	**9**	**0**	**0**	**9**

Introduction- classification- basic concepts- Resonant switch- Load Resonant converters- ZVS , Clamped voltage topologies- DC link inverters with Zero Voltage Switching- Series and parallel Resonant inverters- Voltage control.

UNIT IV	**DC-AC CONVERTERS**	**9**	**0**	**0**	**9**

Introduction – Multilevel concept – Types of multilevel inverters – Diode-clamped MLI – Flying capacitors MLI – Cascaded MLI – Cascaded MLI – Applications – Switching device currents – DC link capacitor voltage balancing – Features of MLI – Comparisons of MLI.

UNIT V	**POWER CONDITIONERS, UPS, AND FILTERS**	**9**	**0**	**0**	**9**

Introduction- Power line disturbances- Power conditioners –UPS: offline UPS, Online UPS, Applications – Filters: Voltage filters, Series-parallel resonant filters, filter without series capacitors, filter for PWM VSI, current filter, DC filters – Design of inductor and transformer for power electronic applications – Selection of capacitors.

Total (45L+0T)= 45 Periods

Text Books:

1.	Simon Ang, Alejandro Oliva," Power-Switching Converters", Third Edition, CRC Press, 2010.
2.	M.H. Rashid – Power Electronics handbook, Elsevier Publication, 2001.

Reference Books:

1.	Ned Mohan, Tore.M.Undeland, William.P.Robbins, "Power Electronics Converters, Applications and Design", 3rd Edition, John Wiley and Sons, 2006.
2.	M.H. Rashid, "Power Electronics circuits, devices and applications", 3rd Edition, PHI, New Delhi, 2007.

E-References:

1.	NPTEL Course: Power Electronics, IIT-B.
2.	www.cdeep.iitb.ac.in. (Electrical Engineering)

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom's Taxonomy Mapped**
CO1	:	Analyze the state space model for DC – DC converters.	L4: Analyzing
CO2	:	Acquire knowledge on switched mode power converters.	L2: Understanding
CO3	:	Outline the PWM techniques for DC-AC converters.	L1: Remembering
CO4	:	Discuss about modern power electronic converters and its applications in electric power utility.	L2: Understanding
CO5	:	Identify the filters and UPS.	L2: Understanding

COURSE ARTICULATION MATRIX															
COs/ POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	2	1	2	2			1					2	2	2	1
CO2	1	1	3	2			1					2	3	3	2
CO3	2	2	2	3			1					1	2	2	1
CO4	2	1	1	2			1					2	2	3	2
CO5	1	1	2	1			1					1	2	2	1
Avg.	**1.6**	**1.2**	**2**	**2**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**1.6**	**2.2**	**2.4**	**1.4**
3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)															

18EEM10	UTILIZATION OF ELECTRICAL ENERGY	SEMESTER			
PREREQUISITES	**CATEGORY**	**PE**	**Credit**		**3**
Electrical Machines, Power System, and Power Electronics	**Hours/Week**	**L**	**T**	**P**	**TH**
		3	**0**	**0**	**3**

Course Objectives:

1.	To understand the economics of power generation, tariff and energy conservation methods.
2.	To impart knowledge on principle and design of illumination systems.
3.	To analyze the performance and different methods of electric heating and electric welding.
4.	To impart knowledge on electric traction systems and their performance.
5.	To understand electric drives for various industrial applications.

UNIT I	**INTRODUCTION**	**9**	**0**	**0**	**9**

Economics of generation – definitions – load duration curve – number and size of generator units – Cost of electrical energy – tariff — availability based Tariff- (ABT) – Battery Energy storage system (BESS)- Frequency based energy measurement - need for electrical energy conservation – methods.- Introduction to energy audit

UNIT II	**ILLUMINATION**	**9**	**0**	**0**	**9**

Introduction-nature of radiation – definition – laws of illumination – luminous efficacy-photometry – lighting calculations – design of illumination systems for residential, commercial, street lighting and sports ground– types of lamps –incandescent lamp- mercury vapour –fluorescent lamp-energy efficiency lamps – types of lighting schemes – requirements of good lighting

UNIT III	**HEATING AND WELDING**	**9**	**0**	**0**	**9**

Introduction- classification of methods of heating – requirements of a good heating material – design of heating element – temperature control of resistance furnace – electric arc furnace –induction heating – dielectric heating – electric welding – resistance welding – electric arc welding-electrical properties of arc-applications of electric arc welding.

UNIT IV	**ELECTRIC TRACTION**	**9**	**0**	**0**	**9**

Introduction – requirements of an ideal traction system – supply systems – train movement -mechanism of train movement – traction motors and control –speed control of three phase induction motor- multiple unit control – braking – recent trends in electric traction.

UNIT V	**DRIVES AND THEIR INDUSTRIAL APPLICATIONS**	**9**	**0**	**0**	**9**

Electric drive –advantages of electric drive-individual drive and group drive –factors affecting selection of motor – types of loads – steady state –transient characteristics –size of motor– load equalization – industrial applications – modern methods of speed control of D.C drives-dynamic braking using thyristors-regenerative braking using thyristors.

Total (45L+0T)= 45 Periods

Text Books:

1.	C.L. Wadhwa, “Generation, Distribution and Utilization of Electrical Energy”, New Age International Pvt.Ltd, 2003.
2.	Eric Openshaw Taylor, “Utilisation of Electric Energy”, English Universities Press Limited, 1937
3.	J.B. Gupta, “Utilization of Electric Power and Electric Traction”, S.K.Kataria and Sons, 2002.

Reference Books:

1.	G.C.Garg, S.K.Gridhar&S.M.Dhir, “A Course in Utilization of Electrical Energy”, Khanna Publishers, Delhi, 2003.
2.	H. Partab, “Art and Science of Utilization of Electrical Energy”, Dhanpat Rai and Co, New Delhi, 2004.

E-References:

1.	www.onlinecourses.nptel.ac.in
2.	www.class-central.com
3.	www.mooc-list.com

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom's Taxonomy Mapped**
CO1	:	Understand the economics of power generation, tariff and energy conservation methods.	L2: Understanding
CO2	:	Interpret the concept behind illumination and design a suitable illumination system for a specific application.	L3: Applying
CO3	:	Design and choose an appropriate heating method for specific application and gain knowledge about electric welding system.	L4: Analyzing
CO4	:	Explain the concepts and recent trends of traction system.	L4: Analyzing
CO5	:	Discuss the concepts of electric drives and their characteristics.	L2: Understanding

COURSE ARTICULATION MATRIX

COs/ POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	3	1	1	1	1	2	1	2	2	1	1	1	2	2	3
CO2	2	3	2	3	1	1	2	1	1			1	3	3	2
CO3	3	3	1	3	1	1	2	1					2	2	3
CO4	1	2	2	3	3	1	2	1					2	3	2
CO5	3	1	1	2	1	1	2	1		1		1	2	2	3
CO6	1	3	3	3	3	1	2	2				1	3	3	2
Avg	**2.17**	**2.17**	**1.67**	**2.5**	**1.67**	**1.17**	**1.83**	**1.33**	**1.5**	**1**	**1**	**1**	**2.33**	**2.5**	**2.5**

3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)

B.E. – MECHANICAL ENGINEERING - MINOR DEGREE

18MEM01	ENGINEERING THERMODYNAMICS *(Use of standard thermodynamic tables, Mollier diagram are permitted)*					
PRE-REQUISITE:		**CATEGORY**	**PE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	To impart the knowledge on concepts of zeroth and first law of thermodynamics.
2.	To make the learners to understand the third law of thermodynamics and analyze the various work and heat interactions in closed and open systems.
3.	To teach properties of pure substance.
4.	To impart knowledge on the concepts of steam power cycle.
5.	To derive thermodynamic relations for ideal and real gases.

UNIT I	**BASIC CONCEPT AND FIRST LAW**	**9**	**0**	**0**	**9**

Role of Thermodynamics in Engineering and Science - Applications of Thermodynamics. Basic concepts - concept of continuum, macroscopic approach, thermodynamic systems, Property, state, path and processes, quasi-static process, Thermodynamic equilibrium, Displacement work, P-V diagram. Zeroth law of thermodynamics – concept of temperature and heat. First law of thermodynamics – application to closed and open systems, steady flow processes with reference to various thermal equipment.

UNIT II	**SECOND LAW AND ENTROPY**	**9**	**0**	**0**	**9**

Heat engine – Refrigerator – Heat Pump, Second law of thermodynamics – Kelvin's and Clausius statements- Equivalence of these statements their corollaries. Reversibility and irreversibility. Carnot cycle, reversed Carnot cycle. Clausius inequality, Concept of entropy, principle of increase of entropy, T-s diagram, T-ds equations, Entropy.

UNIT III	**PROPERTIES OF PURE SUBSTANCES**	**9**	**0**	**0**	**9**

Steam - formation and its thermodynamic properties - p-v, p-T, T-v, T-s, h-s diagrams. PVT surface. Determination of dryness fraction. Calculation of work done and heat transfer in non-flow and flow processes using Steam Table and Mollier Chart.

UNIT IV	**STEAM POWER CYCLE**	**9**	**0**	**0**	**9**

Basic Rankine cycle, T-s & h-s diagrams - Performance Improvement - Reheat cycle, regenerative cycle and their combination cycles.

UNIT V	**IDEAL AND REAL GASES AND THERMO DYNAMIC RELATIONS**	**9**	**0**	**0**	**9**

Properties of ideal and real gases, equation of state of ideal and real gases, Avogadro's law, Vander Waal's equation of states, Principle of corresponding states, reduced properties and compressibility chart. Exact differentials, Maxwell relations, Specific heat equations, Tds, relations, Clausius Clapeyron equations and Joule Thomson Coefficient.

Total (45L)= 45 Periods

Text Books:

1.	Nag. P.K, "Engineering Thermodynamics", Tata McGraw-Hill, New Delhi, 2017.
2.	Sonntag, R.E., Borgnakke, C., and Van Wylen, G.J., Fundamentals of Thermodynamics, 6th ed., John Wiley, 2003.
3.	Arora C.P, "Thermodynamics", Tata McGraw Hill, New Delhi, 2003.
4.	Venwylen and Sontag, "Classical Thermodynamics", Wiley Eastern, 1987.

Reference Books:	
1.	Cengel, “Thermodynamics- An Engineering Approach”, 3rd Edition, Tata McGraw Hill, 2015.
2.	Merala C, Pother, Craig W and Somerton, “Thermodynamics for Engineers”, Schaum Outline Series, Tata McGrawHill, New Delhi, 2004.

COURSE OUTCOMES: Upon completion of this course, the students will be able to:		**Bloom Taxonomy Mapped**
CO1	Understand the concepts of zeroth, first and second law of thermodynamics.	Remember
CO2	Analyze the various work and heat interactions for different types of processes for closed and open systems	Evaluate
CO3	Evaluate the different properties of pure substances using steam tables and Mollier chart	Evaluate
CO4	Analyze the performance of steam power cycle.	Analyze
CO5	Derive thermodynamic relations for ideal and real gases.	Analyze

COURSE ARTICULATION MATRIX															
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	2			1					1	3	1	1
CO2	3	3	2	2			1					1	3	1	1
CO3	3	3	3	2		1	1					1	3	1	1
CO4	2	3	2	2		1	1					1	3	1	1
CO5	3	3	2	2		1						1	3	1	1
Avg	**2.8**	**3**	**2.2**	**2**		**1**	**1**					**1**	**3**	**1**	**1**
3/2/1 – indicates strength of correlation (3 – High, 2- Medium, 1- Low)															

18MEM02	FLUID MECHANICS AND MACHINERY				
PRE-REQUISITE:	**CATEGORY**	**PE**	**Credit**		**3**
1.Engineering Physics 2.Engineering Chemistry 3.Engineering Mathematics	**Hours/Week**	**L**	**T**	**P**	**TH**
		3	**0**	**0**	**3**

Course Objectives:

1.	To understand the basic concepts and properties of fluids.
2.	To analyze the kinematic and dynamic concepts of fluid flow.
3.	To understand the various incompressible fluid flow through pipes and between parallel plates.
4.	To apply the principles of fluid mechanics to design and operation of hydraulic turbines.
5.	To apply the principles of fluid mechanics to design and operation of hydraulic pumps.

UNIT I	**INTRODUCTION AND FLUID STATICS**	**9**	**0**	**0**	**9**

Basic concepts and units of measurement of physical quantities- Classification of fluids - Properties of fluids – density, relative density, vapour pressure, surface tension, Capillarity and viscosity. Fluid statics- hydrostatic pressure, buoyancy and Archimedes' principle.

UNIT II	**FLUID KINEMATICS AND DYNAMICS**	**9**	**0**	**0**	**9**

Classification of fluid flow - system and control volume - Lagrangian and Eulerian description for fluid flow - flow patterns-streamline, pathline, streakline and timeline. Velocity potential function and Stream function - continuity equation and its applications. Fluid dynamics - Bernoulli's equation and its applications. Dimensional analysis – Buckingham's theorem, dimensional homogeneity, similarity-laws and models.

UNIT III	**FLOW THROUGH PIPES AND PLATES**	**9**	**0**	**0**	**9**

Incompressible fluid flow-Laminar flow- Hagen-Poiseuille equation, shear stress, pressure gradient relationship - flow through pipes and flow between parallel plates. Turbulent flow – flow through pipes, friction factors in turbulent flow - total energy line, hydraulic gradient line, flow through pipes in series and parallel- Moody's friction factor chart. Power transmission-Boundary layer flows - Boundary layer thickness, momentum thickness, energy thickness-boundary layer separation.

UNIT IV	**HYDRAULIC TURBINES**	**9**	**0**	**0**	**9**

Hydraulic turbines classification-impulse and reaction turbines-Working Principle, work done-efficiency and performance curves for Pelton, Francis and Kaplan turbines (Only descriptive) - Comparison between impulse and reaction turbine-specific speed degree of reaction -draft tubes.

UNIT V	**HYDRAULIC PUMPS**	**9**	**0**	**0**	**9**

Classification of hydraulic pumps- Centrifugal pumps - working principle, specific speed, performance curves and priming(Only descriptive) - Reciprocating pumps - classification, working principle, indicator diagram, air vessels and performance curves. Cavitation in pumps (Only descriptive) - Working principles of gear and vane pumps.

Total (45L)= 45 Periods

Text Books:

1.	Bansal, R.K., "A Textbook of Fluid Mechanics and Hydraulic Machines, 9th Ed", Laxmi Publication Pvt Ltd, 2010.
2.	Rajput, R.K., "A Textbook of Fluid Mechanics and Hydraulic Mechanics", S.Chand and Company Ltd, 2011.
3.	Subramanya. K., "Fluid Mechanics and Hydraulic Machines", Tata McGraw Hill Publishing Company Ltd, 2011.

Reference Books:	
1.	White, “Fluid Mechanics, 8 Ed”, McGraw Hill India, 2017.
2.	Munson, Young and Okiishi, “Fundamentals of Fluid Mechanics 8 th Edition”, Wiley, 2016.
3.	Yunuscengel, John. M.cimbala, “Fluid Mechanics Fundamentals and Applications”, McGraw Hill, 2017.
4.	Som, S.K, Biswas.G and SumanChakraborty, “Introduction to Fluid Mechanics and Fluid Machines”, Tata McGraw Hill India, 2011.
5.	Dr.P.N.Modi, Dr.S.M.Seth, “Hydraulics and Fluid Mechanics including Hydraulic Machines”, Standard book house, 2018.
E-References:	
1.	NPTEL courses: http://nptel.iitm.ac.in/courses.php - web and video sources on fluid mechanics.

COURSE OUTCOMES: **Upon completion of the course, the students will be able to:**		**Bloom’s Taxonomy Mapped**
CO1	Understand the basic concepts and properties of fluids.	Remember
CO2	Analyze the kinematic and dynamic concepts of fluid flow.	Analyze
CO3	Understand the various incompressible fluid flow through pipes and between parallel plates.	Understand
CO4	Apply the principles of fluid mechanics to design and operation of hydraulic turbines.	Apply
CO5	Apply the principles of fluid mechanics to design and operation of hydraulic pumps.	Apply

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	1	1				2				1		2	2	1
CO2	3	3	1		2								2	2	1
CO3	2	3	2	2	1								2	2	1
CO4	3	3	3	2	1	2	1						2	2	1
CO5	3	3	3	2	1	2	1						2	2	1
Avg	**2.8**	**2.6**	**2**	**2**	**1.25**	**2**	**1.3**				**1**		**2**	**2**	**1**

3/2/1 – indicates strength of correlation (3 – High, 2- Medium, 1- Low)

18MEM03	MANUFACTURING PROCESSES					
PRE-REQUISITE:		**CATEGORY**	**PE**	**Credit**		**3**
1. Basic science, Engineering mathematics, Engineering Physics 2. Engineering Materials		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	To make the students familiarize with various manufacturing processes and fabrication techniques of metals and design of casting.
2.	To develop design concepts of various manufacturing processes.
3.	Gain knowledge to select appropriate manufacturing processes for various parts.
4.	To develop an entrepreneur skill among the students.
5.	To evaluate and select plastic deformation processes for various parts.

UNIT I	**CASTING**	**9**	**0**	**0**	**9**

Concepts of Manufacturing Process -Sand casting -Patterns – Design of Pattern, mould and cores- gating and risering design, solidification time calculation - Moulding machines - Core making. Special moulding processes – CO2 moulding; shell moulding, investment moulding, pressure die casting, centrifugal casting, casting defects.

UNIT II	**WELDING**	**9**	**0**	**0**	**9**

Classification of welding processes. Principles of Oxy-acetylene gas welding. Metal arc welding, resistance welding, submerged arc welding, tungsten inert gas welding, metal inert gas welding, plasma arc welding, thermit welding, electron beam welding, laser beam welding, defects in welding, Soldering and Brazing, Adhesive Bonding.

UNIT III	**METAL FORMING**	**10**	**0**	**0**	**10**

Metallurgical aspects of metal forming, slip, twinning mechanics of plastic deformation, load estimation of bulk deformation processes, Hot working and cold working of metals, Forging processes – open, closed and impression die forging – forging operations. Rolling of metals– Types of Rolling mill – Flat strip rolling – shape rolling operations – Defects in rolled parts. Principle of rod and wire drawing – Tube drawing – Principles of Extrusion – Types.

UNIT IV	**SHAPING OF PLASTICS**	**8**	**0**	**0**	**8**

Types of plastics - Characteristics of the forming and shaping processes – Moulding of Thermoplastics – Working principles and typical applications of - Injection moulding – Plunger and screw machines – Blow moulding – Rotational moulding – Film blowing – Extrusion - Typical industrial applications – Thermoforming – Processing of Thermosets – Working principles and typical applications - Compression moulding – Transfer moulding.

UNIT V	**SHEET METAL FORMING AND POWDER METALLURGY**	**9**	**0**	**0**	**9**

Formability of Sheet Metal, load estimation of sheet metal processes - Shearing, Deep drawing, Bending operations- types of presses used, Super Plastic forming; Introduction to Powder Metallurgy– Principal steps involved – sintering and compacting techniques, Advantages, limitations and applications of powder metallurgy.

Total (45L) = 45 Periods

Text Books:

1.	HajraChoudhury, "Elements of Workshop Technology", Vol. I and II, Media Promoters and Publishers Pvt., Ltd., Mumbai, 2005.
2.	NagendraParashar B.S. and Mittal R.K., "Elements of Manufacturing Processes", Prentice-Hall of India Private Limited, 2007.

Reference Books:

1.	Serope Kalpajian, Steven R.Schmid, "Manufacturing Processes for Engineering Materials", 4/e, Pearson Education, Inc. 2007.
2.	Jain. R.K., and S.C. Gupta, "Production Technology", 16th Edition, Khanna Publishers, 2001.
3.	"H.M.T. "Production Technology – Handbook", Tata McGraw-Hill, 2000.
4.	Roy. A. Linberg, "Process and Materials of Manufacture", PHI, 2000.
5.	Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems.
E-References:	
1.	https://fdocuments.in/document/production-technology-55844cac00bfc.html?page=40

COURSE OUTCOMES: **Upon completion of the course, the students will be able to:**		**Bloom's Taxonomy Mapped**
CO1	Describe the operational features of various casting processes, design gate and riser and discover various defects in casting.	Understand
CO2	Explain various metal joining processes and compare them.	Understand
CO3	Summarize several types of metal forming processes and select suitable method for different applications.	Analyze
CO4	Analyze various manufacturing methods for plastics and their needs in industry.	Analyze
CO5	Describe various sheet metal forming processes, load estimation calculation and principles of powder metallurgy	Understand

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	1	2	1						1			1	2	1
CO2	2	1	2	1		1			1	1			1	2	1
CO3	1	1	1	1						1			1	1	1
CO4	1	1	1		1					1			1	1	1
CO5		1							1	1			1		1
Avg	**1.5**	**1**	**1.5**	**1**	**1**	**1**			**1**	**1**			**1**	**1.5**	**1**

3/2/1 – indicates strength of correlation (3 – High, 2- Medium, 1- Low)

18MEM04	MATERIALS ENGINEERING					
PRE-REQUISITE:		**CATEGORY**	**PE**	**Credit**		**3**
1. Engineering Physics 2. Engineering Chemistry		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	To impart concept on reactions, treatment, microstructure and mechanical behavior of engineering materials at different temperature.
2.	To learn basic principles in metallurgy and materials engineering.
3.	To identity and select suitable engineering materials based on their applications.

UNIT I	**PHASE DIAGRAMS**	**9**	**0**	**0**	**9**

Crystal structures, Phases, solid solution types, compounds, Hume- Rothery rules; Gibb's phase rule; Binary isomorphous alloy systems – Eutectic, Eutectoid, Peritectic systems. Lever rule, Equilibrium and non-equilibrium cooling, Fe-C Equilibrium diagram - effects of alloying elements – Ferrite and Austenite Stabilizers, TTT and CCT diagrams.

UNIT II	**HEAT TREATMENT**	**9**	**0**	**0**	**9**

Definition – Full annealing, stress relief, recrystallisation and spheroidizing –normalizing, hardening and Tempering of steel. Isothermal transformation diagrams – cooling curves superimposed on I.T. diagram CCR - Hardenability, Jominy end quench test – Austempering, martempering – case hardening, carburising, nitriding, cyaniding, carbo-nitriding – Flame and Induction hardening. Heat treatment of non-ferrous alloys - precipitation hardening. Heat treatment of HSS tools, gears, springs and gauges.

UNIT III	**FERROUS AND NON FERROUS METALS**	**9**	**0**	**0**	**9**

Plain carbon steels – Tool steels - maraging steels – HSLA steels .Stainless steels- ferritic and Austenitic, martensitic, duplex and precipitation hardened stainless steels. Types of Cast Irons- Gray cast iron, white cast iron, malleable cast iron, S.G.Iron. Copper alloys – Brass, Bronze and Cupronickel, Aluminium alloys, Bearing alloys.

UNIT IV	**MECHANICAL PROPERTIES AND TESTING**	**9**	**0**	**0**	**9**

Mechanical properties of engineering materials - Mechanisms of plastic deformation, slip and twinning – Creep, Fatigue and Fracture - Types of fracture – Testing of materials - tension, compression and shear loads - fatigue and creep tests – hardness and its effects – testing for hardness (Brinell, Vickers and Rockwell) - Impact test - Izod and Charpy.

UNIT V	**NON DESTRUCTIVE TESTING AND SURFACE ENGINEERING**	**9**	**0**	**0**	**9**

Non Destructive Testing: Basic principles - Testing method - Radiographic testing, Ultrasonic testing, Magnetic Particle Inspection and Liquid Penetrant Inspections. Introduction to surface engineering - Definition, diffusion techniques, deposition methods, high and low energy beam methods, surface engineering charts, elastic contact mechanics.

Total (45L) = 45 Periods

Text Books:

1.	Kenneth G. Budinski and Michael K. Buinski, "Engineering Materials", Prentice Hall of India Ltd, 2002.
2.	Raghavan, V, "Materials Science and Engineering", Prentice Hall of India (P) Ltd., 1999.
3.	Aswani.K.G, "A Text Book of Material Science", S.Chand and Co. Ltd., New Delhi, 2001.
4.	Khanna O.P., "A Text Book of Materials Science and Metallurgy", DhanpatRai Sons, 2004.

Reference Books:

1.	William. D.Callsber, "Material Science and Engineering", John Wiley and Sons, 1997.
2.	Sydney.H.Avner, "Introduction to Physical Metallurgy" Mc Graw Hill Book Company, 1994.

COURSE OUTCOMES: **Upon completion of the course, the students will be able to:**		**Bloom's Taxonomy Mapped**
CO1	Understand the formation of materials and their classification based on atomic structure.	Understand
CO2	Understand the principles of various heat treatment processes in fabrication industry.	Understand
CO3	Describe properties, applications and types of various ferrous and non-ferrous metals used in fabrication industry	Understand
CO4	Describe various types of failure and select methods for destructive testing	Understand
CO5	Select methods for non destructive testing	Evaluate

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	1	2	2	1	1	1						2	3	1
CO2	1		2	1	1	2	1						2	3	1
CO3		1	1	1	1		1						3	2	1
CO4		2	2	1	1	1	1						2	3	1
CO5		2	2	2	1		1						2	2	1
Avg	**1**	**1.5**	**1.8**	**1.4**	**1.0**	**1.3**	**1**						**2.2**	**2.6**	**1.0**

3/2/1 – indicates strength of correlation (3 – High, 2- Medium, 1- Low)

18MEM05	KINEMATICS OF MACHINERY					
PRE-REQUISITE:		**CATEGORY**	**PE**	**Credit**		**3**
1. Engineering graphics. 2.Engineering Mechanics		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	To understand the basic components and layout of linkages in the assembly of a system/ machine.
2.	To understand the principles in analyzing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism.
3.	To understand basics of cam profile and its displacement.
4.	To understand the basic concepts of toothed gearing and kinematics of gear trains.
5.	Illustrate the effects of friction drives in transmission system.

UNIT I	**BASICS OF MECHANISMS**	**9**	**0**	**0**	**9**

Classification of mechanisms- Basic kinematic concepts and definitions- Degree of freedom, mobility- Grashof's law, Kinematic inversions of four bar chain and slider-crank chains Limit positions- Mechanical advantage - Transmission angle- Description of some common mechanisms- Quick return mechanism, straight-line generators.

UNIT II	**KINEMATIC ANALYSIS**	**9**	**0**	**0**	**9**

Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centres - kinematic analysis of simple mechanisms- slider-crank mechanism dynamics Coincident points- Coriolis component of acceleration introduction to linkage synthesis three Position graphical synthesis for motion and path generation.

UNIT III	**KINEMATICS OF CAM**	**9**	**0**	**0**	**9**

Classification of cams and followers- Terminology and definitions- Displacement diagrams- Uniform velocity, parabolic, simple harmonic and cycloidal motions- derivatives of follower motions- specified contour cams circular and tangent cams- pressure angle and undercutting, sizing of cams, graphical method for cam profile design.

UNIT IV	**GEARS AND GEAR TRAINS**	**9**	**0**	**0**	**9**

Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference / undercutting- helical, bevel, worm, rack & pinion gears, epicyclic and regular gear train kinematics.

UNIT V	**FRICTION IN MACHINE ELEMENTS**	**9**	**0**	**0**	**9**

Surface contacts- sliding and rolling friction- friction drives- friction in screw threads – bearings and lubrication- friction Clutches- belt and rope drives.

Total (45L) = 45 Periods

Text Books:

1.	Rattan S.S, "Theory of Machines", Tata McGraw Hill Publishing Company Ltd., New Delhi, 1998.
2.	Ghosh, A and Mallick, A.K, "Theory of Mechanisms and Machines", East-West Pvt. Ltd., New Delhi, 1988.

Reference Books:

1.	Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 1984.
2.	Rao J.S and Dukkipati R.V, "Mechanism and Machine Theory", Wiley-Eastern Ltd., New Delhi, 1992.

3.	Erdman AG and Sandor G N, “Mechanism Design, Analysis and Synthesis”, Vol.I, PHI Inc., 1997.
4.	Ambekar A.G, “Mechanism and Machine Theory” Prentice Hall of India, New Delhi, 2007.
5.	John Hannah and Stephens R C, “Mechanisms of Machines”, Viva Low Price Student Edition, New Delhi, 1999.
E-References:	
1.	https://archive.nptel.ac.in/courses/112/104/112104121/
2.	https://nptel.ac.in/courses/112106270
3.	http://velhightech.com/Documents/ME8492 Kinematics of Machinery.pdf

COURSE OUTCOMES: **Upon completion of the course, the students will be able to:**		**Bloom’s Taxonomy Mapped**
CO1	Demonstrate and understand the concepts of various mechanisms and pairs.	Apply
CO2	Analyze the velocity and acceleration of simple mechanisms.	Analyze
CO3	Construct the cam profile for various motion.	Create
CO4	Solve problems on gears and gear trains.	Evaluate
CO5	Evaluate the friction in transmission system	Evaluate

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	1									3	1	
CO2	3	2	2	1									3	1	
CO3	3	2	2	1									3	1	
CO4	3	2	2	1									3	1	
CO5	3	2	2	1									3	1	
Avg	**3**	**2**	**2**	**1**									**3**	**1**	

3/2/1 – indicates strength of correlation (3 – High, 2- Medium, 1- Low)

18MEM06	HYDRAULICS AND PNEUMATICS					
PRE-REQUISITE:		**CATEGORY**	**PE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	To enable the students understand the basics of hydraulics and pneumatics
2.	Applying the working principles of hydraulic actuators and control components.
3.	Designing and develop hydraulic circuits and systems.
4.	Applying the working principles of pneumatic power system and its components.
5.	Solving problems and troubles in fluid power systems.

UNIT I	**FLUID POWER PRINICIPLES AND HYDRAULIC PUMPS**	**9**	**0**	**0**	**9**

Introduction to Fluid power – Advantages and Applications – Fluid power systems – Types of fluids - Properties of fluids and selection – Basics of Hydraulics – Pascal's Law – Principles of flow - Friction loss – Work, Power and Torque - Problems, Sources of Hydraulic power; Pumping Theory – Pump Classification – Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criteria of pumps – Fixed and Variable displacement pumps – Problems.

UNIT II	**HYDRAULIC ACTUATORS AND CONTROL COMPONENTS**	**9**	**0**	**0**	**9**

Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning – Rotary actuators - Hydraulic motors - Control Components : Direction Control, Flow control and pressure control valves – Types, Construction and Operation – Accessories; Reservoirs, Pressure Switches – Filters – types and selection - Applications – Fluid Power ANSI Symbols – Problems.

UNIT III	**HYDRAULIC CIRCUITS AND SYSTEMS**	**9**	**0**	**0**	**9**

Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double - Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail - Safe, Speed Control, Deceleration circuits, Sizing of hydraulic systems, Hydrostatic transmission, Electro hydraulic circuits – Servo and Proportional valves – Applications - Mechanical, hydraulic servo systems.

UNIT IV	**PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS**	**9**	**0**	**0**	**9**

Properties of air – Air preparation and distribution – Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit – classification - single cylinder and multi cylinder circuits - Cascade method – Integration of fringe circuits, Electro Pneumatic System – Elements – Ladder diagram – timer circuits problems, Introduction to fluidics and pneumatic logic circuits.

UNIT V	**DESIGN OF FLUID POWER CIRCUITS AND TROUBLESHOOTING**	**9**	**0**	**0**	**9**

Servo systems, Hydro mechanical servo systems, electro hydraulic servo systems and proportional Valves, Introduction to electro hydraulic pneumatic logic circuits, ladder diagrams, PLC applications in fluid power control. Fluid power circuits, failure and troubleshooting. Design of Pneumatic circuits for metal working, handling, clamping counter and timer circuits. – Low cost Automation – Hydraulic and Pneumatic power packs. Case studies: A simple sequence, synchronize circuits using hydraulic and pneumatics components.

Total (45L) = 45 Periods

Text Books:

1.	Manjumdar S.R, "Oil Hydraulics", Tata McGraw-Hill, December 2002.

2.	Anthony Esposito, “Fluid Power with Applications”, Pearson Education 2013.
Reference Books:	
1.	Andrew Parr, “Hydraulic and Pneumatics”, Jaico Publications House, 2005.
2.	Bolton W. “Pneumatic and hydraulic system”, Butterworth-Heinemann 1997
3.	Majumdar S.R., “Pneumatic systems – Principles and maintenance”, Tata McGraw Hill, 2010
4.	Shanmugasundaram.K, “Hydraulic and Pneumatic controls”, Chand & Co, 2006
5.	Srinivasan.R. “Hydraulic and Pneumatic Controls”, Vijay Nicole Imprints, 2008.
E-References:	
1.	http://www.fluidpowerjournal.com
2.	http://14.139.160.15/courses/112102011/2
3.	https://www.nfpa.com/home.htm

COURSE OUTCOMES: **Upon completion of the course, the students will be able to:**		**Bloom’s Taxonomy Mapped**
CO1	Select the components as per the application	Evaluate
CO2	Apply the working principles of hydraulic actuators and control components.	Apply
CO3	Design and develop hydraulic circuits and systems.	Create
CO4	Apply the working principles of pneumatic power system and its components.	Apply
CO5	Solve problems and troubles in fluid power systems.	Evaluate

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1										1	1	1
CO2		2	2	1									1	1	1
CO3	1	2	3			1							1	2	1
CO4	1	1	3	2	2								2	1	1
CO5	1	1	2										1	1	1
Avg	**1.25**	**1.4**	**2.2**	**1.5**	**2**	**1**							**1.2**	**1.2**	**1**

3/2/1 – indicates strength of correlation (3 – High, 2- Medium, 1- Low)

18MEM07	DESIGN OF MACHINE ELEMENTS				
PRE-REQUISITE:	**CATEGORY**	**PE**	**Credit**		**3**
1. Student should study engineering mechanics. 2. Student should study kinematic of machinery.	**Hours/Week**	**L**	**T**	**P**	**TH**
		3	**0**	**0**	**3**

Course Objectives:

1.	Understanding of background in mechanics of materials and design of machine components.
2.	An understanding of the origins, nature and applicability of empirical design principles, based on safety considerations
3.	An understanding the design of shafts and couplings.
4.	Familiarize the design of energy storing elements and engine components.
5.	An appreciation of the relationships between component level design and overall machine system design and performance

UNIT I	**STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS**	**9**	**0**	**0**	**9**

Introduction to the design process – Product development cycle- factors influencing machine design, selection of materials based on mechanical properties - Preferred numbers– Direct, Bending and Torsional stress – Impact and shock loading – Calculation of principle stresses for various load combinations, eccentric loading – Factor of safety -theories of failure – stress concentration – design for variable loading – Soderberg, Goodman and Gerber relations .

UNIT II	**DESIGN OF SHAFTS AND COUPLINGS**	**9**	**0**	**0**	**9**

Design of solid and hollow shafts based on strength, rigidity and critical speed – Design of keys and key ways - Design of rigid and flexible couplings.

UNIT III	**DESIGN OF THREADED FASTENERS, RIVETED AND WELDED JOINTS**	**9**	**0**	**0**	**9**

Threaded fasteners - Design of bolted joints including eccentric loading – Design of riveted and welded joints for pressure vessels and structures- theory of bonded joints.

UNIT IV	**DESIGN OF ENERGY STORING ELEMENTS AND ENGINE COMPONENTS**	**9**	**0**	**0**	**9**

Various types of springs, optimization of helical springs - rubber springs - Flywheels considering stresses in rims and arms for engines and punching machines- Connecting rods and crank shafts.

UNIT V	**DESIGN OF BEARINGS**	**9**	**0**	**0**	**9**

Sliding contact and rolling contact bearings - Hydrodynamic journal bearings, Sommerfeld Number - Selection of Rolling Contact bearings.

Total (45L) = 45 Periods

Text Books:

1.	Bhandari V.B, “Design of Machine Elements”, Tata McGraw Hill Book Co, 2020
2.	Md.Jalaludeen.S, “A text book of Machine Design”, Anuradha Publications, 2006

Reference Books:

1.	Shigley, J.E. and Mischke, C.R., Mechanical Engineering Design, Fifth Edition, McGraw-Hill International; 1989.
2.	Deutschman, D., Michels, W.J. and Wilson, C.E., Machine Design Theory and Practice, Macmillan, 1992.

3.	Juvinal, R.C., Fundamentals of Machine Component Design, John Wiley, 1994.
4.	PSG Tech, "Design Data Handbook", M/s.DPV Printers, Coimbatore, 2009
E-References:	
1.	https://nptel.ac.in/courses/112105124
2.	Design of Machine Elements - V. B. Bhandari - Google Books
3.	A Textbook of Machine Design by R.S.Khurmi And J.K.Gupta [tortuka] 1490186411865.pdf | DocDroid

COURSE OUTCOMES: On completion of the course the student will be able to		**Bloom's Taxonomy Mapped**
CO1	Understand the influence of steady and variable stresses in machine component design.	Understand
CO2	Apply the concepts of design to shafts, keys and couplings.	Apply
CO3	Familiarize the design of temporary and permanent joints.	Understand
CO4	Design the various energy storing elements and engine components.	Analyse
CO5	Familiarize the design of various types of bearings.	Understand

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	1	2		1	1				1		3	2	1
CO2	2	2	1	2		1	1				1		3	2	1
CO3	2	2	1	2		1	1				1		3	2	1
CO4	2	2	1	2		1	1				1		3	2	1
CO5	2	2	1	2		1	1				1		3	2	1
Avg	**2.0**	**2.0**	**1.0**	**2.0**		**1.0**	**1.0**				**1.0**		**3.0**	**2.0**	**1.0**

3/2/1 – indicates strength of correlation (3 – High, 2- Medium, 1- Low)

18MEM08	HEAT AND MASS TRANSFER					
PREREQUISITES		**CATEGORY**	**PE**	**Credit**		**3**
1.The laws and basic concepts of thermodynamics 2. The concept of energy transfers and their conversion principles		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

COURSE OBJECTIVES	
1.	Understanding the science behind conduction heat transfer and its applications.
2.	Differentiating the concepts of forced and natural convection heat transfer.
3.	Describing the laws and concepts of radiation heat transfer.
4.	Understanding phase change processes and analyzing heat exchangers.
5.	Studying the concept of mass transfer process and its modes.

UNIT-I	**CONDUCTION HEAT TRANSFER**	**9**	**0**	**0**	**9**

General Differential equation – Cartesian(derivation of General Differential Equation), Cylindrical (derivation of General Differential Equation) and Spherical Coordinates – One DimensionalSteady State Heat-Concepts of electrical analogy, Conduction — plane and Composite Systems – Conduction with Internal HeatGeneration., Critical thickness of insulation.

Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis – Semi Infiniteand Infinite Solids –Use of Heisler's charts.

UNIT-II	**CONVECTION HEAT TRANSFER**	**9**	**0**	**0**	**9**

Conservation equations, boundary layer concept – Forced convection: external flow – flow over plates, cylinders, spheres and bank of tubes. Internal flow – entrance effects.

Free convection –flow over vertical plate, horizontal plate, inclined plate, cylinders and spheres.

UNIT-III	**BOILING, CONDENSATION AND HEAT EXCHANGERS**	**9**	**0**	**0**	**9**

Regimes of Pool boiling and Flow boiling, Nusselt's theory of condensation- correlations in boiling and condensation. Heat Exchanger types - Overall Heat Transfer Co-efficient – Fouling Factors. LMTD and NTU methods.

UNIT-IV	**RADIATION HEAT TRANSFER**	**9**	**0**	**0**	**9**

Radiation laws - Black Body and Gray body Radiation - Shape Factor - Electrical Analogy -Radiation Shields.

UNIT-V	**MASS TRANSFER**	**9**	**0**	**0**	**9**

Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state Molecular Diffusion - Equimolal counter diffusion. Basic Convective Mass Transfer Problems.

Total(45L) = 45 Periods

TEXT BOOKS:	
1	R.C. Sachdeva, "Fundamentals of Engineering Heat & Mass transfer", New Age International Publishers, 2017
2	Frank P. Incropera and David P. Dewitt, "Fundamentals of Heat and Mass Transfer", John Wiley & Sons, 7th Edition, 2014.
REFERENCE BOOKS:	
1	Yunus A. Cengel, "Heat Transfer A Practical Approach" – Tata McGraw Hill, 5 th Edition - 2013
2	Holman, J.P., "Heat and Mass Transfer", Tata McGraw Hill, 2017
3	Kothandaraman, C.P., "Fundamentals of Heat and Mass Transfer", New Age International, New Delhi, 2012
4	Ozisik, M.N., "Heat Transfer", McGraw Hill Book Co., 1994.

COURSE OUTCOMES: On completion of the course the student will be able to:		**Bloom's Taxonomy Mapped**
CO1	Analyze the mechanism of heat conduction under steady and transient conditions.	Apply
CO2	Develop solutions to problems involving convective heat transfer.	Create
CO3	Design a heat exchanger for any specific application.	Understand
CO4	Adopt the concept of radiation heat transfer in real time systems.	Understand
CO5	Develop solutions to problems involving combined heat and mass transfer.	Apply

COURSE ARTICULATION MATRIX															
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	2		1						3	3	1
CO2	3	3	3	3	2		1						3	3	1
CO3	3	3	3	3	2		1						3	3	1
CO4	3	3	3	3	2		1						3	2	1
CO5	2	2	2	2	1		1						3	1	
Avg	**2.8**	**2.8**	**2.8**	**2.8**	**1.8**		**1**						**3**	**2.4**	**1**
3/2/1 – indicates strength of correlation (3 – High, 2- Medium, 1- Low)															

18MEM09	METROLOGY AND QUALITY CONTROL					
PREREQUISITES		**CATEGORY**	**PE**	**Credit**		**3**
		Horus/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

COURSE OBJECTIVES

1.	Explaining the importance of measurements in engineering and the factors affecting measurements and to compute measurement uncertainty
2.	Applying the applications of linear and angular measuring instruments
3.	Interpretation of various tolerance symbols.
4.	Applying the SQC methods in manufacturing.
5.	Applying the advances in measurements for quality control.

UNIT-I	**BASICS OF MEASUREMENT SYSTEM AND DEVICES**	**9**	**0**	**0**	**9**

Definition of metrology, accuracy, precision and sensitivity, Abbe‘s principle. Three stages of generalized measurement system - mechanical loading – static characteristics of instruments – factors considered in selection of instruments - commonly used terms, error analysis and classification - sources of error. Measurement uncertainty.

UNIT-II	**CALIBRATION OF INSTRUMENTS AND QUALITY STANDARDS**	**9**	**0**	**0**	**9**

Calibration of measuring instruments - principles of calibration, Calibration of Instruments - Vernier caliper, Micrometer, feeler gauges, dial indicator, surface plates, slip gauges, care of gauge blocks. General cares and rules in measurement, ISO 9000 quality standards. Comparators- mechanical, electrical, optical and pneumatic.

UNIT-III	**GEOMETRICAL MEASUREMENT AND MACHINE ELEMENTS**	**9**	**0**	**0**	**9**

Angular measurement - optical protractors, sine bar, roundness measurement, limit gauge, design of plug gauge, Taylor‘s principle, three basic types of limit gauges, Tomlinson surface meter, computer controlled CMM. ISO metric thread, measurement of major, minor and effective diameters. Gear terminology; spur gear measurement, checking of composite errors, base pitch measurement. Principle of interferometry, laser interferometer, Machine vision, Fundamental of GD&T. Inspection of straightness, flatness, roundness deviations.

UNIT-IV	**STATISTICAL QUALITY CONTROL**	**9**	**0**	**0**	**9**

Surface finish – terminology and measurements – Optical measuring instruments –Acceptance test for machines. Statistical Quality Control - Control charts - Sampling plans.

UNIT-V	**SIX SIGMA**	**9**	**0**	**0**	**9**

Six sigma: Define measure, analyse, improve and control phases. Analyze phase tools: CommonTools: Histogram, Box Plot, Control chart, Scatter chart, Cause and effect diagram, Pareto analysis, interrelations diagram. Special Tools: Regression Analysis, Hypothesis Testing, ANOVA Multi variate analysis.

Total(45L) = 45 Periods

TEXT BOOKS:

1	Gupta.I.C, ―A text book of Engineering Metrology, Dhanpat Rai publications, New Delhi, 2018
2	Beckwith.T.G, Roy D. Marangoni, John H. Lienhard, - Mechanical Measurements‖, Prentice Hall, 2006

REFERENCE BOOKS:

1	Jain.R.K, ―Mechanical and Industrial Measurements, Khanna Publishers, Delhi, 1999.
2	Holmen.J.P, ―Experimental Methods for Engineers‖, Tata McGraw Hill Publications Co Limited, 2017.

3	Grant, E.L., Statistical Quality Control, Mc Graw-Hill, 2004. 3. Doeblin E.O., Measurement Systems, Mc Graw-Hill, 2004.
4	Alan S Morris, ―Measurement and Instrumentation Principles, Butterworth, 2006.
5	De Feo J A and Barnard W W, ―Six Sigma: Break trough and BeyondG, Tata McGraw-Hill, New Delhi, 2005.
E-REFERENCES:	
1	https://nitsri.ac.in/Department/Mechanical%20Engineering/MEC_405_Book_2,_for_Unit_2B.pdf
2	https://www.nist.gov/system/files/documents/srm/NIST-SRM-RM-Articlefinal.pdf
3	https://www.researchgate.net/publication/319587859_Computer-Aided_Metrology-CAM

COURSE OUTCOMES: On completion of the course the student will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the importance of measurements in engineering and the factors affecting measurements and to compute measurement uncertainty.	Understand
CO2	Apply the working principle and the applications of linear and angular measuring instruments.	Apply
CO3	Interpret of various tolerance symbols.	Apply
CO4	Apply the SQC methods in manufacturing.	Apply
CO5	Apply the advances in measurements for quality control in manufacturing industries.	Apply

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1							2	1	2				2	1	
CO2							3	1	2				1	2	
CO3							2	1					2	1	
CO4				3			2		1				1	2	
CO5				2				3	1				2	1	
Avg				**2.5**			**2.25**	**1.5**	**1.5**				**1.6**	**1.4**	

3/2/1 – indicates strength of correlation (3 – High, 2- Medium, 1- Low)

18MEMI10	DYNAMICS OF MACHINERY					
PREREQUISITES		**CATEGORY**	**PE**	**Credit**		**3**
Engineering Mechanics, Kinematics of Machinery, Strength of Materials		**Hours\Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

COURSE OBJECTIVES:

1.	To impart students with the knowledge about motion, masses and forces in machines and the Principle of Virtual Work.
2.	To facilitate the students, to understand the concept of balancing of rotating and reciprocating masses.
3.	To teach concepts of free vibration analyses of one and two degree-of-freedom rigid body systems
4.	To teach concepts of forced vibrations analyses of rigid body systems and to give awareness to students on the phenomenon of vibration and its effects.
5.	To learn about the concept of various types of governors.

UNIT I	**FORCE ANALYSIS**	**9**	**0**	**0**	**9**

Static Force Analysis, Free Body Diagrams, Conditions of Two, Three and Four Force Members. Inertia Forces and D'Alembert's Principle – Inertia Force Analysis in Reciprocating Engines – Crank Shaft Torque. Flywheels – Turning Moment Diagrams and Fluctuation of Energy of reciprocating engine mechanisms, Coefficient of Fluctuation of Energy and Speed, Weight of Flywheel Required.

UNIT II	**BALANCING**	**9**	**0**	**0**	**9**

Static and dynamic balancing - Balancing of rotating masses - Balancing a single cylinder Engine - Balancing Multi-cylinder Engines - Partial balancing in locomotive Engines - Balancing linkages - balancing machines

UNIT III	**FREE VIBRATION**	**9**	**0**	**0**	**9**

Basic Features of Vibratory Systems – Types – Single Degree of Freedom System – Transverse Vibration of Beams – Natural Frequency by Energy Method, Dunkerly's Method - Critical Speed - Damped Free Vibration of Single Degree Freedom System -Types of Damping – Free Vibration with Viscous Damping, Critically Damped System, Under Damped System. Torsional Systems: Natural Frequency of Two and Three Rotor Systems.

UNIT IV	**FORCED VIBRATION**	**9**	**0**	**0**	**9**

Response to Periodic Force – Harmonic Force – Force caused by Unbalance – Support Motion - Logarithmic Decrement-Magnification Factor – Vibration Isolation and Transmissibility.

UNIT V	**GOVERNORS**	**9**	**0**	**0**	**9**

Governors - Types - Centrifugal governors - Gravity controlled and spring controlled centrifugal governors – Characteristics - Effect of friction - Controlling Force - other governor mechanisms.

Total (45L) = 45 Periods

TEXT BOOKS:

1.	Design of Machinery, Fourth Edition, by R.L. Norton, McGraw Hill, 2007
2.	Mechanical Vibration, V.P.Singh, Dhanpatrai, Delhi

REFERENCE BOOKS:

1.	Ballaney, P.L., "Theory of Machines and Mechanisms", Khanna Publishers, New Delhi, 2002.
2.	Shigley, J.E. and Uicker, J.J., "Theory of Machines and Mechanisms", TMH ND, 1998.
3.	Amithabha Ghosh, and Ashok Kumar Malik., "Theory of Mechanisms and Machines", 2nd Ed., Affiliated East and West Press Limited, 1998.
4.	Prof.Nakara, IIT-Delhi Reference Books

E-REFERENCES:	
1.	www.university.youth4work.com/IIT_Kharagpur_Indian-Institute-of-Technology/study/1653-dynamics-of-Machinery-ebook
2.	http://nptel.ac.in/courses/112104114/

COURSE OUTCOMES: On completion of the course the student will be able to		Bloom's Taxonomy Mapped
CO1	Apply basic principles of mechanisms in mechanical system.	Apply
CO2	Familiarize the static and dynamic analysis of simple mechanisms.	Understand
CO3	Analyze the mechanical systems subjected to free vibration.	Analyze
CO4	Analyze mechanical systems subjected to forced vibration.	Analyze
CO5	Analyze the various types of governors and its speed control mechanism.	Analyze

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	3	1					1		3	2	1	2
CO2	2	2	3	2	1					1		3	2	1	2
CO3	2	2	3	2						1		3	2	1	2
CO4	2	2	3	2	1					1		3	2	1	2
CO5	1	2	3	2						1		3	2	1	1
Avg	**1.8**	**2.0**	**3.0**	**2.2**	**1**					**1.0**		**3.0**	**2.0**	**1.0**	**1.8**

3/2/1 – indicates strength of correlation (3 – High, 2- Medium, 1- Low)

MINOR DEGREE: METALLURGICAL ENGINEEING

18MTM01	ADVANCED PHYSICAL METALLURGY		Semester			
PREREQUISITES		Category	OE	Credit		3
Engineering physics		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives

1	To impart knowledge on the crystal structure, diffusion, phase diagrams for various engineering materials.

Unit I	CRYSTAL STRUCTURES	9	0	0	9

Review of atomic bonds, Lattice, unit cell, crystal systems and Bravais lattices; Principal crystal structures – BCC, FCC, HCP and its characteristics; Miller indices for crystallographic planes and directions, interplanar spacing; Volume, planar and linear atomic density; Polymorphism and allotropy; CsCl, NaCl, Diamond structures; single crystal and polycrystalline and amorphous materials; isotropy and anisotropy; Simple problems in the above topics

Unit II	CRYSTALLINE IMPERFECTIONS	9	0	0	9

Types of point defects, effect of temperature on vacancy concentration, interstitial sites-octahedral and tetrahedral sites; Line defects – dislocations – Edge, screw and mixed dislocations, Burger's vector, slip and twinning; Planar defects – grain boundaries, tilt boundaries, small angle grain boundaries; ASTM grain size number, grain size determinations; Volume defects; Simple problems in the above topics.

Unit III	ATOMIC DIFFUSION IN SOLIDS AND SOLIDIFICATION OF METAL	9	0	0	9

Diffusion mechanisms, steady state diffusion and non-steady state diffusion-Fick's first law and second law; Kirkendall effect and Darken's equation; Factors affecting diffusion; Industrial applications of diffusion processes; Simple problems in the above topics; Basic principles of solidification of metals and alloys; Growth of crystals– Planar growth, dendritic growth, Solidification time, dendrite size; Cooling curves; Cast or Ingot structure, Solidification defects – Control of casting structure; Directional solidification – single crystal growth; Simple problems in the above topics.

Unit IV	PHASE DIAGRAMS	9	0	0	9

Phases, solid solution types, compounds, Hume- Rothery rules; Gibb's phase rule; Phase diagram determination; Binary isomorphous alloy systems – composition and amount of phases, development of microstructure – equilibrium and non-equilibrium cooling- Coring and its effects, homogenization; Binary eutectic system - composition and amount of phases, development of microstructure; Eutectoid, Peritectic and monotectic reaction, Phase diagrams with intermediate phases and compounds; Ternary phase diagrams. Simple problems in the above topics.

Unit V	IRON-CARBON PHASE DIAGRAM	9	0	0	9

Iron-carbon diagram, Phases in Fe-C system, Invariant reactions, Microstructure of slowly cooled steels, composition and amount of phases, Effect of Alloying elements on Fe-C system, Type, structure, properties and applications of Plain Carbon Steels and different types of Cast iron; IS Specification for Steels and Cast Irons, Simple problems in above topics.

Total (45+0) = 45 Hours

Text Books:	
1	Donald R. Askeland,"The Science and Engineering of Materials", Thomson Learning, India Edition, 2007.
2	William D.Callister, "Materials Science and Engineering – An Introduction", 4th edition, JohnWiley & Sons, New York, USA, 1997.
Reference Books:	
1	Avner S H."An Introduction to Physical Metallurgy", McGraw Hill Book Co, New York, USA, 1997.
2	Donald R Askeland," Essentials of Material Science and Engineering ", Thomson Learning, India Edition, 2007
3	Raghavan V., "Physical Metallurgy – Principles and Practice", Prentice Hall of India Ltd., New Delhi, 199.
4	William F.Smith, "Foundations of Materials Science and Engineering", Second Edition, McGraw-Hill Inc, New York, 1993.

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom's Taxonomy Mapped**
CO1	:	Describe the basic crystal structure, orientation and their influence on macroscopic properties.	L2: Understanding
CO2	:	Discuss the role of imperfections in strengthening the materials.	L2: Understanding
CO3	:	Diagonise the diffusion mechanism in solidification of materials under different conditions.	L4:Analysing
CO4	:	Apply the concept of phase diagrams in equilibrium transformation of materials phases.	L3:Applying
CO5	:	Construct the Fe-Fe_3C phase diagram and discuss various properties of steel and cast iron.	L3:Applying

COURSE ARTICULATION MATRIX

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1		1	1								1		1	
CO2	1	1				1	1						1			1
CO3	1	1	1	1		1							1	1		
CO4	1	1		1	1								1			
CO5	1	1		1									1			1
Avg.	1.0	1.0	1.0	1.0	1.0	1.0	1.0						1.0	1.0	1.0	1.0

3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)

18MTM02	THERMODYNAMICS AND KINETICS IN METALLURGY	Semester			
PREREQUISITES	Category	OE	Credit		3
Engineering physics and Engineering chemistry	Hours/Week	L	T	P	TH
		3	0	0	3

Course Learning Objectives

1	To learn the basic principles and concepts of thermodynamics in the field of Metallurgy and materials; and to learn about equations and their applications.

Unit I	FUNDAMENTAL CONCEPT AND INTERNAL ENERGY	9	0	0	9

Introduction: System and surrounding, Classification of systems, Path and state properties, Thermodynamic processes, Thermodynamic equilibrium, Reversible and Irreversible processes. First law of thermodynamics: Heat and work, Internal energy, Heat capacity of materials, Cp-Cv relations, Nernst Equation, Enthalpy, Thermochemistry Hess's law, Kirchoff's law, Maximum flame temperature.

Unit II	ENTROPY AND AUXILARY FUNCTIONS	9	0	0	9

Second law of thermodynamics: Carnot cycle, Entropy - Statistical interpretation of entropy, Free energy, Combined statement of first and second laws, Thermodynamic functions - Maxwell's relations, Gibbs Helmholtz equation. Third and Zeroth laws of thermodynamics : Definition, concept and applications

Unit III	THERMODYNAMIC POTENTIALS AND PHASE EQUILIBRIA	9	0	0	9

Thermodynamic potentials: Fugacity, Activity and Equilibrium constant. Clausius - Clayperon equation, Troutons rule. Le Chatelier's principle, Vant Hoff's equation. Equilibria in phase diagrams: Phase rule, Phase stability, Thermodynamics of surfaces, interfaces and defects, P-G-T diagrams, Application of free energy - composition diagrams to the study of alloy systems.

Unit IV	THERMODYNAMICS OF SOLUTIONS	9	0	0	9

Gibbs - Duhem equation, Partial and integral molar quantities, chemical potential, Ideal solutions - Raoult's law, Real solutions, Activity coefficient, Henry's law, Alternative standard states, Sievert's law, Mixing functions and excess functions, Regular solutions, Applications of Gibbs - Duhem equation.

Unit V	THERMODYNAMICS OF REACTIONS AND KINETICS	9	0	0	9

Electro chemical process: Cells, Interconversion of free energy and electrical work, Determination of thermodynamic quantities using reversible cells, Solid electrolytic cells. Kinetics: First, Second and third order reactions, Arrhenius equation - activation energy, Determination of order of the reaction.

Total (45+0) = 45 Hours

Text Books:	
1	Upadhyaya G S andDube R K., "Problems in Metallurgical Thermodynamics & Kinetics",Pergamon, 1977.
2	Ahindra Ghosh, Text book of Materials & MetallurgicalThermodynamics, Prentice Hall India, 2002
3	. David R Gaskell, "Introduction to the Thermodynamics of Materials", Fifth Edition, Taylor & Francis, 2008
Reference Books:	
1	David V Ragone, "Thermodynamics of Materials - Volume-1", John Wiley & Sons, Inc. 1995.
2	Dr S.K Dutta,Prof A.B.Lele – Metallurgical thermodynamics kinetics and numericals,S.Chand& co Ltd.,New Delhi 2011
3	Darken LS and Gurry R W,"Physical Chemistry of Metals", CBS publications and distributors, 2002.
4	Parker R H, "An introduction to chemical metallurgy", Pergamon press, New York, second edition, 1978.
5	Kapoor M.L., "Chemical and Metallurgical Thermodynamics Vol. I and II", Nem Chand, 1st Ed., 1981

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom's Taxonomy Mapped**
CO1	:	Discuss the fundamental concepts of thermodynamics and internal energy	L2: Understanding
CO2	:	State the thermodynamics entropy and auxilary functions.	L2: Understanding
CO3	:	Identify the basic laws, chemical potential and phase equilibria.	L4:Analysing
CO4	:	Describe the thermodynamics of the solution and various important equations.	L2: Understanding
CO5	:	Apply to solve problems related to electrochemical processes and kinetics.	L3:Applying

COURSE ARTICULATION MATRIX

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1		1	1								1	1		
CO2	1	1	1										1		1	
CO3	1	1		1	1								1			
CO4	1			1	1								1		1	1
CO5	1	1				1	1						1		1	
Avg.	1.0	1.0	1.0	1.0	1.0	1.0	1.0						1.0	1.0	1.0	1.0

3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)

18MTM03	MECHANICAL BEHAVIOUR OF MATERIALS		Semester			
PREREQUISITES			**OE**	**Credit**		**3**
Engineering physics		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	To know the fundamental concepts of deformation behaviour for structural engineering applications.

Unit I	**DISLOCATIONS AND PLASTIC DEFORMATION**	**9**	**0**	**0**	**9**

Strength of perfect crystal and need for dislocations; Characteristics of dislocations – Edge dislocation, Screw dislocation, Burger's vector, mixed dislocation, dislocation loops; Movement of dislocation – Pierls stress, Cross slip, Climb; Dislocations in FCC, HCP and BCC lattice; Stress fields and energies of dislocations, forces on and between dislocations; Dislocation density; Intersections of dislocations – Jogs and kinks; Dislocation multiplication; Dislocation pile-ups; Deformation by slip and twinning; Critical resolved shear stress; Deformation bands and kink bands.

Unit II	**STRENGTHENING MECHANISMS**	**9**	**0**	**0**	**9**

Strain hardening; Grain boundary strengthening; Solid solution strengthening - yield-point phenomenon, strain ageing; Precipitation hardening - Conditions for precipitation hardening, Ageing, Formation of precipitates, coarsening of precipitates, Mechanism of strengthening; Dispersion strengthening; Fiber strengthening; Martensite strengthening - examples for above strengthening mechanisms from ferrous and non-ferrous systems, Bauschinger effect; Preferred orientation; Sever plastic deformation.

Unit III	**FRACTURE AND FRACTURE MECHANICS**	**9**	**0**	**0**	**9**

Types of fracture – ductile and brittle fracture, Ductile to Brittle Transition Temperature (DBTT), Metallurgical factors affecting DBTT, determination of DBTT, Hydrogen embrittlement and other embrittlement, Theoretical cohesive strength of metals, Griffith's theory of brittle fracture, Orowan's modification. Fracture mechanics - introduction, modes of fracture, stress intensity factor, strain energy release rate, fracture toughness and determination of KIC, introduction to COD, J integral.

Unit IV	**FATIGUE BEHAVIOUR AND TESTS**	**9**	**0**	**0**	**9**

Fatigue: Stress cycles, S-N curves, effect of mean stress, factors affecting fatigue, structural changes accompanying fatigue, cumulative damage, HCF / LCF, thermo-mechanical fatigue, application of fracture mechanics to fatigue crack propagation, fatigue testing machines.

Unit V	**CREEP BEHAVIOUR AND TESTS**	**9**	**0**	**0**	**9**

Creep curve, stages in creep curve and explanation, structural changes during creep, creep mechanisms, metallurgical factors affecting creep, high temperature alloys, stress rupture testing, creep testing machines, parametetric methods of extrapolation. Deformation Mechanism Maps

Total (45+0) = 45 Hours

Text Books:	
1	George. E. Dieter, “Mechanical Metallurgy”, 3rd Edition, McGraw-Hill Publications, New York, SI Edition, 2004
2	Marc Andr’e Meyers, Krishan Kumar Chawla, “Mechanical Behavior of Materials”, Cambridge University Press, UK, 2009.
Reference Books:	
1	Reed Hill, R.E., "Physical Metallurgy Principles", Affiliated East West Press, New Delhi, 1992.
2	Davis.H.E. Troxell G.E., Hauck.G.E.W. “The Testing of Engineering Materials”, McGraw-Hill, 1982.
3	Wulff et al Vol. III “Mechanical Behavior of Materials”, John Wiley and Sons, New York, USA, 1983.
4	Honeycombe R.W.K., “Plastic Deformation of Materials”, Edward Arnold Publishers, 1984

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom’s Taxonomy Mapped**
CO1	:	Discuss the mechanical behaviour of materials.	L2: Understanding
CO2	:	Discuss the strengthening mechanisms of materials.	L2: Understanding
CO3	:	List the various types of fractures and their mechanisms, fracture mechanics and various theories describing fracture mechanics.	L2: Understanding
CO4	:	Discuss the fatigue behaviour and the mechanism of fatigue, SN curve and fatigue testing machines.	L2: Understanding
CO5	:	Describe the creep behaviour and mechanism, factors affecting creep and creep testing machines.	L2: Understanding

COURSE ARTICULATION MATRIX

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1		1	1								1	1		
CO2	1	1		1	1								1	1		
CO3	1	1	1		1										1	1
CO4	1	1				1	1								1	1
CO5	1	1		1	1								1	1		
Avg.	1.0	1.0	1.0	1.0	1.0	1.0	1.0						1.0	1.0	1.0	1.0
3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)																

18MTM04	RATE PROCESSES IN METALLURGY		Semester			
PREREQUISITES			OE	Credit		3
Engineering physics		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives

1	To learn the basic principles and concepts of kinetics in the domain of metallurgy and materials; to learn about equations and their applications; And to appreciate that metallurgical kinetics as a Knowledge base with abundant applications.

Unit I	INTRODUCTION	9	0	0	9

Introduction: Role of kinetics, heterogeneous and homogeneous kinetics, Role of heat and mass transfer in metallurgical kinetics, rate expression, Effect of Temperature and concentration on reaction kinetics: effect of temperature (Arrhenius Equation), Effect of concentration (order of a reaction), significance and determination of activation energy.

Unit II	KINETICS OF SOLID-FLUID REACTION	9	0	0	9

Kinetics of solid-fluid reaction: kinetic steps, rate controlling step, definition of various resistances in series, shrinking core model, chemical reaction as rate controlling step, Product layer diffusion as rate controlling step, Mass transfer through external fluid film as rate controlling step, heat transfer as the rate controlling step, Concentration boundary layer, definition and significance of heat and mass transfer coefficient, Theoretical models for mass transfer coefficients, Correlations for heat and mass transfer coefficients

Unit III	LIQUID-SOLID PHASE TRANSFORMATION	9	0	0	9

Principles of Solidification in metals and alloys: thermodynamics involved, eutectic and peritectic Solidification, Homogeneous and heterogeneous nucleation, Mechanisms of growth. Rapid Solidification Processing.

Unit IV	SOLID STATE PHASE TRANSFORMATIONS	9	0	0	9

Nucleation and growth Kinetics, homogeneous and heterogeneous transformation, Precipitation: Coherency, age hardening, particle Coarsening. Ostwald ripening, Order-disorder transformation, spinodal decomposition, massive transformations

Unit V	SOLID STATE PHASE TRANSFORMATIONS IN STEEL	9	0	0	9

Reconstructive and displacive transformations; Pearlitic transformation: mechanism and kinetics: Johnson-Mehl equation, morphology of pearlite; Bainitic transformation: mechanism and kinetics; morphology of upper bainite and lower bainite; Martensitic transformation: Mechanism- diffusionless displacive nature; morphology of high carbon and low carbon martensite.

Total (45+0) = 45 Hours

Text Books:

1.	Ahindra Ghosh and Sudipto Ghosh, A Text book of Metallurgical Kinetics, PHI learning Pvt. Ltd., New Delhi, 2014
2.	H.S. Ray, Kinetics of Metallurgical Reactions, International Science publisher, 1993.
3.	F. Habashi, Kinetics of Metallurgical Processes, Metallurgy Extractive Québec, 1999.
4.	Upadhyaya G S and Dube R K., "Problems in Metallurgical Thermodynamics & Kinetics", Pergamon, 1977.

Reference Books:

1.	Phase transformations in metals and alloys- D.A. Potter and K.E. Easterling, CRC Press, 1992. 2. Transformations in Metals, P.G. Shewmon, Mc-Graw Hill, 1969.
2.	Introduction to Physical Metallurgy – S. N. Avner, Tata McGraw Hill, 1997.
3.	Physical Metallurgy Principles, R. E. Reed-Hill and R. Abbaschian, 3rd ed, PWS-Kent Publishing, 1992.
4.	Modern Physical Metallurgy, R. E. Smallman, Butterworths, 1963

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom's Taxonomy Mapped**
CO1	:	Discuss the thermodynamic aspects of phase changes.	L2: Understanding
CO2	:	Discuss the fundamentals of solid –fluid reactions.	L2: Understanding
CO3	:	Explain the eutectic and peritectic solidifications and rapid solidification processes.	L2: Understanding
CO4	:	Describe the fundamentals of solidification.	L1: Remembering
CO5	:	Apply the solid state phase transformations in steel.	L3:Applying

COURSE ARTICULATION MATRIX

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	1	1		1	1								1			1
CO2	1	1			1	1									1	1
CO3	1	1		1	1								1	1		
CO4	1	1		1	1									1		1
CO5	1		1			1	1								1	1
Avg.	1.0	1.0	1.0	1.0	1.0	1.0	1.0						1.0	1.0	1.0	1.0

3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)

18MTM05	CORROSION AND SURFACE ENGINEERING		Semester			
PREREQUISITES			OE	Credit		3
Engineering chemistry		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives

1 To understand the corrosion and surface engineering, with its application in engineering field.

Unit I	MECHANISMS AND TYPES OF CORROSION	9	0	0	9

Principles of direct and Electro chemical Corrosion, Hydrogen evolution and Oxygen absorption mechanisms – Galvanic corrosion, Galvanic series-specific types of corrosion such as uniform, Pitting, Intergranular, Cavitations, Crevice Fretting, Erosion and Stress Corrosion, corrosion fatigue, hydrogen damage –Factors influencing corrosion

Unit II	TESTING AND PREVENTION OF CORROSION	9	0	0	9

Corrosion testing techniques and procedures- Corrosion Testing ASTM Standards, Pitting Corrosion Test, Hydrogen Induced Cracking Test, Sulphide Stress Corrosion Cracking Test- Prevention of Corrosion-Design against corrosion –Modifications of corrosive environment –Inhibitors – Cathodic Protection –Special surfacing processes.

Unit III	CORROSION OF INDUSTRIAL COMPONENTS	9	0	0	9

Corrosion in fossil fuel power plants, Automotive industry, Chemical processing industries, corrosion in petroleum production operations and refining, Corrosion of pipelines- wear of industrial components.

Unit IV	SURFACE ENGINEERING FOR WEAR AND CORROSION RESISTANCE	9	0	0	9

Diffusion coatings –Electro and Electroless Plating –Hot dip coating –Hard facing-Metal spraying, Flame and Arc processes- Conversion coating –Selection of coating for wear and Corrosion resistance.

Unit V	THIN LAYER ENGINEERING PROCESSES	9	0	0	9

Laser and Electron Beam hardening –Effect of process variables such as power and scan speed - Physical vapor deposition, Thermal evaporation, Arc vaporization, Sputtering, Ion plating - Chemical vapor deposition – Coating of tools, TiC, TiN, Al_2O_3 and Diamond coating-Properties and applications of thin coatings.

Total (45+0) = 45 Hours

Reference Books:

1. Fontana. G., Corrosion Engineering, McGraw Hill,1985.
2. Kenneth G. Budinski, Surface Engineering for Wear Resistance, Prenticehall,1992.
3. ASM Metals Hand Book –Vol. 5, Surface Engineering,1996.
4. Denny A Jones, “Principles and prevention of corrosion”, 2nd edition, Prentice Hall, New Jersey,1995.
5. ASM International, Surface Engineering for Corrosion and Wear Resistance,2005.
6. Schweitzer. P.A., Corrosion Engineering Hand Book, 3rd Edition, Marcel Decker, 1996.

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom's Taxonomy Mapped**
CO1	:	Name the different types of corrosion and their mechanism.	L2: Understanding
CO2	:	Estimate corrosion resistance by different tests.	L4:Analysing
CO3	:	Explain the corrosion behavior of different metals in different industries.	L2: Understanding
CO4	:	Classify the different forms of processing techniques of surface engineering materials.	L1: Remembering
CO5	:	Select the type of deposition and spraying technique.	L3:Applying

COURSE ARTICULATION MATRIX

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	1	1		1	1								1	1		
CO2	1	1		1		1							1	1		
CO3	1	1	1	1			1								1	1
CO4	1	1		1	1										1	1
CO5	1	1		1	1								1	1		
Avg.	1.0	1.0	1.0	1.0	1.0	1.0	1.0						1.0	1.0	1.0	1.0

3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)

18MTM06	MATERIALS CHARACTERIZATION		Semester			
PREREQUISITES			OE	Credit		3
Engineering physics		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives

1	To acquire knowledge on various characterizations, chemical and thermal analysis of metallurgical components using its analysis tools.

Unit I	**OPTICAL MICROSCOPY**	**9**	**0**	**0**	**9**

Metallographic specimen preparation. Macro-examination -applications. Metallurgical microscope - principle, construction and working, , Optic properties - magnification, numerical aperture, resolving power, depth of focus, depth of field, different light sources, lens aberrations and their remedial measures, Various illumination techniques-bright field , dark field, phase-contrast, polarized light illuminations, interference microscopy, high temperature microscopy; Quantitative metallography – Image analysis.

Unit II	**X-RAY DIFFRACTION**	**9**	**0**	**0**	**9**

Characteristic X-ray spectrum, Bragg's Law, Diffraction methods - Laue method, rotating crystal method and powder method. Diffraction intensity – structure factor calculation. X-ray diffractometer -general features, filters and counters. Applications of X-ray diffraction in materials characterisation – Determination of crystallite size, crystal structure, precise lattice parameter, measurement of stress.

Unit III	**ELECTRON MICROSCOPY**	**9**	**0**	**0**	**9**

Electron beam - specimen interactions. Construction and operation of Transmission Electron Microscopy – Diffraction effects and image formation, various imaging modes, selected area diffraction, applications, specimen preparation techniques. Scanning electron microscopy – principle, equipment, various operating modes and applications, Electron probe microanalyser (EPMA)- principle, instrumentation, qualitative and quantitative analysis. Introduction to HRTEM, FESEM, EBSD.

Unit IV	**SPECTROSCOPIC TECHNIQUES**	**9**	**0**	**0**	**9**

X-ray spectroscopy – EDS and WDS. Principle, instrumentation, working and applications of Auger Electron spectroscopy, X-ray photoelectron spectroscopy and Secondary ion mass spectroscopy / ion microprobe. Optical emission spectroscopy, Atomic Absorption spectroscopy and X-ray fluorescence spectroscopy - principle, construction, working and applications. UV-Vis, FTIR and Raman spectroscopy.

Unit V	**THERMAL ANALYSIS AND ADVANCED CHARACTERIZATION TECHNIQUES**	**9**	**0**	**0**	**9**

Thermal Analysis: Principles of differential thermal analysis, differential scanning calorimetry and thermo-graviometric analysis – Instrumentation and applications. Advanced characterization techniques: Scanning probe microscopy - STM and AFM - principle, instrumentation and applications. Field ion microscopy including atom probe - principles, instrumentation and applications.

Total (45+0) = 45 Hours

Text Books:

1.	Cullity, B.D., Elements of X Ray Diffraction, Addison-Wesley Publishing Company Inc, Philippines, 1978
2.	Brandon, D. and W.D. Kaplan, Microstructural Characterization of Materials, John Wiley & Sons Ltd, England, 2013.
3.	Leng, Y., Materials Characterization: Introduction to Microscopic and Spectroscopic Methods, John Wiley & Sons (Asia) Pte Ltd, Singapore, 2008

Reference Books:	
1.	ASM Handbook, Volume 10, Materials Characterization, ASM international, USA, 1986.
2.	Vander Voort, G.F., Metallography: Principle and practice, ASM International, 1999.
3.	Phillips V A, Modern Metallographic Techniques and their Applications, Wiley Eastern, 1971.
4.	Angelo, P. C., Materials Characterization, Reed Elsevier India Pvt Ltd, Haryana, 2013.

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom's Taxonomy Mapped**
CO1	:	Discuss the principles of metallurgical microscope, optical properties and various illumination techniques.	L2: Understanding
CO2	:	Analyze the various diffraction methods, X-ray diffractometer and determination of crystal parameter.	L4:Analysing
CO3	:	Discuss the principles of TEM, SEM, EPMA.	L2: Understanding
CO4	:	Explain various spectroscopic techniques,	L2: Understanding
CO5	:	Discuss the chemical and thermal analysis using advanced methods.	L2: Understanding

COURSE ARTICULATION MATRIX

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	1	`1		1	1								1		1	
CO2	1	1	1	1		1							1			1
CO3	1		1			1	1					1	1			1
CO4	1	1		1	1							1	1			1
CO5	1	1		1	1								1		1	
Avg.	1.0	1.0	1.0	1.0	1.0	1.0	1.0					1.0	1.0		1.0	1.0
3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)																

18MTM07	AUTOMOTIVE, AEROSPACE AND DEFENCE MATERIALS		Semester			
PREREQUISITES			OE	Credit		3
Engineering physics		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives

1	To understand the properties and applications various materials suitable for automobile, aircraft and defnce industries and its components.

Unit I	**MATERIALS FOR ENGINES AND TRANSMISSION SYSTEMS**	**9**	**0**	**0**	**9**

Materials selection for IC engines: Piston, piston rings, cylinder, Engine block, Connecting rod, Crank shaft, Fly wheels, Gear box, Gears, Splines, Clutches.

Unit II	**MATERIALS FOR AUTOMOTIVE STRUCTURES**	**9**	**0**	**0**	**9**

Materials selection for bearings, leaf springs, chasis & frames, Bumper, shock absorbers, wind screens, panels, brake shoes, Disc, wheels, differentials , damping and antifriction fluids, Tyres and tubes. Materials for electronic devices meant for engine control, ABS, Steering, Suspension, Sensors, anti-collision, Anti-fog, Head lamps.

Unit III	**AEROSPACE METALS AND ALLOYS**	**9**	**0**	**0**	**9**

Types of corrosion – Effect of corrosion on mechanical properties – Stress corrosion cracking – Corrosion resistance materials used for space vehicles. Heat treatment of carbon steels – aluminium alloys, magnesium alloys and titanium alloys – Effect of alloying treatment, heat resistance alloys – tool and die steels, magnetic alloys, powder metallurgy- application of materials in Thermal protection systems of Aerospace vehicles – super alloys

Unit IV	**CERAMICS AND COMPOSITES**	**9**	**0**	**0**	**9**

Introduction – physical metallurgy – modern ceramic materials – cermet - cutting tools – glass ceramic –production of semi-fabricated forms - Plastics and rubber – Carbon/Carbon composites, Fabrication processes involved in metal matrix composites - shape memory alloys – applications in aerospace vehicle design.

Unit V	**NUCLEAR WASTE AND RADIATION PROTECTION, IRRADIATION EFEFCTS**	**9**	**0**	**0**	**9**

Introduction-unit of nuclear radiation-Types of waste –disposal –ICRP recommendations-radiation hazards and prevention –radiation dose units - Irradiation Examination of Fuels, Irradiation behaviour of metallic uranium – irradiation growth, thermal cycling, swelling, adjusted uranium, blistering in uranium rods. Irradiation effects in ceramic oxide and mixed oxide fuels, definition and units of burn up, main causes of fuel element failure in power reactors and remedies to avoid failures.

Total (45+0) = 45 Hours

Reference Books:

1.	ASM Handbook, “Selection of Materials Vol. 1 and 2”, ASM Metals Park, Ohio. USA, 1991.
2.	Materials Science and Engineering, Willium D. Callister, Jr. John Wiley & Sons publications Or Callister’s Materials Science and Engineering Adapted By R. Balasubramaniam, Wiley India, Edition -2010.
3.	Material Science and Engineering, V. Raghavan, Prentice Hall of India, 4th Edition.
4.	Engineering Metallurgy Applied Physical Metallurgy, R. A. Higgins, 6th Edition

5.	Gladius Lewis, "Selection of Engineering Materials", Prentice Hall Inc. New Jersey USA, 1995.
6.	Charles J A and Crane. F A. A., "Selection and Use of Engineering Materials", 3rd Edition, Butterworths, London UK, 1996
7.	ASM Handbook. "Materials Selection and Design", Vol. 20- ASM Metals Park Ohio.USA, 1997
8.	Cantor," Automotive Engineering: Lightweight, Functional, and Novel Materials", Taylor & Francis Group, London, 2006

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom's Taxonomy Mapped**
CO1	:	Describe the materials selection criteria for engine and transmission systems.	L2: Understanding
CO2	:	Analyze the different materials used for automotive structures and Different electronic materials for automotive applications.	L4:Analysing
CO3	:	Explain various topics such as elements of aerospace materials and mechanical behaviour of materials,	L2: Understanding
CO4	:	Compare the ceramics and composites of aerospace materials	L4:Analysing
CO5	:	Examine the fuels for nuclear materials.	L3:Applying

COURSE ARTICULATION MATRIX

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	1	1		1	1								1	1		
CO2	1	1	1			1							1	1		
CO3	1			1	1								1		1	
CO4	1	1	1				1						1			1
CO5	1	1		1	1								1			1
Avg.	1.0	1.0	1.0	1.0	1.0	1.0	1.0						1.0	1.0	1.0	1.0

3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)