BMS College of Engineering, Bangalore

ಬಿ.ಎಂ.ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ, ಬೆಂಗಳೂರು

(ಸ್ವಾಯತ್ತ ವಿದ್ಯಾ ಸಂಸ್ಥೆ)

ಬುಲ್ ಟೆಂಪಲ್ ರಸ್ತೆ, ಬೆಂಗಳೂರು – ೫೬೦ ೦೧೯

Department of Electronics and Telecommunication Engineering

(Earlier Telecommunication Engineering)

Scheme: III to VIII Semesters

Syllabus: III to VIII Semesters

For Batch Admitted 2021 onwards

Institute Vision

Promoting Prosperity of mankind by augmenting human resource capital through Quality Technical Education & Training

Institute Mission

Accomplish excellence in the field of Technical Education through Education, Research and Service needs of society

Department Vision

Our graduates shall be globally competent Engineering professionals

Department Mission

The department will achieve the Vision through:

- Curriculum designed for holistic development
- Effective implementation of the designed curriculum
- Active association with Industry, Academia and Alumni
- Research leading to publications/patent/start-up
- Emphasis on professional ethics, contribution to society and concern for environment

Program Educational Objectives

The Program Educational Objectives (PEOs) describe the professional accomplishments of our graduates about three-five years after having completed the under-graduate program in Telecommunication Engineering. We describe the progress of our graduates through four PEOs. The first PEO reflects their professional career pursued through the knowledge acquired either as employees or as entrepreneurs, the second PEO is focused on their desire to upgrade their technical skills, the third PEO describes their communication skills and team skills, while the fourth PEO describes their attitude through their concern for environment and society.

The PEOs of the program are as under:

PEO1	Graduates will compete on a global platform to pursue their professional career in Electronics and Telecommunication Engineering and allied disciplines
PEO2	Graduates will pursue higher education and/or engage in continuous up gradation of their professional skills
PEO3	Graduates will communicate effectively and will demonstrate professional behaviour while working in diverse teams
PEO4	Graduates will demonstrate high regard for human rights, have concern for society and environment

Program Outcomes (POs)

Program Outcomes (POs), are attributes acquired by the student at the time of graduation. The POs given in the Table below, are identical to the Graduate Attributes (GAs) specified by National Board of Accreditation (NBA), and are common across all branches of engineering. These attributes are measured at the time of Graduation, and hence computed every year for the outgoing Batch. The POs are addressed and attained through the Course Outcomes (COs) of various courses of the curriculum, and help in the attainment of the PEOs.

PO1	**Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation to the solution of complex engineering problems.
PO2	**Problem analysis:** Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern Tool Usage :**Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations
PO6	**The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.
PO8	**Ethics: Apply** ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning:** Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

Program Specific Outcomes (PSOs)

The Program Specific Outcomes (PSOs), are defined by the stakeholders of the program, and describe the skills in addition to the POs (defined by NBA), expected by the Telecommunication Engineering student at the time of graduation. Similar to the POs, they are addressed through the outcomes of the courses, however, they are exclusive to the branch. The PSOs are developed through the teaching-learning process of various courses of the curriculum. The National Board of Accreditation (www.nbaind.org), recommends having 2-4 PSOs for a program. After series of discussions with the stakeholders of the program, the Department of Telecommunication Engineering has arrived at three PSOs. Through these PSOs, we attempt to develop the ability to: (i) Build Electronic Systems, (ii) Build Communication Systems, (iii) Simulate systems using Engineering Tools and (iv) Holistic Personality.

At the time of graduation, the Telecommunication Engineers will have the ability to	
PSO1	**Build Electronic Systems** : formulate the problem, design, implement, analyze and demonstrate a feasible solution to the problem, using suitable electronic components
PSO2	**Build Telecommunication Systems** : design, implement, analyze and demonstrate the telecommunication system to receive and(or) transmit signals through the specified channel
PSO3	**Simulate Systems:** Develop, test, analyze and demonstrate algorithms to simulate Electronic systems / Telecommunication systems / Networking protocols using the specified Engineering Tool for services such as voice, data, image, and video transport
PSO4	**Holistic Personality:** Demonstrate research skill, entrepreneurial skill, written & oral communication skills, interpersonal skills, and negotiation skills together with the right emotional quotient and compliance to professional norms

Distribution of credits among various Curricular Components
(Batch Admitted 2021 onwards)

Curricular Component/Semester	I	II	III	IV	V	VI	VII	VIII	Total
Basic science Course(BS)	8	8	3	3			1		23
Engineering Science Course(ES)	10	10		4					24
Professional Core Course(PC)			16	11	15	11	7		60
Professional Elective Course(PE)					3	3	3	3	12
Open Elective Course(OE)						3	3	3	9
Project/Mini-Project(PW)					2	2	2	5	11+4=15
Seminar on Internship(SR)				1		1		2	
Humanities and Social sciences, Management Course(HS)	1	1	2	2	2	2		3	13
Ability Enhancement Course/Mandatory Course(AEC)	1	1	1	1					4
Non-Credit Mandatory Course(NCMC)	-	-	NC	NC	NC	NC	NC	NC	6 Units
Total credits	20	20	22	22	22	22	16	16	160

III Semester Scheme

Course Code	Course Title	Type	L:T:P	Credits	Hours	CIE	SEE	Total
22MA3BSTFN	Transform Calculus, Fourier Series and Numerical Techniques	BS	2:1:0	3	4	50	50	100
22ES3PCECA	Electric Circuit Analysis	PC	3:1:0	4	5	50	50	100
22ET3PCSSA	Signals and Systems: Analog	PC	3:1:0	4	5	50	50	100
22ET3PCALC	Analog and Linear Circuits	PC	3:0:1	4	5	50	50	100
22ES3PCDCS	Digital Circuits	PC	3:0:1	4	5	50	50	100
22ET3AEMCP	Mathematics Concepts using python	AE	0:1:0	1	2	50	50	100
22MA3HSUHV	Universal Human Values	HS	0:1:0	1	2	50	50	100
22MA3HSSAK/ 22MA3HSBAK	Samskrutika Kannada / Balake Kannada	HS	1:0:0	1	1	50	50	100
22ET3NCCLA	Cultural Activity	NCMC		P/NP	-			P/NP
Total			**15:5:2**	**22**	**29**	**400**	**400**	**800**

IV Semester Scheme

Course Code	Course Title	Type	L:T:P	Credits	Hours	CIE	SEE	Total
22MA4BSCPS	Complex Analysis, Probability and Statistical Methods	BS	2:1:0	3	4	50	50	100
22ET4PCSSD	Signals and Systems: Digital	PC	2:1:0	3	4	50	50	100
22ET4PCCS1	Communication Systems-1	PC	3:0:1	4	5	50	50	100
22ES4PCAPP	ARM Processor and Programming	PC	3:0:1	4	5	50	50	100
22ES4ESCST	Control Systems	ES	3:1:0	4	5	50	50	100
22ET4AEDPY	Data Science using Python	AE	0:1:0	1	2	50	50	100
22ET4SRIN1	Seminar- Internship involving Social Activity	INT	0:0:1	1	2	50	50	100
22CV4HSEVS	Environmental Studies	HS	1:0:0	1	1	50	50	100
22MA4HSCPH	Constitution of India, Professional Ethics and Human Rights	HS	1:0:0	1	1	50	50	100
22ET4NCPYA	Physical Activity	NCMC	-	P/NP	-			P/NP
Total			**15:4:3**	**22**	**29**	**450**	**450**	**900**

V Semester Scheme

Course Code		Course Title	Type	L:T:P	Credits	Hours	CIE	SEE	Total
22ET5PCEM1		Electromagnetics	PC	3:1:0	4	5	50	50	100
22ET5PCSPM		Signal Processing for Multimedia	PC	2:1:0	3	4	50	50	100
22ET5PCCCN		Computer Communication Networks	PC	3:0:1	4	5	50	50	100
22ET5PCCS2		Communications Systems-2	PC	3:0:1	4	5	50	50	100
22ES5HSPMF		Project Management and Finance	HS	2:0:0	2	2	50	50	100
22ET5PE1	DD	Digital System Design	PE	3:0:0	3	3	50	50	100
	OC	Optical Fibre Communication							
	CA	Computer Architecture							
	DS	C++ and Data Structures							
22ET5PWMP1		Mini Project-1	PW	0:0:2	2	4	50	50	100
22ET5NCENI		Effective Negotiation With Emotional Intelligence	NCMC		P/NP				P/NP
Total				**16:2:4**	**22**	**28**	**350**	**350**	**700**

VI Semester Scheme

Course Code		Course Title	Type	L:T:P	Credits	Hours	CIE	SEE	Total
22ET6PCVLS		Fundamentals of VLSI	PC	3:0:1	4	5	50	50	100
22ET6PCWCN		Wireless and Cellular Networks	PC	3:0:1	4	5	50	50	100
22ET6PCTLA		Transmission Lines and Antennas	PC	2:1:0	3	4	50	50	100
22ES6HSIPL		Intellectual Property Rights And Cyber Law	HS	2:0:0	2	2	50	50	100
22ET6PE2	ES	Embedded System Design	PE	3:0:0	3	3	50	50	100
	SC	Satellite Communication							
	IT	Internet of Things							
	OS	Operating System							
22ET6OE1	CN	Computer Communication Networks	OE	3:0:0	3	3	50	50	100
	DS	Distributed Systems							
	OR	Operation Research							
22ET6SRIN2		Internship Based Seminar	INT	0:0:1	1	2	50	50	100
22ET6PWMP2		Mini Project-2	PW	0:0:2	2	4	50	50	100
22ET6NCPDC		Personality Development, Aptitude And Communication Skills	NCMC		P/NP				
Total				**16:1:5**	**22**	**28**	**400**	**400**	**800**

VII Semester Scheme

Course Code		Course Title	Type	L:T:P	Credits	Hours	CIE	SEE	Total
22ES7BSBFE		Biology for Engineers	BS	1:0:0	1	1	50	50	100
22ET7PCMWR		Microwaves and Radar	PC	3:0:1	4	5	50	50	100
22ET7PCSTN		Sustainable Telecom Networks	PC	0:1:0	1	2	50	50	100
22ET7PCSIE		Signal Integrity and EMI/EMC	PC	2:0:0	2	2	50	50	100
22ET7PE3	AD	ASIC Design	PE	3:0:0	3	3	50	50	100
	CV	Computer Vision							
	NS	Cryptography & Network Security							
	DS	Data Science							
22ET7OE2	CY	Cryptography	OE	3:0:0	3	3	50	50	100
	CH	Communication in Health Care							
	LA	Linear Algebra							
22ET7PWRER		Project Based on Identified Research Work	PW	0:0:2	2	4	50	50	100
22ET7NCMC1		MOOCs/ Virtual Lab with certification	NCMC	-	P/NP		-	-	P/NP
Total				**12:1:3**	**16**	**20**	**350**	**350**	**700**

VIII Semester Scheme

Course Code		Course Title	Type	L:T:P	Credits	Hours	CIE	SEE	Total
22ES8HSIFE		Innovation for Entrepreneurship	HS	2:0:0	2	2	50	50	100
25MA8HSIKL		Indian Knowledge System	HS	1:0:0	1	1	50	50	100
22ET8PE4	LV	Low Power VLSI	PE	3:0:0	3	3	50	50	100
	SN	Adhoc and Sensor Networks							
	BS	Block Chain & Cyber Security							
	AI	Machine Learning & Artificial Intelligence							
22ET8OE3	NS	Network Security	OE	3:0:0	3	3	50	50	100
	SC	Principles of Satellite Communication							
	NM	Numerical Methods							
22ET8SRIN3		Seminar based on Internship	INT	0:0:2	2	4	50	50	100
22ET8PWMPJ		Major Project	PW	0:0:5	5	10	50	50	100
22ET8NCMC2		MOOCs/ Virtual Lab with certification	NCMC		P/NP				P/NP
		Details of 100 AICTE Activity Points Earned							P/NP
Total				**9:0:7**	**16**	**23**	**300**	**300**	**600**

Program Electives

Domain Area	Program Elective-1 (V Sem)	Program Elective-2 (VI Sem)	Program Elective-3 (VII Sem)	Program Elective-4 (VIII Sem)
VLSI	Digital System Design 22ET5PE1DD	Embedded System Design 22ET6PE2ES	ASIC Design 22ET7PE3AD	Low Power VLSI 22ET8PE4LV
Communication	Optical Fiber Communication 22ET5PE1OC	Satellite Communication 22ET6PE2SC	Computer Vision 22ET7PE3CV	Adhoc and Sensor Networks 22ET8PE4SN
Networking	Computer Architecture 22ET5PE1CA	Internet of Things 22ET6PE2IT	Cryptography & Network Security 22ET7PE3NS	Block Chain & Cyber Security 22ET8PE4BS
Programming Skills	C++ and Data Structures 22ET5PE1DS	Operating System 22ET6PE2OS	Introduction to Data Science 22ET7PE3DS	Machine Learning & Artificial Intelligence 22ET8PE4AI

Open Electives

Domain Area	Program Elective-1 (VI Sem)	Program Elective-3 (VII Sem)	Program Elective-4 (VIII Sem)
Cyber Security	Computer Communication Networks 22ET6OE1CN	Cryptography 22ET7OE2CY	Network Security 22ET8OE3NS
Communication	Distributed Systems 22ET6OE1DS	Communication in Health Care 22ET7OE2CH	Principles of Satellite Communication 22ET8OE3SC
Mathematical	Operation Research 22ET6OE1OR	Linear Algebra 22ET7OE2LA	Numerical Methods 22ET8OE3NM

III Semester

Course Title	Transform Calculus, Fourier Series And Numerical Techniques				
Course Code	22MA3BSTFN	Credits	3	L:T:P	2:1:0
(COMMON TO ALL BRANCHES EXCEPT CS, IS AND AI& ML)		Pedagogy: 30 Lectures+ 10Tutorial sessions			

COURSE OBJECTIVES: The purpose of the course is to facilitate the learners to:

- Appreciate the importance of Series, Transforms and Numerical Techniques in Engineering Problems.
- Acquire the knowledge of Series, Transforms and Numerical Techniques to apply them in their core domain.
- Improve their Mathematical thinking and acquire skills required for sustained lifelong learning.

TEACHING-LEARNING PROCESS (General Instructions):

These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Encourage the students for group learning to improve their creative and analytical skills.

MODULE - I

LAPLACE TRANSFORMS:

Definition and Laplace transforms of elementary functions (statements only). Problems on Laplace transform of $e^{at} f(t)$, $t^n f(t)$, $\frac{f(t)}{t}$. Laplace Transforms of derivatives and integrals, Laplace Transform of periodic functions (statement only) and unit-step function –problems. Inverse Laplace transforms definition and problems, solution of differential equations.

Teaching-Learning Process	Chalk and talk method / Power Point Presentation

MODULE - II

FOURIER SERIES:

Introduction to infinite series, convergence and divergence. Periodic functions, Dirichlet's condition. Fourier series of periodic functions with period 2π and arbitrary period. Complex Fourier series. Practical harmonic analysis.

Teaching-Learning Process	Chalk and talk method / Power Point Presentation

MODULE - III

FOURIER TRANSFORMS:

Definition and problems on Fourier Transform. Fourier sine and cosine transforms – Problems. Inverse Fourier transform, Inverse Fourier cosine and sine transforms - Problems. Convolution theorem (only statement) – problems.

Teaching-Learning Process	Chalk and talk method / Power Point Presentation

MODULE - IV

NUMERICAL SOLUTIONS OF PDE:

Classification of second-order partial differential equations, finite difference approximation of derivatives. Solution of one-dimensional heat equation by Schmidt explicit formula and Crank-Nicholson method. Solution of one-dimensional wave equation using explicit three level formula and implicit scheme.

Teaching-Learning Process	Chalk and talk method / Power Point Presentation

MODULE - V

CALCULUS OF VARIATIONS: **[08 hours]**

Definition, Variation of a functional, Euler's equation, variational problems.

Applications: Hanging cable problem, Brachistochrone problem.

Z-TRANSFORMS: Definition, Standard Z-transforms, Damping rule, Shifting rule, Initial value and final value theorems-problems. Inverse Z-transform and applications to solve difference equations.

Teaching-Learning Process	Chalk and talk method / Power Point Presentation

Course outcomes (Course Skills Set)

After successfully completing the course, the student will be able to understand the topics:

Course Code	CO	COURSE OUTCOME (CO)	PO	Strength
22MA3BSTFN	CO 1	Apply the concepts of Transform Techniques, optimization and Finite Difference Methods to solve engineering problems.	1	3
	CO 2	Analyze the solution of differential equations using Transform Techniques, optimization and Finite Difference Methods	1	1
	CO 3	Demonstrate the importance of Transform Techniques, optimization and Finite Difference Methods in engineering using Programing tools.	5,9,10	1

Assessment Details (both CIE and SEE)

Component	Type of assessment	Max. Marks	Total	50 % Weightage	Total
CIE – Theory	Quiz	10	100	5	50
	AAT	10		5	
	Test 1	40		20	
	Test 2	40		20	
	Test 3	40		20	
SEE	End Exam	100		50	

Two best scores out of the three tests will be considered for CIE.

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

SEMESTER END EXAMINATION:

- Each unit consists of one full question.
- Five full questions to be answered.
- To set one question each from Units 2, 3 & 4 and two questions each from Unit 1 and Unit 5.

TEXT BOOKS:

1. B. S. Grewal: "Higher Engineering Mathematics", Khanna publishers, 44th Ed.2018
2. E. Kreyszig: "Advanced Engineering Mathematics", John Wiley & Sons, 10th Ed. (Reprint), 2016.

REFERENCE BOOKS:

1. B.V. Ramana: "Higher Engineering Mathematics", McGraw-Hill Education, 11th Ed.
2. Srimanta Pal & Subodh C. Bhunia: "Engineering Mathematics "Oxford University Press, 3rd Reprint, 2016.
3. N. P Bali and Manish Goyal: "A textbook of Engineering Mathematics", Laxmi Publications.

4. C. Ray Wylie, Louis C. Barrett: "Advanced Engineering Mathematics", McGraw–Hill Book Co. New York, 6th Edition.
5. Gupta C.B, Sing S. R. and Mukesh Kumar: "Engineering Mathematic for Semester I and II", Mc- Graw Hill Education (India) Pvt. Ltd 2015.
6. H. K. Dass and Er. Rajnish Verma: "Higher Engineering Mathematics", S. Chand Publication (2014).
7. James Stewart: "Calculus" Cengage publications, 7th edition, 4th Reprint 2019.

E books and online course materials:

1. http://www.class-central.com/subject/math(MOOCs)
2. http://academicearth.org/
3. http://www.bookstreet.in.
4. VTU e-Shikshana Program
5. VTU EDUSAT Program

Course Title	Electric Circuit Analysis				
Course Code	22ES3PCECA	Credits	4	L:T:P	3:1:0
Pedagogy: 40 Lectures+ 10Tutorial sessions					
MODULE - I					
Basic Concepts of Circuits and analysis: Practical sources, Source transformations, Loop and node analysis with linearly dependent and independent sources for DC and AC circuits, Analysis of network involving concepts of super node, super mesh. Network reduction using Star to Delta transformation and Delta to Star transformation					
MODULE - II					
Network Topology and Series and Parallel Resonance: Graph of a network, Concept of tree and Co-tree, Incidence matrix, tie-set, tie-set schedule & cutset, cut-set schedule, Formulation & solution of equilibrium equations. Resonant Circuits: Series and parallel resonance, Frequency response of series and parallel circuits, Q factor, Bandwidth.					
MODULE - III					
Network Theorems: Superposition, Reciprocity, Millman's, Thevenin's and Norton's theorems; Maximum power transfer theorem.					
MODULE - IV					
Transient Behaviour and Initial Conditions: Behaviour of circuit elements under switching condition and their representation, Evaluation of Initial and final conditions in RL, RC and RLC circuits for DC conditions. Review of Laplace transforms, Waveform Synthesis, Initial and Final value theorems, Step, Ramp and Impulse responses, solution of simple R-L, R-C, R-L-C networks for DC excitations using Laplace transforms.					
MODULE - V					
Two Port Network Parameters Definition of Z, Y, T and h parameters, symmetric and reciprocity conditions, modelling of two port network parameters, relationship between parameters sets.					

TEXT BOOKS:

1. "Network Analysis", M.E.Vanvalkenburg, PHI/ Pearson Education, 3rd Edition. Reprint 2002.
2. " Network and systems ", Roy Choudhury, 2nd edition, 2006 reprint, New Age International Publications.
3. Theory and Problems of Electric Circuits, Schaum's Series, 2nd Edition McGraw Hill.

REFERENCE BOOKS:

1. "Engineering Circuit Analysis", Hayt, Kemmerly and Durbin, TMH 6th 2002.
2. "Network analysis and Synthesis", Franklin F. Kuo, Wiley Edition.
3. "Analysis of Linear Systems", David K. Cheng, Narosa Publishing House, 11th reprint, 2002.
4. "Circuits", Bruce Carlson, Thomson learning, 2000. Reprint 2002.
5. "Network analysis and Synthesis", D. Anand Kumar, PHI Learning, 2019.

E Books:

1. Nptel.ac.in/courses/108105065- Networks signals and systems by Prof T.K. Basu, IIT Kharagpur.
2. Nptel.ac.in/courses/108102042- Circuit Theory by Prof Dutta Roy S.C, IIT Delhi
3. www.electrodiction.com/circuit-theory.

MOOCs:

1. https://swayam.gov.in/nd1_noc19_ee36/preview
2. http://elearning.vtu.ac.in/06ES34.html
3. https://www.coursera.org/course/circuits

Course Outcomes:

At the end of the course, students will have the

CO1	Ability to define, understand and explain concepts related to electrical circuits		PSO3(3)
CO2	Ability to apply the knowledge of KVL, KCL, Graph Theory and network theorems to the given electrical circuit to obtain the desired parameter	PO1(3)	
CO3	Ability to analyze given electrical circuit to arrive at a suitable conclusion	PO2(3)	
CO4	Ability to conduct experiments to demonstrate the specified concept/ application of electrical circuit on the Multisim platform	PO1(3) PO5(3)	
CO5	Ability to analyse the given electrical circuit on the Multisim platform to compute the desired parameter	PO2(2) PO5(2)	

Course Title	Signals and Systems: Analog				
Course Code	22ET3PCSSA	Credits	4	L:T:P	3:1:0
Pedagogy: 40 Lectures+ 10Tutorial sessions					

MODULE - I

SIGNALS

Signal definition; signal classification; Elementary signals; Signal transformation of independent and dependent variable; Random Signals; Statistical averages;

SYSTEMS

System definition; system classification; The Linear Time Invariant (LTI) system; Testing a given system for linearity;

MODULE - II

SIGNALS: Time Domain Representation

Impulse response; Properties of impulse response; Measurement techniques for impulse response and step response of practical circuits;

The convolution integral; Methods of evaluating the convolution integral; Correlation; Auto-correlation; Cross-correlation; Hilbert Transform; Representation of signals in terms of a set of orthogonal functions; Orthonormal and Orthogonal signals;

MODULE - III

SIGNALS: Frequency Domain Representation

Fourier Transform of continuous time non-periodic signals; Properties of Fourier Transform; Fourier series of continuous time periodic signals; The Fourier transform of periodic signals; Magnitude Spectrum; Phase Spectrum; Spectrum of sum of signals; Spectrum of product of signals; Spectrum of periodic signals; Energy Spectral Density; Power Spectral Density; Band-pass signals; in-phase and quadrature-phase components; Canonical representation of band pass signals

MODULE - IV

LTI Systems: Representation And Classification

The constant coefficient differential equation; Impulse Response; Relating the Fourier Transform to the Laplace Transform; System Transfer Function; Pole-zero plot; Frequency Response; Block Diagram representation;

MODULE - V

LTI Systems: Design And Analysis

Ideal filters; Butterworth Filters; Butterworth Polynomials; Design of prototype Butterworth filters; Frequency transformation; Practical implementation of Butterworth filters; Filtered output for deterministic signals; Filtered output for random processes;

Tutorial Sessions: Tutorial sessions shall include numerical examples in the classroom; numerical examples implemented in the laboratory using discrete components; using electronic circuit simulation software (Multisim); using Python (an open source programming tool)

Course Outcomes:

At the end of the course, students will have the

CO1	Ability to **obtain** the specified parameter/representation for the given continuous time signal/system using time domain, frequency domain and transform domain representation	**PO1 (3)**	**PSO1(3)** **PSO3(3)**
CO2	Ability to **analyse and classify** the given signal/system using time domain, frequency domain and transform domain representation	**PO2(3)**	
CO3	Ability to **design** analog Butterworth filters to meet given specifications	**PO3(2)**	
CO4	Ability to **conduct investigation** through implementation of the experiment, to represent/model the given signal/system	**PO4(1)**	
CO5	Ability to design, formulate, implement and demonstrate an application of an identified concept(s) of the course, through an **Open-Ended experiment** using discrete components/ Multisim/ Python	**PO5(1)**	
CO6	Ability to make an **oral presentation** of the application concepts of the course for transmission of audio /image/ video/ data signal for benefit of society	**PO6(1)** **PO10(1)** **PO12(1)**	

TEXT BOOKS:

1. 'Signals & Systems', Simon Haykin and Barry Van Veen, John Wily and Sons
2. 'Integrated Electronics', by Jacob Millman and Christos C Halkias, Tata McGraw Hill Edition

REFERENCE BOOKS:

1. H. P Hsu, R. Ranjan, "Signals and Systems", Scham's outlines, TMH, 2006
2. B. P.Lathi, "Linear Systems and Signals", Oxford University Press, 2005
3. Ganesh Rao and SatishTunga, "Signals and Systems", Sanguine Technical Publishers, 2004

E-Books:

1. NPTEL lecture Video on Signals and Systems by Prof. S.C.Dutta Roy, http://www.satishkashyap.com/2012/04/iit-video-lectures-on-signals-and.html
2. NPTEL lecture Video on Signals and Systems by Prof. T.K. Basu,IIT Kharagpur. http://www.nptel.ac.in/courses/108105065/
3. NPTEL on line Course Modules–IIT Bombay –Signals and Systems http://www.cdeep.iitb.ac.in/nptel/Electrical%20&%20Comm%20Engg/Signals%20and%20System/TOC-M1.html

MOOCs:

1. Analog Filters Part A: https://youtu.be/C7AAYVCAeNU
2. Analog Filters Part B: https://youtu.be/rn2PxSlJ3iI
3. Analog Filters Part C: https://youtu.be/9bFdx7PaYiw
4. Analog Filters Part D: https://youtu.be/YeYGyROhN_w
5. 'Signals and Systems', VTU-EDUSAT, P10,
6. http://117.239.61.113/econtent/courses/ECE/06EC44/index.php
7. https://bmsce.ac.in/Content/TE/Butterworth_filters.pdf
8. https://bmsce.ac.in/Content/TE/Fourier_series_Examples.pdf
9. https://bmsce.ac.in/Content/TE/Fourier_Transform_Examples_and_Properties.pdf
10. https://bmsce.ac.in/home/contentView/Electronics-and-Telecommunication-Engineering/TE/19

Course Title	Analog and Linear Circuits				
Course Code	22ET3PCALC	Credits	4	L:T:P	3:0:1

Pedagogy: 40 Lectures+ 10 Practical sessions

MODULE - I

Diode Applications: clippers, Clampers.
Bipolar Junction Transistor (BJTs): DC biasing– Introduction, operating point, voltage divider Bias configuration ,Biasing using a collector to base feedback resistor,

BJT AC Analysis: Introduction, Application in the AC Domain, BJT Transistor Modeling, Voltage Divider Bias, BJT Frequency Response.

MODULE - II

Feedback concepts: Feedback connection types- Voltage series, Voltage-shunt, Current Series and Current Shunt Feedback.

Practical feedback Circuits: Voltage series, Current series feedback and voltage Shunt feedback.
Power Amplifiers: Introduction- Definitions and Amplifier Types, Amplifier Efficiency Series-Fed Class A Amplifier: DC Bias Operation, AC operation, Power Consideration, Efficiency.
Transformer coupled Class A Amplifier: Operation of Amplifier Stage : DC load line, Quiescent operating point, AC load line , Signal Swing and Output AC power.

Class B operation: Class B Amplifier Circuits, Transformer coupled Push-Pull Circuits, Complementary Symmetry Circuits and Amplifier Distortion

MODULE - III

MOSFETS: Biasing in MOS amplifier circuits---Biasing by fixing VGS, Biasing by fixing VG and connecting a resistor in the source , Biasing using a drain to gate feedback resistor, biasing using a current source.
Single stage MOS amplifiers: The basic structure, characterizing amplifiers, The CS amplifier, The CS amplifier with a source resistance, Common gate (CG) Amplifier, The common Drain or source follower Amplifier

MODULE - IV

Introduction to Operational amplifiers: Op-amp AC and DC Amplifiers, concept of negative feedback and virtual short, analysis of simple operational amplifier circuits, Frequency response of amplifiers, instrumentation amplifiers, current and voltage sources, Precision Rectifiers, comparators

MODULE - V

Data Converters and Timers: DAC-weighted resistor and R-2R ladder, ADC-Successive approximation type applications, Dual slope ADC,Delta-Sigma ADC,Flash ADC. Timers: Functional block diagram of 555, Applications: Astable and Monostable multivibrators, Phase locked loop.

List of Experiments

1. Diode clipping circuits- Single/Double ended
2. Diode clamping Circuits – Positive clamping/negative clamping
3. Performance analysis of Transistor as a switch
4. Precision rectifiers: Half wave rectifier

5. Precision rectifiers: Full wave rectifier
6. To design and implement using Op-amp:
   (i)Inverting and non-Inverting ZCD
   (ii) Positive and negative Voltage level detectors
7. To design and implement using 555 timers:
   (i) Astable Multivibrator
   (ii) Monostable multivibrator
8. To design and implement 4-bit R-2R Digital to Analog Converter
9. To obtain the characteristics of MOSFET (using simulation tool/hardware)
10. To design and implement using Op-amp:Instrumentation amplifier

Course outcomes:

At the end of the course on **Analog and Linear Circuits** , the student will have the ability to

CO1	Ability to **define** ,**understand** and **explain** concepts related to diodes and transistors (BJTs and MOSFETs)	--	PSO1(3) PSO3(2)
CO2	Ability to **apply** the knowledge of network theorems to the given analog and linear circuit to obtain the desired parameter	PO1(3)	
CO3	Ability to **analyze** given analog and linear circuit to arrive at a suitable conclusion	PO2(3)	
CO4	Ability to **design** analog and linear circuit for given application and specifications	PO3(2)	
CO5	Ability to **design and conduct experiment** using analog and linear circuit for given application and specifications	PO3(2) PO5(3)	
CO6	Ability to **conduct** experiments to verify THREE parameters of the datasheet of the given electronic component	PO4(2) PO5(3)	
CO7	Ability to implement a **mini-project** to implement and demonstrate the **given problem** using suitable analog and linear circuit	PO2 (2) PO5 (2) PO9 (1)	

TEXT BOOKS:

1. Electronic Devices and Circuit Theory-Robert L. Boylestad and Louis Nashelsky-10thedition (Pearson Education)

2. Microelectronic Circuits-Theory and applications by Adel S. Sedra and Kenneth C.Smith 5th Edition (Oxford International Student Edition)

3. Linear Integrated circuits- D Roy Choudhury&Shail B Jain (New AgePublication)

REFERENCE BOOKS:

1. Electronic Devices and Circuits- Millman and Halkias, TMH

2. Electronic Devices and Circuits- David A Bell - PHI 4thedition

E Books:

1. ww.pyroelectro.com/edu/analog
2. http://freevideolectures.com/course/3020/circuits-for-Analog-System-Design

MOOCs:

1. https://www.mooc-list.com/course/electronic-systems-and-digital-electronics-uninettuno?static=true
2. http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-012-microelectronic-devices-and-circuits-spring-2009/

Course Title	DIGITAL CIRCUITS				
Course Code	22ES3PCDCS	Credits	4	L:T:P	3:0:1

Pedagogy: 40 Lectures+ 10 Practical sessions

MODULE - I

Introduction: Review of Boolean algebra, logic gates.

Simplification of Boolean functions: Three Variable, Four Variable-K– Maps, The Tabulation Method, Design with Basic gates, NAND gates and NOR gates.

Introduction to Verilog:

Structure of Verilog module, Operators, Data Types, Styles of Description. Introduction to test bench

MODULE - II

Arithmetic Circuits: Introduction, Half adder, Half subtractor, Full adder, Full subtractor, Parallel Adders; Carry Look Ahead Adder and Ripple carry adder, Decimal Adder.

Verilog Data flow description: Highlights of Data flow description, Structure of Data flow description.

MODULE - III

Combination Logic Circuits: Code conversion, Magnitude Comparator, Decoders, Multiplexers, Read Only memories (ROM), Programmable Logic Arrays (PLAs). Modeling using data flow description.

MODULE - IV

Sequential Logic Circuits:

The Basic Flip-flop circuit, Clocked Flip-flops, Triggering of Flip-flops: Master Slave Flip-Flops, Edge Triggered Flip Flops, Characteristic Equations, Conversion of flip-flops.

Verilog Behavioral description: Structure, Variable Assignment Statement, Sequential Statements, Loop Statements, Verilog Behavioral Description of Combinational and Sequential Circuits.

MODULE - V

Verilog Structural description: Highlights of Structural description, Organization of structural description, Structural description of Combinational and Sequential Circuits- Shift Registers, Ripple Counters, Synchronous Counters.

List of Experiments

Sl.No	Title of Experiment
1	Adders, Subtractors and Comparators
2	Applications of IC 7483
3	Multiplexers (using Gates and IC) and their applications.
4	Decoders/DeMultiplexers (using Gates and IC) and their applications.
5	BCD to Decimal decoder using 7-segment display.
6	Verification of MSJK Flip-flop (using Gates and IC 7476).
7	Asynchronous counters (using ICs 7476, 7490, 7493).
8	Synchronous Counters (using ICs 7476, 74190/74192).
9	Shift registers and their applications (using ICs 7476, 7495).

Course outcomes:

At the end of the course on **Digital Circuits** , the student will have the ability to

CO1	Apply the fundamentals of Boolean algebra, logic gates, and Boolean function simplification techniques to design efficient digital circuits.	PO1(3)	PSO1(3) PSO3(2)
CO2	Analyze and design combinational circuits such as adders, subtractors, multiplexers, decoders, and programmable logic devices using first principles of mathematics and engineering sciences.	PO2(3)	
CO3	Develop optimized combinational and sequential logic circuit designs using Verilog HDL for real-time digital applications.	PO3(3)	
CO4	Investigate and evaluate the performance of digital circuits through simulations and hardware implementation using Verilog-based descriptions.	PO4(2)	
CO5	Utilize modern CAD tools, hardware description languages, and digital simulation environments for modeling and verification of digital circuits.	PO5(3)	
CO6	Demonstrate the ability to manage digital circuit design projects using engineering and management principles in multidisciplinary settings.	PO11(2)	
CO7	Recognize the need for lifelong learning and staying updated with advancements in digital circuit design, FPGA implementation, and hardware description languages	PO12(2)	

TEXT BOOKS:

1. Digital Logic and Computer Design- M. Morris Mano, Prentice Hall – Pearson Education
2. Verilog HDL –Samir Palnitkar

Digital Principles and Design- Donald Givone, Tata Mc Graw Hill

REFERENCE BOOKS:

1. Digital Design : Principles and Practices 4th Edition, John F. Wakerly
2. Fundamental of Logic Design- Charles Roth Jr., Thomas Learning
3. Digital Logic Applications and principles- John Yarbrough, Pearson Education

HDL Programming VHDL and Verilog by Nazeih M Botros, 2009 reprint,Dreamtech press.

E-Books:

1. http://www.panstanford.com/pdf/9789814364591fm.pdf
2. https://easyengineering.net/digital-logic-and-computer-design-by-morris-mano/
3. https://www.sciencedirect.com/book/9780750645829/digital-logic-design
4. https://easyengineering.net/fundamentals-of-digital-circuits-by-anand-kumar/

Moocs:

1. https://nptel.ac.in/courses/108105113/

https://nptel.ac.in/courses/Verilog fundamentals

Course Title	MATHEMATICS CONCEPTS USING PYTHON				
Course Code	22ET3AEMCP	Credits	1	L:T:P	0:1:0
Pedagogy: 15 Lectures					

MODULE - I

Introduction to numpy; matplotlib; Plotting of Functions; The Text Editor for mathematical equations Elementary Functions; Calculus (Integration, Differentiation); Defining Functions; Develop Code for a given equation; Write the equation for a given code

MODULE - II

Discrete Probability distribution: Probability and Statistics; Discrete Probability Functions (Binomial, Poisson); Probability Functions; Cumulative distribution functions, covariance,correlation,joint probability distribution, Bayes Theorem.

MODULE - III

Continuous Probability distribution: Probability and Statistics; Continuous Probability Functions (Uniform, Normal, Exponential); Cumulative distribution functions, covariance, joint probability distribution, Central limit Theorem.

MODULE - IV

Generation of periodic signals from Fourier Series; Fourier Transform of signals (Periodic and Non-periodic)

MODULE - V

Differential equation; Pole-zero plot; Magnitude response; Impulse response; Step response; System classification;

Course Outcomes: ***At the end of the course, students will have the***

CO1	Ability to **develop the Python code** for a given mathematical equation, and represent in the specified format	**PO1 (3)** **PO5 (3)**	**PSO3(3)**
CO2	Ability to **analyse the Python code** to obtain the mathematical equation	**PO2(3)** **PO5 (3)**	
CO3	Ability to **develop the code** for representing the given mathematical equation in the text editor of Python, using relevant Latex code	**PO10(2)** **PO5 (3)**	
CO4	Ability to develop the Python code to **model** and represent the given analog system transfer function and **classify the system**	**PO3(3)** **PO4(3)** **PO5(3)**	

Text books:

1. Probability and Statistics (Schaum's Outline series)

References:

1. Python Tutorial, Release 3.7.0 by Guido van Rossum and the Python development team, 2018
2. Python Data Analytics, by Fabio Nelli, Apress

E-books:

1.https://colab.research.google.com/drive/1n1Oiz28iErVCNrB0wy3jT_0re0xRACkE?usp=sharing
2. https://colab.research.google.com/drive/1LqNaeegWDvO8LPlf4UeodI_jyfU09fQn?usp=sharing

MOOCS:

Essential Mathematics for Machine Learning; By Prof. Sanjeev Kumar, Prof. S. K. Gupta | IIT Roorkee

Course Title		Universal Human Values			
Course Code	22MA3HSUHV	Credits	1	L-T-P	0:1:0

Pedagogy: 15 Lectures

MODULE - I

Human values for Self-excellence – What is value?, The values for human integration, Golden silence, Peace and non-violence in thought, Word and Deed, Thought culture, individual and group activities.

MODULE - II

Integrating human values into life- Significant spiritual values - Health and Harmony with Nature,Truth and Wisdom, Love and Compassion, Creativity and Appreciation of Beauty, Peace and Justice, National Unity and Global Solidarity, Global Spirituality, Principles of communication -Heartful Communication, Principles of Self-management, individual and group activities.

MODULE - III

Self-transformation – Discover the personality, Heart based living, Healthy Life Style, Peak Performance, Mapping core values with Sustainable Development Goals, individual and group activities.

MODULE - IV

Live light - Character vs. Personality, Dealing with Stress, Time management, The Power of Pause, Empathy vs Sympathy, individual and group activities.

MODULE - V

Your destiny - Self-Awareness, Situational Awareness, Transforming Behaviour, Transformation Factors, Thoughts-Habits-Destiny, Science of Belief, Decision Making, individual and group activities.

Course Outcomes:

At the end of the course, students will have the

CO1	Conduct self-exploration and distinguish between values and skills, happiness and accumulation of physical facilities, the self and the body, Intension and Competence of an individual
CO2	Analyze the value of harmonious relationship based on trust and respect in personal and professional life
CO3	Examine the role of a human being in ensuring harmony in society and nature
CO4	Apply the understanding of ethics in life and profession

Reference Material

1. https://heartfulness.org/education/training-and-curriculum/
2. Conscious living content – available at: www.heartfulness.org/cmspublic
3. https://fdp-si.aicte-india.org/5day_onlineUHV.php
4. The 4-Part Nonviolent Communication (NVC) Process Developed by Marshall B. Rosenberg, Ph.D, available at http://www.nonviolentcommunication.com/aboutnvc/4partprocess.htm

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Course Title	ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ				
Course Code	22MA3HSSAK	Credits	1	L – T – P	1:0:0
CIE	50 Marks (100% weightage)		SEE	100 Marks (50% weightage)	

Course Outcomes:

After successfully completing the course, students will be able to understand the following topics:

Sl. No.	Course Outcomes	PO	PSO
CO1	ಕನ್ನಡ ಭಾಷೆ, ಸಾಹಿತ್ಯ ಮತ್ತು ಕನ್ನಡ ಸಂಸ್ಕೃತಿಯ ಪರಿಚಯವಾಗುತ್ತದೆ.	10	–
CO2	ಕನ್ನಡ ಸಾಹಿತ್ಯದ ಆಧುನಿಕಪೂರ್ವ ಮತ್ತು ಆಧುನಿಕ ಕಾವ್ಯಗಳು ಮತ್ತು ಸಂಸ್ಕೃತಿಯ ಬಗ್ಗೆ ಆಸಕ್ತಿ ಮೂಡುತ್ತದೆ.	10	–
CO3	ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯ, ಕನ್ನಡ ಭಾಷಾಭ್ಯಾಸ; ಸಾಮಾನ್ಯ ಕನ್ನಡ ಹಾಗೂ ಆಡಳಿತ ಕನ್ನಡದ ಪದಗಳ ಪರಿಚಯವಾಗುತ್ತದೆ.	9	–

ಘಟಕ – ೧

ಲೇಖನಗಳು:

೧. ಕರ್ನಾಟಕದ ಏಕೀಕರಣ: ಒಂದು ಅಪೂರ್ವ ಚರಿತ್ರೆ – ಜಿ. ವೆಂಕಟಸುಬ್ಬಯ್ಯ.

೨. ಆಡಳಿತ ಭಾಷೆಯಾಗಿ ಕನ್ನಡ – ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ ಮತ್ತು ಪ್ರೊ. ವಿ. ಕೇಶವಮೂರ್ತಿ.

ಘಟಕ – ೨

ಆಧುನಿಕ ಪೂರ್ವದ ಕಾವ್ಯಭಾಗ:

೧. ವಚನಗಳು: ಬಸವಣ್ಣ, ಅಕ್ಕ ಮಹಾದೇವಿ, ಅಲ್ಲಮಪ್ರಭು, ಚೇಡರ ದಾಸಿಮಯ್ಯ, ಆಯ್ದಕ್ಕಿ ಲಕ್ಕಮ್ಮ.

೨. ಕೀರ್ತನೆಗಳು: ಆದರಿಂದೇನು ಫಲ ಇದರಿಂದೇನು ಫಲ – ಪುರಂದರದಾಸರು
ತಲ್ಲಣಿಸದಿರು ಕಂಡ್ಯ ತಾಳು ಮನವೇ – ಕನಕದಾಸರು

ಘಟಕ – ೩

ಆಧುನಿಕ ಕಾವ್ಯಭಾಗ:

೧. ಕುರುಡು ಕಾಂಚಾಣ: ದ. ರಾ. ಬೇಂದ್ರೆ.

೨. ಹೊಸಬಾಳಿನ ಗೀತೆ: ಕುವೆಂಪು

ಘಟಕ – ೪

ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯ, ಕಥೆ ಮತ್ತು ಪ್ರವಾಸ ಕಥನ:

೧. ಡಾ. ಸರ್. ಎಂ. ವಿಶ್ವೇಶ್ವರಯ್ಯ: ವ್ಯಕ್ತಿ ಮತ್ತು ಐತಿಹ್ಯ: ಎ. ಎನ್. ಮೂರ್ತಿರಾವ್

೨. ಮೆಗಾನೆ ಎಂಬ ಗಿರಿಜನ ಪರ್ವತ: ಹಿ. ಚಿ. ಬೋರಲಿಂಗಯ್ಯ

ಘಟಕ – ೫

ವಿಜ್ಞಾನ ಮತ್ತು ತಂತ್ರಜ್ಞಾನ: ಕನ್ನಡ–ಕಂಪ್ಯೂಟರ್ ಶಬ್ದಕೋಶ

ಪಠ್ಯ ಪುಸ್ತಕ:

'ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ', ಡಾ. ಹಿ. ಚಿ. ಬೋರಲಿಂಗಯ್ಯ ಮತ್ತು ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ, ಪ್ರಸಾರಾಂಗ, ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ.

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Course Title	ಬಳಕೆ ಕನ್ನಡ				
Course Code	22MA3HSBAK	Credits	1	L – T – P	1:0:0
CIE	50 Marks (100% weightage)		SEE	100 Marks (50% weightage)	

Course Outcomes:

At the end of the course, students will have the ability to:

Sl. No.	Course Outcomes	PO	PSO
CO1	Create awareness regarding the necessity of learning local lan guage for a comfortable living and to know more about Kannada culture and literature.	10	–
CO2	Develop proper speaking, reading and writing skills in Kannada	10	–
CO3	Engage as a member of a team and enhance the skill in group com munication and presentation.	9	–

UNIT – I

1. Introduction, Necessity of learning a local language. Methods to learn the Kannada language.
2. Easy learning of a Kannada Language: A few tips. Hints for correct and polite conservation, Listening and Speaking Activities, Key to Transcription.
3. ವಯ್ಯಕ್ತಿಕ, ಸ್ವಾಮ್ಯ ಸೂಚಕ / ಸಂಬಂಧಿತ ಸರ್ವನಾಮಗಳು ಮತ್ತು ಪ್ರಶ್ನಾರ್ಥಕ ಪದಗಳು. Personal pronouns, Possessive forms, Interrogative words.

UNIT – II

1. ಗುಣ, ಪರಿಮಾಣ ಮತ್ತು ವರ್ಣ (ಬಣ್ಣ) ವಿಶೇಷಣಗಳು, ಸಂಖ್ಯಾವಾಚಕಗಳು Qualitative, quantitative and colour adjectives, numerals.
2. ಕಾರಕ ರೂಪಗಳು ಮತ್ತು ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯಗಳು, ಸಪ್ತಮಿ, ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯಗಳು (ಅ, ಅದು, ಅವು, ಅಲ್ಲಿ). Predictive forms, locative case.

UNIT – III

1. ಚತುರ್ಥಿ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯದ ಬಳಕೆ ಮತ್ತು ಸಂಖ್ಯಾವಾಚಕಗಳು Dative cases and numerals.
2. ಸಂಖ್ಯಾವಾಚಕಗಳು ಮತ್ತು ಬಹುವಚನ ನಾಮರೂಪಗಳು Ordinal numerals and plural markers.

UNIT – IV

1. ಅಪ್ಪಣೆ / ಒಪ್ಪಿಗೆ, ನಿರ್ದೇಶನ, ಪ್ರೋತ್ಸಾಹ ಮತ್ತು ಒತ್ತಾಯ ಅರ್ಥರೂಪ ಪದಗಳು ಮತ್ತು ವಾಕ್ಯಗಳು. Permission, Commands, Encouraging and Urging words (Imperative words and sentences)
2. 'ಇರು ಮತ್ತು ಇರಲ್ಲ' ಸಹಾಯಕ ಕ್ರಿಯಾಪದಗಳು, ಸಂಭಾವ್ಯ ಸೂಚಕ ಮತ್ತು ನಿಷೇಧಾರ್ಥಕ ಕ್ರಿಯಾ–ಪದಗಳು. Helping verbs "iru" and "iralla", corresponding future and negation verbs.

UNIT – V

1. ಕರ್ನಾಟಕ ರಾಜ್ಯ ಮತ್ತು ರಾಜ್ಯದ ಬಗ್ಗೆ ಕುರಿತಾದ ಇತರ ಮಾಹಿತಿಗಳು. Karnataka State and General Information about the state.

ಪಠ್ಯ ಪುಸ್ತಕ:

'ಬಳಕೆ ಕನ್ನಡ', ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ, ಪ್ರಸಾರಾಂಗ, ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ.

Course Title	CULTURAL ACTIVITY				
Course Code	22ET3NCCLA	Credits	0	L:T:P	-

The college provides opportunity for students to associate with a large number of Cultural activities.

Sample Affinity groups are listed below:

- Ninaad- Indian Music Team
- The Grove House- The Western Music Team
- Paramva- The Contemporary DanceTeam
- Danz Addix- The Western Dance Team
- Panache- The Fashion Team
- Pravrutti- The Theatre Team
- Photography Club
- Chirantana- Kannada Sangha
- Fine Arts Club
- Inksanity- The Literary Club
- Samskrithi Sambhrama – The Folk Dance Club
- VAK- The MCeeing Club
- Rotaract
- Bullz Racing
- TEDx BMSCE
- Quiz Club

Students regularly associated with ANY one of the above activities, and certified by the concerned faculty in-charge, shall be awarded a Pass Grade in the Course.

Students who are not associated with the above affinity groups, shall participate in cultural events organized by the department.

Course Outcomes: ***At the end of the course, students will have the***

CO1	Demonstrate artistic and creative skills by actively participating in cultural activities, fostering teamwork and leadership.	**PO9(3)**	
CO2	Develop communication and interpersonal skills through participation in events such as music, dance, theatre, literature, and public speaking.	**PO10(2)**	
CO3	Exhibit social responsibility and organizational skills by contributing to cultural events and community-driven initiatives.	**PO6(2)**	

IV Semester

Course Title	Complex Analysis, Probability And Statistical Methods				
Course Code	22MA4BSCPS	Credits	3	L:T:P	2:1:0
Pedagogy: 30 Lectures+ 10 Tutorial sessions					

Course Objectives:

- Provide insight into applications of complex variables, conformal mapping arising in potentialtheory, quantum mechanics, heat conduction and field theory.
- Special functions familiarize the Power series solution required to analyse the Engineering Problems.
- To have insight into Statistical methods, Correlation and regression analysis.
- To develop probability distribution of discrete and continuous random variables, Joint probability distribution occurs in digital signal processing, design engineering and microwave engineering.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

- In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied mathematical skills.
- State the need for Mathematics with Engineering Studies and Provide real-life examples.
- Support and guide the students for self–study.
- You will also be responsible for assigning homework, grading assignments and quizzes, anddocumenting students' progress.
- Encourage the students for group learning to improve their creative and analytical skills.
- Show short related video lectures in the following ways:
  - ✓ As an introduction to new topics (pre-lecture activity).
  - ✓ As a revision of topics (post-lecture activity).
  - ✓ As additional examples (post-lecture activity).
  - ✓ As an additional material of challenging topics (pre-and post-lecture activity).

As a model solution for some exercises (post-lecture activity).

MODULE - I

Review of a function of a complex variable, limits, continuity and differentiability. Analytic functions: Cauchy-Riemann equations in Cartesian and polar forms and consequences. Construction of analytic functions by Milne-Thomson method, Problems.

Complex integration: Line integral of a complex function, Cauchy's theorem and Cauchy's integral formula and problems.

Self-Study: Conformal transformations: Discussion of transformations: $w = z^2$, $w = e^z$, $w = z + 1/z$ ($z \neq 0$). Bilinear transformations- Problems (RBT Levels: L1, L2 and L3) Pedagogy: Chalk and Board, Problem based learning

MODULE - II

SPECIAL FUNCTIONS:

Series solution of Bessel's differential equation leading to $J_n(x)$ Bessel's function of the first kind, Properties, Orthogonality of Bessel's functions. Series solution of Legendre's differential equation leading to $P_n(x)$ Legendre polynomials. Rodrigue's formula (without proof), problems.

Self-Study: Recurrence Relations.

(RBT Levels: L1, L2 and L3) Pedagogy: Chalk and Board, Problem based learning

MODULE - III

STATISTICAL METHODS:

Correlation and regression-Karl Pearson's coefficient of correlation and rank correlation, problems. Regression analysis, lines of regression, problems. Curve Fitting: Curve fitting by the method of least squares, fitting the curves of the forms $y = ax + b$, $y = ax^b$ and $y = ax^2 + bx + c$.

Self-study: Angle between two regression lines, problems

(RBT Levels: L1, L2 and L3)

Pedagogy: Chalk and Board, Problem based learning

MODULE - IV

PROBABILITY DISTRIBUTIONS:

Review of basic probability theory. Random variables (discrete and continuous), probability mass and density functions. Mathematical expectation, mean and variance. Binomial, Poisson and normal distributions- problems (derivations for mean and standard deviation for Binomial and Poisson distributions only)-Illustrative examples.

Joint probability distribution: Joint Probability distribution for two discrete random variables, expectation, covariance and correlation.

Self-Study: Hiper Geometric Distribution, Exponential Distribution,

(RBT Levels: L1, L2 and L3)

Pedagogy: Chalk and Board, Problem based learning

MODULE - V

STATISTICAL INFERENCE:

Sampling Theory: Introduction to sampling distributions, standard error, Type-I and Type-II errors. Test of hypothesis for means, student's t-distribution, Chi-square distribution as a test of goodness of fit.

Self-Study: Paired t –test, F-test for ratio of variance.

(RBT Levels: L1, L2 and L3)

Pedagogy: Chalk and Board, Problem based learning

Course Outcomes: ***At the end of the course, students will have the***

CO1	Apply the concepts of complex variables, special functions, probability and statistics to solve engineering problems.	**PO1 (3)**	
CO2	Analyze the engineering data/problems using special functions, complex variables and statistical methods	**PO1(1)**	
CO3	Demonstrate the importance of complex variables, special functions and statistical methods using programing tools.	**PO5(1)** **PO9(1)** **PO10(1)**	

TEXT BOOKS:

- Higher Engineering Mathematics, B. S. Grewal Khanna Publishers 44th Edition, 2017.
- Advanced Engineering Mathematics, E. Kreyszig: John Wiley & Sons, 10th Ed. (Reprint), 2016.

REFERENCES:

- Advanced Engineering Mathematics C. Ray Wylie, Louis C.Barrett McGraw-Hill 6th Edition 1995.
- Higher Engineering Mathematics B. V. Ramana McGraw-Hill 11th Edition, 2010.
- A Text-Book of Engineering Mathematics N. P. Bali and Manish Goyal Laxmi Publications 2014.
- Advanced Engineering Mathematics Chandrika Prasad and Reena Garg Khanna Publishing, 2018.

E books and online course materials

- http://nptel.ac.in/courses.php?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicearth.org/
- http://www.bookstreet.in.
- VTU EDUSAT PROGRAMME – 20
- VTU e-Shikshana Program

Course Title	Signals and Systems: Digital				
Course Code	22ET4PCSSD	Credits	3	L:T:P	2:1:0
Pedagogy: 30 Lectures+ 10 Tutorial sessions					

MODULE - I

DIGITAL SIGNALS AND SYSTEMS

Digitals Signals; definition and classification; Elementary signals; Signal transformation of independent and dependent variable; Random Signals; Pseudo Random Binary Sequence (PRBS); System definition; system classification; The Linear Time Invariant (LTI) system; Testing a given system for linearity;

SAMPLING THEOREM

Sampling Theorem; statement and proof; converting a given analog signal to a digital signal; ideal sampling; natural sampling; sampling of band-pass signals;

MODULE - II

SIGNALS: TIME DOMAIN REPRESENTATION

Impulse response; Properties of impulse response; Impulse response of a given difference equation; The convolution sum; Methods of evaluating the convolution sum; Linear Convolution; Circular Convolution; properties of convolution sum; Correlation; Auto- correlation; Cross-correlation; Representation of signals in terms of a set of orthogonal functions; Orthonormal and Orthogonal signals; Gold Sequence

MODULE - III

SIGNALS: FREQUENCY DOMAIN REPRESENTATION

The Discrete Time Fourier Transform (DTFT); Discrete Fourier Transform (DFT); Properties of DFT; Methods of evaluating the DFT – overlap-add; overlap-save; The Fast Fourier Transform; Decimation in Time – Fast Fourier Transform; Decimation in Frequency – Fast Fourier Transform; Spectrum of analog signal; Spectrum of sampled signal; aliasing; up-sampling; down-sampling;

MODULE - IV

LTI SYSTEMS: REPRESENTATION and CLASSIFICATION

The constant coefficient difference equation; Impulse Response; Relating the Discrete Time Fourier Transform to the Z Transform; System Transfer Function; Pole-zero plot; Power Spectral Density; Frequency Response

LTI SYSTEMS: DESIGN and ANALYSIS

Ideal Filters; Finite Impulse Response (FIR) Filters; Design of FIR Filters using the Window Method; Design of FIR Filters using the Frequency Sampling Method; Implementation structure for FIR Filters – Linear Phase structure; Frequency Sampling Structure;

FIR filters for One-dimensional signals (data, bio - signals, audio signals); Spectrum of the signal; Filter specifications for desired output; design filter to meet specifications; obtain the filtered output; Rate conversion of an audio signal;

MODULE - V

LTI SYSTEMS: APPLICATIONS

Infinite Impulse Response (IIR) Filters; Design of IIR Butterworth Filters using Impulse Invariant method; Design of IIR Butterworth Filters using the Bilinear Transform; Implementation structure for IIR Filters- Direct Form-I and Direct Form-II;

Introduction to wavelet transforms; wavelet transforms for data compression; de-noising;

IIR filters for One-dimensional signals (data, bio - signals, audio signals); Spectrum of the signal; Filter specifications for desired output; design filter to meet specifications; obtain the filtered output; Rate conversion of an audio signal;

Two-dimensional signal; Image; Spectrum of the image; Low-pass filtered image; high-pass filtered image; compression of an image; de-noising an image.

Course Outcomes:

At the end of the course, students will have the ability to

CO1	Ability to **obtain** the specified parameter/representation for the given discrete time signal/system using time domain, frequency domain and transform domain representation	**PO1 (3)**	**PSO1(3)** **PSO3(3)**
CO2	Ability to **analyse and classify** the given signal/system using time domain, frequency domain and transform domain representation	**PO2(3)**	
CO3	Ability to **design** digital filters to meet given specifications, and use the filter for 1-dimensional signals, audio and 2-dimensional images	**PO3(3)**	
CO4	Ability to **conduct investigation** through implementation of the experiment, to represent/model the given signal/system	**PO4(1)** **PO5(2)**	
CO5	Ability to design, formulate, implement and demonstrate an application of signal processing **identified** during the seminar of the earlier Course on 'Signals and Systems: Analog', through a **Mini-project** using Python	**PO5(2)**	
CO6	Ability to make an **oral presentation** of the application digital Signal Processing for representation/ transmission of audio /image/ video/ data signal for benefit of society	**PO6(1)** **PO10(1)** **PO12(1)**	

Text books:

1. **Theory and application of Digital signal processing**, Lawrence R Rabiner and Bernard Gold, Prentice Hall, Easter Economy Edition
2. **Digital Signal Processing Concepts using Python,** B Kanmani, ISTE-WPLP, *(Book proposal accepted, work-in-progress)*

Reference books:

1. Fundamentals of Digital Signal Processing, Lonnie Ludeman, John Wiley & Sons; Wiley International 1st Edition, 1988.
2. Discrete-Time Signal Processing, Alan V. Oppenheim, Ronald W. Schafer, John R. Buck, Prentice-

Hall Signal Processing Series, 2nd Edition, 1999
3. Understanding Digital Signal Processing, Richard G. Lyons Prentice Hall, March 25, 2nd Edition 2004
4. Digital Signal Processing: Fundamentals and Applications, Li Tan, Academic Press, 1st edition 2007
5. Schaum's Outline of Digital Signal Processing, Monson Hayes, McGraw- Hill, 1st edition, 1998

E-books:

1. The scientist and engineers guide to DSP by Steven smith
2. http://www.dspguide.com/pdfbook.htm

MOOCS:

1. Sampling Theorem Part A: https://youtu.be/zJ-e3UxXSeo
2. Sampling Theorem Part B: https://youtu.be/Rbu7laRN6dM
3. Sampling Theorem Part C: https://youtu.be/sHCuHoibQAs
4. Sampling Theorem Part D: https://youtu.be/mtRwC1HPIno
5. https://bmsce.ac.in/home/contentView/Electronics-and-Telecommunication-Engineering/TE/83

Laboratory *Sessions:* *Laboratory sessions shall include time-domain, frequency domain representation of signals; design and analysis of FIR and IIR Filters; use of the designed filter to pass a given input and obtain the corresponding output; Signals of both one-dimensional and two-dimensional shall be considered. The programming tool shall be Python (an open source programming tool*

Course Title	Communication Systems-1				
Course Code	22ET4PCCS1	Credits	4	L:T:P	3:0:1
Pedagogy: 40 Lectures+ 10 Practical sessions					

MODULE I

Amplitude Modulation (AM): Introduction, AM: Time-Domain description, Frequency – Domain description. Generation of AM wave: square law modulator, switching modulator. Detection of AM waves: square law detector, envelop detector.

Double side band suppressed carrier modulation (DSBSC): Time-Domain description, Frequency Domain representation, Generation of DSBSC waves: balanced modulator, ring modulator. Coherent detection of DSBSC modulated waves.

MODULE II

Single Side-Band Modulation (SSB): Quadrature carrier multiplexing, Single side-band modulation, Frequency-Domain description of SSB wave. Phase discrimination method for generating an SSB modulated wave. Demodulation of SSB waves,

Vestigial Side-Band Modulation (VSB): Frequency – Domain description, Generation of VSB modulated wave, Time – Domain Canonical representation of VSB, Frequency translation, FDM: Frequency division multiplexing

MODULE III

Angle Modulation (FM): Basic definitions, FM, narrow band FM, wide band FM, transmission bandwidth of FM waves, generation of FM waves: indirect FM and direct FM. Demodulation of FM waves, FM stereo multiplexing, Phase-locked loop Noise in FM receivers, FM threshold effect, Pre-emphasis and De-emphasis in FM. Figure of merit of FM

MODULE IV

Introduction to Digital Communication: Block Diagram of Digital Communication System, TDM,Pulse-Digital Modulation: Elements of PCM, Noise in PCM systems, Quantization, Companding, T1 digital Hierarchy.

Base-band Data transmission: Elements of binary PAM, Baseband shaping, Optimum transmitting and receiving filters, Correlative coding, Eye pattern, Examples: Line coding

MODULE V

Signal Processing for Data Transmission: Gram-Schmidt Orthogonalization Procedure, Matched Filters, and Their Properties.

Band-Pass Data Transmission: Time and Frequency Domain Representation of ASK, FSK, and PSK; Generation and Detection; Performance Analysis: Power, Bandwidth, and Bit Error Rate.

Course Outcomes:

At the end of the course, the student will have the ability to,

CO1	Ability to define, understand and explain concepts of modulation, demodulation, time and frequency domain representation of analog and digital communication systems.		**PSO2(1)**
CO2	Ability to **apply** the knowledge of signal processing to obtain the time and frequency domain representation communication systems.	**PO1 (3)**	

CO3	Ability to **analyze** the concepts and related to analog and digital communication.	**PO2(2)**	
CO4	Ability to **conduct experiments** to demonstrate concepts related to analog and digital communication using suitable electronic components/Engineering Tool (Matlab).	**PO5(3)**	
CO5	Ability to make an effective **oral presentation** on broadcast standards, contribution to society, impact on health, effect on environment.	**PO10 (1)**	
CO6	Ability to perform in a team to **build an AM/FM** receiver using discrete components and demonstrate the live reception	**PO4(1) PO5 (1)**	

List of Experiments

1. Analog filters;
2. Generation and demodulation of AM, DSB-SC,
3. Generation FM, pre-emphasis and de-emphasis
4. Generation of SSB (using Multisim)
5. Sampling Theorem verification
6. Generation of PAM, PWM, PPM, PAM-TDM
7. Generation of ASK, PSK
8. Demodulation of ASK, FSK, PSK

TEXT BOOKS:

1. An Introduction to Analog and Digital Communication, Simon Haykins, John Wiley, 2003
2. Digital Communications By Simon Haykins –John Wiley 2003

REFERENCE BOOKS:

1. Modern digital and analog Communication systems B. P. Lathi, 3rd ed 2005 Oxford University press.
2. Communication Systems, Harold P.E, Stern Samy and A Mahmond, Pearson Edn, 2004.
3. Communication Systems: Singh and Sapre: Analog and digital TMH 2nd , Ed 2007
4. Analog and Digital communications by Simon Haykins –John Wiley

MOOCs:

1.https://swayam.gov.in/nd1_noc19_ee46/preview

Course Title	ARM Processor and Programming				
Course Code	22ES4PCAPP	Credits	4	L:T:P	3:0:1
Pedagogy: 40 Lectures+ 10 Practical sessions					

MODULE I

Overview of computing systems: Basic structure of computers- function units of a computer, bus structure, performance of the processor, memory location and addresses, memory and I/O systems , basic processing unit, pipelining, computer peripherals

MODULE II

ARM Processor fundamentals -RISC and ARM Design philosophy, ARM core Dataflow model, programming model, processor states and operating modes, exceptions and interrupts, ARM pipeline, ARM instruction set, Assembler rules and Directives, load/store architecture, ARM-THUMB interworking, programming

MODULE III

Embedded C codes- overview of C compiler and optimization, Basic C data types, Local variable types, C looping and structures, Registrar allocation, function calls, pointer aliasing, Writing and optimizing assembly codes, mixing C and Assembly, programming, instruction scheduling

MODULE IV

Subroutines and stacks-introduction, stack, subroutines, passing parameters to Subroutines, Exception and interrupt handling- Vector Table, Exception priorities, link register offsets, interrupts. Interrupt handling schemes

MODULE V

Application of ARM controller LPC 2148: Memory map, memory and I/O mapped peripherals- ADC, DAC and UART, firmware and boot loader, introduction to Embedded Operating System

List of Experiments:

1. Divide an 8-bit variable into two 4 bit nibbles and store one nibble in each byte of a 16 bit variable. Store the disassembled byte in memory location (pointed by result)
2. Compare 2 values stored in memory location and store the higher value in a memory location (pointed by result)
3. Write a program to add two 64-bit numbers and store the result in a memory location.
4. Add a series of 16-bit numbers stored in sequential location in memory (called Table)and store the result in memory
5. Find the factorial of a given number
6. Write an assembly language program using the ARM instruction set to find the largest in a series of numbers stored in memory. Store the largest number in a memory location
7. ALP to multiply two 16 bit binary numbers.
8. ALP to find the sum of first 10 integer numbers.
9. Write a program in C for the ARM processor to read data from the 8-bit on board DIP switch and display the value on the 8 LEDs

10. Write a program in C for the ARM processor to use the built in DAC to generate the following waveforms - square, ramp, triangle and sine

11. Write a program in C for the ARM processor to rotate the stepper motor in both directions.

12. Establish serial communication between the ARM kit and the PC and do the following: Send a character from the ARM kit to the serial terminal on the PC Send a character from the PC to the ARM Kit and display it on the LED, Send a character from the PC to the ARM Kit. The program on the ARM processor should add 2 to it and send it back to the PC

Course Outcomes:

At the end of the course, students will have the ability to

CO1	Ability to understand and explain, the functional blocks of a computer and peripherals, performance of a processor, memory and I/O systems, ARM processor, interrupts and exceptions, Stacks and subroutines		
CO2	Ability to apply the knowledge of assembly/C code to develop assembly/embedded C programs to perform a specific task	**PO1(3)**	
CO3	Ability to analyse/debug the given code to perform a specific task	**PO2(2)**	
CO4	Ability to design and develop the logic to interface memory, I/O and peripherals to ARM controller	**PO3(3)**	
CO5	Ability to conduct experiments by simulating assembly and Embedded C code using IDE and interface the hardware modules to ARM development board and develop codes for specific applications	**PO5,PO9(3)**	
CO6	Ability to implement a mini-project to develop solutions to the given problem using simulation tools	**PO8(3),PO10(3) PO12(3)**	

TEXT BOOKS:

1. Computer Organization and Architecture, Carl Hamacher, Zvonko Vranesic, McGraw-Hill,2001
2. ARM System Developer's Guide, Sloss, Symes, WrightMorgan Kaufmann Publishers, Elsevier,2005
3. ARM Assembly Language- Fundamentals and Techniques, William Hohl, CRC press, Taylor and Frncis,2009

REFERENCE BOOKS:

1.Computer Organisation & Architecture , William Stallings, PHI , 2010
2.ARM System –on-Chip Architecture , Steve Furber, Seocnd Edition, Pearson, 2010

E- books:

https://www.pdfdrive.com/embedded-systems-introduction-to-arm-cortextm-m-microcontrollers-e176014882.html

MOOCS:

1. https://onlinecourses.nptel.ac.in/noc20_cs15
2. https://nptel.ac.in/courses/117106111

Course Title	Control Systems				
Course Code	22ES4ESCST	Credits	4	L:T:P	3:1:0

Pedagogy: 40 Lectures+ 10 Tutorial sessions

MODULE I

Introduction: Examples of Control Systems, open loop vs Closed loop Systems.
Mathematical Modeling of Linear Systems: Transfer functions, Mechanical Systems, Analogous Systems, Block diagram, Signal Flow graph, Transfer Functions of Lag & Lead Compensators.

MODULE II

Controllers & Time Response Analysis: Step response of first order, second order systems, response specification, steady state error and error constants. Effect of PI, PD and PID controllers on the time response of the system.

MODULE III

Stability Analysis: Concept of stability, RH criterion, applications of RH criterion with limitations.

Root locus technique: Introduction to root locus concepts, Construction rules, Analysis of stability by root locus plot

MODULE IV

Frequency Response Analysis: Frequency domain specification, Polar plots, Nyquist plot, Stability Analysis using Nyquist criterion, Bode plots, GM and PM, Relative stability

MODULE V

State Variable Analysis: Concept of state variables, physical variable model, phase variable model, canonical model, obtaining transfer function from state model.

List of experiments:

- Determine the overall transfer function of the a control system
- Determine rise time, peak time, peak overshoot and settling time for the given transfer function.
- To obtain and plot the Unit step, Unit ramp response of a closed loop control system.
- To obtain Nyquist diagram for given transfer function.
- Determine the root locus of the given characteristic equation for the given control system.
- Determine gain margin, phase margin, gain crossover frequency and phase crossover frequency for the given control system.

Design and analysis of controllers

Course Outcomes:

At the end of the course, students will have the ability to

CO1	Ability to **define, understand and explain** concepts related to linear control systems	--	PSO3(3)
CO2	Ability to **apply** the concepts of control systems and signal processing to obtain the specified parameter/ system function	PO1(3)	

CO3	Ability to **analyze** the given linear control system and arrive at a suitable conclusion	PO2(2)	
CO4	Ability to **conduct experiments** to demonstrate concepts related to linear control systems using the engineering tool: Matlab/ Simulink	PO1(3) PO5(3)	
CO5	Ability to **design** controllers to meet given specifications	PO3(2) PO5(2)	

TEXT BOOKS:

1. Control Engineering by Nagrath & Gopal, New Age International Publishers
2. Engineering control systems - Norman S. Nise, John WILEY & sons , fifth Edition

REFERENCE BOOKS:

1. Modern control Engineering-Ogata, Prentice Hall
2. Automatic Control Systems- B.C Kuo, John Wiley and Sons

E Books:

1. http://en.wikibooks.org/wiki/Control_Systems
2. http://www.electrical4u.com/control-system-closed-loop-open-loop-control-system/#practical-examples-of-open-loop-control-system
3. http://www.facstaff.bucknell.edu/mastascu/eControlHTML/CourseIndex.html

MOOCs:

1. https://swayam.gov.in/explorer
2. https://www.edx.org/course/

Course Title	Data Science using Python				
Course Code	22ET4AEDPY	Credits	1	L:T:P	0:1:0

Pedagogy: 15 Lectures

MODULE I

Introduction to Data Types in Python; Numpy; Matplotlib; Pandas; Functions; Probability and Statistics.

MODULE II

Introduction to Machine learning concepts – Bias/variance, over-fitting and train/test splits.
Types of Machine learning – Supervised, Unsupervised, Semi-supervised, Classification and Regression algorithms

MODULE III

Regression algorithms, Linear Regression, Logistic Regression algorithms, the concept, and implementation using Python.

MODULE IV

The Naïve Bayes Classifier for Discrete and Continuous Input; Decision Trees (for Discrete and Continuous Input and Output); the concept, and implementation using Python.

MODULE V

Kmeans Clustering; Regularization; Introduction to Neural Networks

Course Outcomes:

At the end of the course, students will have the

CO1	Ability to **develop the Python code** for a given Probability Distribution, and compute statistical averages for given data	**PO1 (3)** **PO5 (3)**	**PSO3(3)**
CO2	Ability to **analyse the Python code** to obtain the mathematical equation	**PO2(3)** **PO5 (3)**	
CO3	Ability to **develop the code** for representing the given mathematical equation in the text editor of Python, using relevant Latex code	**PO10(2)** **PO5 (3)**	
CO4	Ability to **develop the Python code** for the Data Science concept from the mathematical equation and verify the result using available built-in functions	**PO3(3)** **PO4(3)** **PO5(3)**	

TEXT BOOKS:

1. Data science from scratch (first principles with python) by Joel Grus, Oreilly, April 2015, 1st edition.

REFERENCE BOOKS:

1. Doing data science (straight talk from the front line) by Rachel Schutt and Cathy O Neil, Oreily, October 2013, 1st edition.

E-books:

1.Python Data Science Handbook *By Jake VanderPlas;*
*2.*https://jakevdp.github.io/PythonDataScienceHandbook/

MOOCS:

1.Python for Data Science , By Prof. Ragunathan Rengasamy , IIT Madras, NPTEL
https://onlinecourses.nptel.ac.in/noc22_cs32/preview

Course Title	SEMINAR-INTERNSHIP INVOLVING SOCIAL ACTIVITY				
Course Code	22ET4SRIN1	Credits	1	L:T:P	0:0:1

During semester breaks, students are encouraged to engage in community service, through an NGO or as an individual. The duration of the activity shall be of 4 to 6 week duration. The work carried out in the semester break is assessed through an oral seminar accompanied by a written report. It is expected that this association will motivate the student to develop simple Electronic (or other) products to make their life comfortable, through suitable projects in later semesters.

At the end of the course, the student will have the ability to,

CO1	Engage in community service	**PO6 (2)**
CO2	Prepare the project report, three minute video and the poster of the work	**PO10 (3)**
CO3	Identify and specify an engineering product that can make their life comfortable	**PO2 (1)**
CO4	Prepare a business plan for a commercial venture of the proposed product, together with complying to relevant norms	**PO7 (2)** **PO8 (3)** **PO11 (2)**
CO5	Identify the community that shall benefit from the product	**PO6 (2)**

Course Title	Environmental studies				
Course Code	22CV4HSEVS	Credits	1	L:T:P	1:0:0

COURSE OBJECTIVE: The students will be able to develop a sense of responsibility about the environment, natural resources, their conservation and Understand the concept, structure and function of different ecosystems and the ill effects of environmental pollution and other environmental issues like population growth, Acid rain, global warming etc.,

COURSE OUTCOME : *At the end of the course, the student will have the ability to,*

CO1: Discuss the components and impacts of human activities on environment.
CO2: Apply the environmental concepts for conservation and protection of natural resources.
CO3: Identify and establish relationship between social, economic and ethical values from environmental perspectives.

UNIT-I

Introduction to Environment

- Definition, about the Earth, Earth's Structure i.e. Atmosphere and its parts, Hydrosphere, Lithosphere and Biosphere.
- Ecology & Ecosystem, Balanced ecosystem, types of Ecosystem.

03 Hrs

UNIT-II

Human Activities on Environment

- Human activities - Food, Shelter, Economic and Social Security.
- Effects of Human activities on Environment:
  i) Agriculture,
  ii) Housing,
  iii) Industries,
  iv) Mining and
  v) Transportation activities.
- Environmental Impact Assessment (E I A)
- Sustainable development

03 Hrs

UNIT-III

Natural Resources

- Definition, Renewable and Non-Renewable sources.
- Major Natural Resources are -
  - Water resources, its availability, quality, water borne & water induced diseases,
  - Mineral resources, classification, uses in various Industries as byproducts.
  - Forest resources – causes & consequences of deforestation, various afforestation

programs.

- Conventional and Non-conventional energy resources -
  - Hydroelectric, Wind power, Solar, Biogas, geothermal energy.
  - Fossil fuel based energy resources – Coal, Oil & Gas, Nuclear power
  - Hydrogen as an alternate future sources of energy.

03 Hrs

UNIT-IV

Introduction, following are few types of pollutions to study -

- Water pollution - definition, types, sources, effects and control of water pollution.
- Land pollution - definition, types, sources, effects, Solid waste management.
- Noise pollution - definition, sources, effects & control of noise pollution.
- Air pollution - definition, sources, effects & control of air pollution.

03 Hrs

UNIT-V

Current Environmental Issues & Importance

- Population growth, effects & Control, Climatic changes,
- Global warming, Acid rain, Ozone layer depletion and its effects.
- Environmental protection – initiatives by Government and non–Govt. Organizations (NGO's), Role of Legal aspects.
- Environmental Education, Women education.

03 Hrs

Total contact hours = 15 (Weekly 1 Hr.)

C I E Marks: Conduct 3 Tests, considering best of 2. The pattern of Test paper consists of two parts. Part-A consists of 20 MCQs for 1 mark each; Part-B consists of 3 descriptive questions, 10 marks each. Student should answer 2 full questions from part-B. Two quizzes, each quiz is for 5 marks covering full syllabus.

TOTAL C I E MARKS: 20+20+10=50 MARKS

SEE QUESTION PAPER PATTERN

PART-A

- 20 Multiple Choice Questions Covering full syllabus
- 1 Mark each, students have to attend all questions

PART-B

- Consist of 4 main questions. It may be subdivisions of 3 or 4.
- Each question consists of 10 marks, covering full syllabus
- Student should answer only 3 full questions.

30 marks

SEE TOTAL MARKS: 20+30=50 MARKS

TEXT BOOKS:

1. Environmental studies by - Dr. Geetha Balakrishna (Revised Edition-Sun star publication)
2. Ecology by – Subramanyam (Tata McGraw Hill Publication)
3. Environmental studies by – Dr. J.P. Sharma (Fourth edition)
4. Environmental studies by – Smriti Srivastav (Published by Kataria & Sons)

REFERENCES:

1. Environmental studies by – Benny Joseph
2. Environmental studies by – Dr. D.L. Manjunath

LEARNING RESOURCES:

1. NPTEL (Open Sources / power point and visuals)
2. Ecological studies / IITR / Open Sources
3. Ministry of Environment and forest & wildlife.

MOOCs:

https://www.coursera.org / course / sustain

CO-PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2										
CO2	2	2										
CO3	1	1										

Course Title	Constitution of India, ProfessionalEthics and Human Rights				
Course Code	22MA4HSCPH	Credits	1	L:T:P	1:0:0

Pedagogy: 15 Lectures

MODULE I

Introduction to Indian Constitution

Framing of the Indian constitution: Role of the Constituent Assembly - Preamble and Salient features of the Constitution of India, Fundamental Rights and its limitations. Fundamental Duties and their significance. Directive Principles of State Policy: Importance and its relevance. Case Studies

MODULE II

Union Executive and State Executive

The Union Executive – The President and the Vice President, the Prime Minister andThe Council of Ministers. The Union Parliament – Lok Sabha & Rajya Sabha.

The Supreme Court of India.

State Executive – The Governors, the Chief Ministers and the Council of Ministers. The State Legislature – Legislative Assembly and Legislative Council. State High Courts.

MODULE III

Election Commission of India, Amendments and Emergency Provisions

Election Commission of India – Powers & Functions – Electoral Process in India.Methods of Constitutional Amendments and their Limitations.

Important Constitutional Amendments – 42nd, 44th, 61st, 74th, 76th, 77th, 86th and 91st.Emergency Provisions. Case Studies.

MODULE IV

Human Rights

Human Rights – Meaning and significance, Types Human Rights, Powers and Functions of National and State Human Rights Commission of India. Human rights in constitution of India

MODULE V

Professional Ethics

Scope and Aims of Engineering Ethics, Responsibilities of Engineers and impediments to Responsibilities. Honesty, Integrity and Reliability; Risks – Safety and Liability in Engineering. Case Studies.

Course Outcomes:

At the end of the course, students will have the ability to

CO1	Recognize the significance of the Indian Constitution as the supreme legal authority.	**Remember**	**PO6, PO12**
CO2	Analyse human rights theories and concepts.	**Analyse**	**PO6, PO12**
CO3	Apply the principles of moral obligations and duties to safeguard the public's welfare and safety.	**Application**	**PO8, PO12**

TEXT BOOKS:

1. "An Introduction to Constitution of India and Professional Ethics" by Merunandan K.B. and B.R. Venkatesh, Meragu Publications, 3rd edition, 2011.
2. "Constitution of India & Professional Ethics & Human Rights" by Phaneesh K. R., Sudha Publications, 10th edition, 2016.

REFERENCE BOOKS:

1. "V.N. Shukla's Constitution of India" by Prof (Dr.) Mahendra Pal Singh (Revised), EasternBook Company, Edition: 13th Edition, 2017, Reprint 2019.
2. "Ethics in Engineering" by Martin, W. Mike.,Schinzinger, Roland., McGraw-Hill Education; 4th edition (February 6, 2004) .

E Books:

1. https://books.google.co.in/books/about/Constitution_of_India_and_Professional_E.html?id=VcvuVt-d88QC
   Constitution of India and Professional Ethics, by G.B. Reddy and Mohd Suhaib, I.K. International Publishing House Pvt. Ltd., 2006.
2. http://www.scribd.com/doc/82372282/Indian-Constitution-M-Raja-Ram-2009#scribd
   Indian Constitution, by M. Raja Ram, New Age International Pvt. Limited, 2009.

Course Title	Physical Activity				
Course Code	22ET4NCPYA	Credits	0	L-T-P	--

The college provides opportunity for students to associate with a large number of physical activities.

Sample activities are listed below:

- Civil Defense/ Self-defense through Karate
- NCC
- Sports for Beginners
  Badminton/ Kho-Kho/ Chess/ Net Ball/ Football/ Table Tennis/ Handball/ Cricket/ Hockey/ Volleyball/ Kabaddi/ Basket Ball/Throw Ball
- Sports for Regular Players:
  Tennis / Athletics / Ball Badminton / Baseball / Billiards & Snookers / Body Building / Roller Skating / Rugby / Softball / Swimming / Yachting / Gymnastic / Archery / Cycling / Equestrian / Fencing / Golf / Karate / Kayaking & Canoeing / Power-lifting / Rowing / Shooting / Squash / Weight Lifting / Boxing / Wrestling / Judo

Students regularly associated with ANY one of the above activities, and certified by the concerned faculty in-charge, shall be awarded a Pass Grade in the Course.

Students who are not associated with the above affinity groups, shall participate in the events organized by the department:

- Yoga for Beginners
- Full/Half-Marathon

Course Outcomes:

At the end of the course, students will have the ability to

CO1	Develop physical fitness, endurance, and motor skills through active participation in sports and fitness activities..	**PO5, PO9**
CO2	Enhance teamwork, discipline, and leadership qualities by engaging in individual and group-based physical activities.	**PO6, PO9**
CO3	Cultivate a lifelong habit of physical well-being and stress management through sports, self-defense, or yoga practices.	**PO7, PO8**

V Semester

Course Title	ELECTROMAGNETICS				
Course Code	22ET5PCEM1	Credits	4	L:T:P	3:1:0
Pedagogy: 40 Lectures+ 10 Tutorial sessions					

Prerequisites:
The knowledge of following subjects is essential to understand this subject:
1. Calculus-Based Physics in Electricity and Magnetism.
2. Analytic Geometry and Calculus II including Vector Analysis and Vector Calculus.
3. Differential Equations; Calculus III including Partial Derivatives, Double and Triple Integrals, Vector Fields, Stoke's Theorem and Linear Algebra.
Objectives: The purpose of the course is to facilitate the learners to:

- Appreciate the importance of vectors, vector calculus, and orthogonal coordinate systems in Engineering Problems.
- Acquire the knowledge of Coulomb's law, Gauss' law, Maxwell's equations, electric field boundary conditions, and electrostatic potential, in basic electric field and potential calculations, BiotSavart's and Ampere's laws, magnetic field boundary conditions and vector magnetic potential.
- Improve their Mathematical thinking and acquire skills required for Electromagnetics

MODULE I	[8Hr L + 2Hr T]
Introduction to electrostatics: Introduction to line integral, surface integral, volume integral of vectors, Coulomb's Law (vector form), Electric Field Intensity (vector form), EFI due to different types of charge distributions. **Gauss' Law and applications:** Electric Flux Density (EFD), Gauss' Law, Divergence: Electric Flux Density (EFD), Gauss' Law, Application, Divergence and Divergence Theorem	
MODULE II	**[8Hr L + 2Hr T]**
Energy and Potential: Energy spent in moving charge, Definition of Potential Difference (PD), PD due to Point Charge and System of Charge, Energy Density, Current and Current Density, Continuity of Current	
MODULE III	**[8Hr L + 2Hr T]**
Conductor and Dielectric properties, Boundary conditions, Poisson's and Laplace's equations: Derivations of Poisson's and Laplace's Equations, solution of Poisson's and Laplace for Single Variables, Capacitance of different configurations using Laplace's equation.	
MODULE IV	**[8Hr L + 2Hr T]**
Steady Magnetic Field: Biot-Savart Law, Ampere's circuital law, Curl, Magnetic Flux, Flux Density, Scalar and Vector Magnetic Potentials, Force on a moving charge, Force on different current element, Inductance and Mutual Inductance Magnetic Boundary Condition.	
MODULE V	**[8Hr L + 2Hr T]**
Time varying fields and Maxwell's equations: Faraday's Law, Displacement Current, Maxwell's Equations in Point and Integral Form, Uniform plane waves, Wave equations , solution of wave equation, wave propagation through good dielectric, good conductor, skin depth, Poynting Theorem.	
TEXT BOOKS:	

1. Engineering Electromagnetics H Hayt, J A Buck, MJaleelAkhtar Tata McGraw-Hill, 8th Edition, 2014.
2. Electromagnetics, Schaum's Outline series Joseph A Ediminister Tata McGraw-Hill, revised second Edition, 2014.

REFERENCE BOOKS:

1. Electromagnetics with Applications, John Krauss and Daniel A Fleisch, McGraw-Hill, 5th Edition, 1999.
2. "Field and wave electromagnetic", David K Chary, Pearson Education Asia, Second Edition – 1989, Indian Reprint – 2001
3. Mathew N. O. Sadiku "Elements of Electromagnetics," Oxford University Publication 2014.

E-References:

1. https://open.umn.edu/opentextbooks/textbooks/532

e-Learnings:

1. https://onlinecourses.nptel.ac.in/noc21_ee83/preview
2. https://onlinecourses.nptel.ac.in/noc21_ph05/preview

Course Outcomes:

At the end of the course, students will have the ability to

CO1	Ability to **define, understand**, and **explain** concepts of static and time varying Electric and Magnetic Fields, Maxwell's equations, wave propagation in different media	--	PSO3(1)
CO2	Ability to **apply** various properties/ laws/theorems of Electric and Magnetic Fields to obtain the specified parameter	PO1(3)	
CO3	Ability to **analyze** the given static and time varying Electric and Magnetic Fields to arrive at a suitable solution	PO2(3)	
CO4	Ability to develop the code in any programming language to demonstrate specified concept (s) of static and time varying Electric and Magnetic Fields	PO3(1) PO5(1) PO12(1)	
CO5	Ability to engage in independent study and make an oral presentation on the applications/ hazards of Electromagnetic radiation	PO6(1) PO10(1) PO12(1)	

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	Total
CO1													-
CO2	3												3
CO3		3											3
CO4			1		1							1	1
CO5						1				1		1	1

Course Title	SIGNAL PROCESSING FOR MULTIMEDIA				
Course Code	22ET5PCSPM	Credits	3	L:T:P	2:1:0
Pedagogy: 26 Lectures+ 10 Tutorial sessions					

Prerequisites:
Signals and Systems: Analog, Signals and Systems: Digital

Objectives: The purpose of the course is to facilitate the learners to:

- Gain fundamental knowledge in understanding the basics of different multimedia networks and applications.
- Understand digitization principle techniques required to analyse different media types.
- Analyse processing and compression techniques required to compress text and image.
- Analyse processing and compression techniques required to compress audio and video.

MODULE - I **[5 Hr. L + 2 Hr. T]**

Fundamentals of Multimedia Communication: Introduction, multimedia information representation, multimedia networks: telephone networks, data networks, broadcast television networks, ISDNs, broadband multiservice networks, multimedia applications: interpersonal communications, interactive applications over internet, entertainment applications.

Multimedia Information Representation: Media types, communication modes, network types, multipoint conferencing: centralized, decentralized and hybrid modes.

MODULE - II **[6 Hr. L + 2 Hr. T]**

Text Representation and Compression: Text representation, unformatted text, formatted text, Hypertext, Code word generation of unformatted text, Text compression principles, Entropy encoding, Source encoding, Transform encoding, Text compression principles: Adaptive Huffman coding, Arithmetic coding, LZW coding.

MODULE - III **[5 Hr. L + 2 Hr. T]**

Image Representation and Compression: Image representation, Graphics, Digitized documents, Digitized Pictures, Raster scan principles, three color image capture methods, Path length calculations, JPEG: Image Preparation, Block Preparation, DCT, Quantization, Entropy encoding, Frame builder, Basics of JPEG decoder, Introduction to Graphics Interchange Format, TIFF and JPEG 2000.

MODULE - IV **[5 Hr. L + 2 Hr. T]**

Audio Processing and Compression: PCM Speech, CD quality audio, Synthesized audio, MIDI, MIDI versus Digital Audio, Adding sound to multimedia projects, Music CDs, Adaptive predictive coding, Linear predictive coding, Prediction error calculation for LPC, Dolby Audio coders.

MODULE - V **[5 Hr. L + 2 Hr. T]**

Video Processing: Introduction to Video compression: Broadcast TV, Color signals, Luminance and Chrominance, Signal bandwidth, digital video: 4:2:2 format, 4:2:0 format, HDTV format, Video compression techniques: Video Compression principles: Frame Types, Introduction to MPEG.

Animation: Pixels: Graph paper, Simple shapes, Grayscale color, RGB Color, Color Transparency. Creating **synthetic videos** using Midjourney (an introduction) **Processing:** The Processing Application, Sketchbook, Coding, The First Sketch.
TEXT BOOKS: 1. Multimedia Communications: Applications, Networks, Protocols, and Standards – Fred Halsall, Pearson Education, Fourth Impression 2009. **2.** Learning Processing – Daniel Shiffman, Elsevier, Second Edition, 2015.
REFERENCE BOOKS: 1. Data Compression: The Complete Reference – David Salomon, Springer, Fourth Edition, 2007. **2.** Multimedia in Practice: Technology and Applications – Judith Jeffcoate, Pearson Education, Fifth Impression 2011.

Course Outcomes:

At the end of the course, students will have the ability to

CO1	Ability to **understand** and **explain** concepts of multimedia communication.	--	PSO3(3)
CO2	Ability to **apply** knowledge of analog and digital communication to various multimedia data, networks and applications.	PO1(3)	
CO3	Ability to **analyze** various communication networks, audio / speech/ video frames. **derive** text encoding, **evaluate** different image compression schemes.	PO2(3)	
CO4	Ability to function effectively as an individual and as a team member to **conduct experiments** using modern engineering tool MATLAB / LabVIEW for a given multimedia application/problem statement.	PO5(1) PO9(1)	

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**Tota l**
CO1													**-**
CO2	**3**												**3**
CO3		**3**											**3**
CO4					**1**				**1**				**1**

Course Title	COMPUTER COMMUNICATION NETWORKS				
Course Code	22ET5PCCCN	Credits	4	L-T-P	3:0:1

Pedagogy: 40 Lectures+ 10 Laboratory sessions

Prerequisites: Basics of Communication

Objectives: Introduction to analysis and design of computer and communication networks through understanding the network layered architecture and the protocol stack and by conducting hands-on programming and lab activities.

MODULE-I	8 Hr.

Introduction: Data communication, Networks, **Network Models:** The OSI Model, Layers in the OSI model, TCP/IP Protocol Suite, addressing; **Physical Layer and media:** Transmission media – Guided media, switching – Introduction, Circuit Switched networks, Datagram Networks, Virtual Circuit Networks.

MODULE-II	8Hr.

Data Link Layer: Data Link Control (DLC): Framing, Flow and Error control, Protocols, Noisy Channels; **Multiple Access:** Random Access, Controlled Access; **WireLANs: Ethernet –** IEEE Standards, Standard Ethernet; **Wireless LANs -** IEEE802.11, Bluetooth.

MODULE-III	8 Hr.

Data Link Layer: Connecting LANs, Backbone networks and Virtual LANs: Connecting Devices, Backbone Networks, Virtual LANs

Network layer: Logical Addressing: IPv4 addresses, IPv6 Addresses; **Internet Protocol:** Internetworking, IPv4, IPv6,Transition from IPv4 to IPv6; Address Mapping, ICMP

MODULE-IV	8 Hr.

Network Layer: Delivery, Forwarding, Unicast Routing Protocols, Multicast Routing Protocol(without application)

Transport layer: Process to process delivery, User Datagram Protocol (UDP), TCP, SCTP.

MODULE-V	8 Hr.

Congestion control & QOS: Data traffic, Congestion, Congestion control, Quality of Service, Techniques to improve QoS

Application layer: Domain Name system: Name space, Domain Name space, Distribution of name space, DNS in the internet, Resolution ; **Remote logging, Electronics mail and File transfer:** Electronic mail, File transfer ; **WWW** and **HTTP:** Architecture, web documents , HTTP

Lab Experiments:

1. Study of different types of Network cables and Practically implement the cross-wired cable and straight through cable using clamping tool
2. Study of Network Devices in Detail
3. Configure network with the following topologies and analyze i) BUS ii) RING iii) Fully connected mesh topology, disable a node in each of the topologies and find the changes.
4. Total unicast message sent
5. Total unicast message received

6. UDP: broadcast throughput at transport layer
7. Study of network IP
8. Connect the computers in Local Area Network
9. Study of basic network command and Network configuration commands.
10. Configure a Network topology using software
11. Performing an Initial Switch Configuration
12. Performing an Initial Router Configuration
13. Simulate Ethernet LAN with 4 nodes , apply relevant TCP and UDP applications and Determine

    i) the number of data packets sent by UDP and TCP

    ii)Number of periodic updates sent by the routing algorithm

    iii)Number of ACK packets sent

    iv)Average jitter of UDP and TCP

Text books:

1.Data Communication and Networking, Behrouz Forouzan, 4th Edition, Tata Mcgraw Hill

Reference books:

1. Computer Networks, Andrew S Tanenbaum, 3rd Edition, PHI
2. J.F. Kurose and K. W. Ross, "Computer Networking – A top down approach featuring the Internet", Pearson Education, 5th Edition

e–Learning :

1.https://onlinecourses.nptel.ac.in/noc22_ee61/
2.https://ocw.mit.edu/courses/6-263j-data-communication-networks-fall-2002/

Course Outcomes:

At the end of the course, students will have the ability to

CO1	Explain the concepts of computer communication networks	-	PSO3(2)
CO2	Apply the concepts of communication fundamentals to obtain the solution for specified parameters	PO1(3)	
CO3	Analyse the given network systems parameters and arrive at suitable conclusions	PO2(2)	
CO4	Design an network system to demonstrate networking concepts using the hardware and software engineering tool: Qualnet / Matlab/packet tracer	PO3(1) PO5(2) PO9(1)	
CO5	Demonstrate and Implement network concepts using suitable computer communication network parameters	PO5(2) PO8 (1) PO10(1) PO12(1)	

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	Tota l
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3
CO3	-	2	-	-	-	-	-	-	-	-	-	-	2
CO4	-	-	1	-	2	-	-	-	1	-	-	-	2
CO5	-	-	-	-	2	-	-	1	-	1	-	1	2

Course Title	COMMUNICATION SYSTEMS-2				
Course Code	22ET5PCCS2	Credits	4	L-T-P	3:0:1
Pedagogy: 40 Lectures+ 10 Laboratory sessions					

Prerequisites: Communication Systems-1

Objectives:

- The course aims at introducing information theory and the practical aspects of data compression and error-control coding. The theoretical concepts are illustrated using practical examples related to the effective storage and transmission of digital and analog data. Recent developments in the field of channel coding are also discussed (Turbo-codes).
- The goal of the course is to introduce the basic techniques for reasoning under uncertainty as well as the computational and graphical tools which are broadly used in this area.
- The theoretical course is complemented by a series of laboratories, in which the students can simulate using various software tools for data compression, error-correction

MODULE-I	8 Hr.

Information Theory and Entropy: Introduction, Measure of information, (Entropy) Average information content of symbols in long independent sequences, Joint Entropy and conditional entropy, Mutual information, Relationship between entropy and mutual information, Mark-off statistical model for information source, Entropy and information rate of mark-off source. Problems

MODULE-II	8Hr.

Source Encoding & Channel Capacity: Encoding of the source output, Kraft inequality, Noiseless coding Theorem, Shannon's encoding algorithm, Shannon's Fano encoding algorithm, Huffman coding, problems.

Discrete communication channels: Representation of channels Channel Capacity, Shannon's Theorem on channel capacity, Channel efficiency, symmetric channel Binary symmetric channel Binary Erasure channel, Cascaded channel, problems

MODULE-III	8 Hr.

Error Control Codes: Introduction, Types of errors, Types of codes : Linear Block Codes: Matrix description, Encoding and syndrome circuits, Syndrome calculation circuit, Hamming weight, Hamming distance, Design of an hamming code, Error detection and correction, Standard arrays and look up table for decoding, Decoding circuit for Linear block codes, problems

Binary Cyclic Codes: Algebraic structures of cyclic codes, properties, Systematic and non-systematic Encoding using an (n-k) bit shift register, Syndrome calculation circuit, Problems

MODULE-IV	8 Hr.

Convolution & Turbo Codes: Introduction to Convolution Codes, Encoder for Convolution Codes using Time domain approach, Transform domain approach, State Diagram and code trees, Trellis

structure, Viterbi Decoding, Introduction to Turbo Codes

MODULE-V	8 Hr.

Band-Pass Transmission & Spread Spectrum: Time and frequency domain representation of DPSK, QPSK; generation and detection; Performance analysis: power and bandwidth, bit error rate. Introduction to OFDM, MSK, GMSK, Need for Spread Spectrum Modulation. PN sequence and its properties, Direct sequence SS system- DS/BPSK Transmitter & Receiver, Frequency hopping, Processing gain, Jamming margin, CDMA

Lab Experiments:

Basics of Matrix

- Polynomial multiplication and division
- Encoding using different encoding algorithms
- Channel capacity of different communication channels
- CRC implementation
- Error detection and correction in Linear Block Code
- Generation of QPSK signals
- Generation of OFDM symbols

Text books:

1. Digital and Analog Communication Systems – K. Sam Shanmugam, John Wiley, 1996.
2. Digital Communication – Simon Haykin, John Wiley, 2003

Reference books:

1. Concepts of Information Theory and Coding – Dr.P.S.Satyanarayana, Dynaram, 2005.
2. Elements of information theory – Thomas M. Cover, John Wiley, 2006

E- References:

1.https://archive.nptel.ac.in/content/storage2/courses/117108097/Learning%20Material%20-%20ITC.pdf

2.http://www.rejinpaul.com/2013/06/anna-university-IT2302-Information-Theory-andCoding-ITC-Notes.html

e–Learning :

1.http:/nptel.ac.in/courses/117101053/1

2.https://www.youtube.com/watch?v=nvmo9voRiSs

Course Outcomes:

At the end of the course, students will have the ability to

CO1	Ability to define, understand and explain concepts related to information theory and coding	
CO2	Ability to apply the knowledge of mathematics and probability and source encoding algorithms to obtain the information of discrete message sources	PO1(3)
CO3	Ability to analyze Convolution coder	PO2(1)
CO4	Ability to design the Block and Convolution codes for a given channel	PO3(3)
CO5	Ability to conduct experiments to demonstrate concepts related to digital communication and information theory and coding	PO5(3)
CO6	Ability to design, implement and demonstrate the specific application of digital communication and coding theory as a member of the team using LabVIEW/ Matlab/ any other	PO5(1) PO11(1) PO12(1)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**Total**
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	**3**	-	-	-	-	-	-	-	-	-	-	-	**3**
CO3	-	**1**	-	-	-	-	-	-	-	-	-	-	**1**
CO4	-	-	**3**	-	-	-	-	-	-	-	-	-	**3**
CO5	-	-	-	-	**3**	-	-	-	-	-	-	-	**3**
CO6	-	-	-	-	**1**			-	-	-	**1**	**1**	**1**

Course Title	PROJECT MANAGEMENT AND FINANCE				
Course Code	22ES5HSPMF	Credits	2	L:T:P	2:0:0

Pedagogy: 26 Lectures

MODULE I **[5Hr]**

Concepts of Project Management - Concepts of project, Categories of project, Project life cycle phases, Project management concepts, Tools and techniques for project management, The project manager, Need, Roles and responsibilities of project manager. Project Leadership and Ethics: Introduction to project leadership, ethics in projects, Multicultural and virtual projects.

MODULE II **[5Hr]**

Establishing the Project - Scope, Time, Cost and performance goals, Feasibility report, Financing Arrangements, Preparation of cost estimates, Finalization of project implementation schedule, Evaluation of the project profitability, Fixing the Zero date.

MODULE III **[5Hr]**

Organizing Human Resources and Contracting - Delegation , Project managers authority, Project organization , Contract , Contract Planning, Tendering and Selection of Contractor, Team building

MODULE IV **[5Hr]**

Organizing Systems and Procedures for Project Implementation – Working of Systems, Work breakdown structure, Planning, Scheduling and Monitoring, Critical Path Method, Gantt Chart/Time Chart, PERT, Project diary

MODULE V **[6Hr]**

Financing of Projects - Capital structure, Menu of financing , Internal accruals , Equity capital, Preference capital , Debentures (or bonds) , Methods of offering term loans , Working capital advances, Miscellaneous sources , Raising venture capital, Project financing structures, Financial closure , Financial institutions.

Course Outcomes:

At the end of the course, the student will have the ability to,

CO1	Apply the knowledge of project management principles and to study the current market trends	**PO1**
CO2	Implement project management methodologies ethically for successful project completion	**PO2** **PO8** **PO9**
CO3	Identify the investment opportunities and to formulate the projects	**PO11**
CO4	Choose projects which benefit society and organizations and apply project phases and document them for future reference	**PO6** **PO10** **PO12**

Text Books:
1.Project Management – S Choudhury, Tata McGRAW Hill Publishing Company Limited 2. Projects- Planning , Analysis , Selection, Financing ,Implementation and Review –Dr. Prasanna Chandra McGRAW Hill Publishing Company Limited 3.Project Management Institute A Guide to the Project Management Body of Knowledge PMBOK Guide (Sixth Edition), Sept 2017
Reference books:
1.Fundamentals of Project Management by Dr.Vijay Kanabar 2.Project Management – David I Cleland – Mcgraw Hill International edition 3.Project Management – Gopalakrishnan – Mcmillan India Ltd 4. Project Management – harry – Maylor- Peason Publication

Course Title	Digital system Design				
Course Code	22ET5PE1DD	Credits	3	L:T:P	3:0:0

Pedagogy: 40 Lectures

Prerequisites: Basic concepts in Digital Circuit design and Verilog HDL
Objectives: To design Digital Systems through Verilog HDL, Simulate the Designs using CAD tools and Implementation using PLDs.

MODULE I

Review of Verilog concepts: Structure of the Verilog Module, Styles (Types) of Description (Data flow modeling, Behavioral modeling, Structural modeling) ports, operators and datatypes,
Synchronous sequential circuits: Moore and Mealy FSM, Design and Implementation of FSM

MODULE II

Switch level modeling: Switch modeling elements, MOS Switches, CMOS Switches, Bidirectional Switches, Power and Ground, Resistive switches
Logic Synthesis with Verilog HDL: What is logic synthesis? Impact of Logic synthesis, Verilog HDL synthesis, Synthesis design Flow, Synthesis examples

MODULE III

Introduction to Programmable Logic Devices : Brief Overview of Programmable Logic Devices, Simple Programmable Logic Devices (SPLDs), Complex Programmable Logic Devices (CPLDs), Field-Programmable Gate Arrays (FPGAs)

MODULE IV

Design of Arithmetic Circuits: BCD to 7-Segment Display Decoder, A BCD Adder, 32-Bit Adders, Traffic Light Controller , State Graphs for Control Circuits, Binary Multipliers, Binary Dividers

MODULE V

SM Charts and Microprogramming: State Machine Charts, Derivation of SM Charts, Realization of SM Charts, Implementation of the Dice Game, Microprogramming, Linked State Machines

Course Outcomes:

At the end of the course, the student will have the ability to,

CO1: Apply the knowledge of Digital Electronics and HDL to describe behaviour of a digital circuits using data flow, Behavioral and structural modelling	**PO 1**
CO2: Analyse the given specifications for a digital circuit to describe the behaviour in HDL	**PO 2**
CO3: Design a digital circuit through HDL for given specifications	**PO3**
CO4: Design and **conduct experiments** using modern engineering CAD tool to: (i) perform simulation (ii) perform synthesis	**PO5** **PO9**

CourseTitle	OPTICAL FIBER COMMUNICATION				
Course Code	22ET5PE1OC	Credits	3	L-T-P	3:0:0
Pedagogy: 40 Lectures					
MODULE-I				**8 Hrs**	
Optical Fiber Waveguides: Introduction, General system, Advantages of Optical fiber Communication, Ray Theory Transmission, Electromagnetic mode theory for optical propagation, Cylindrical Fiber, Cut-off wavelength, mode field diameter, phase velocity, group velocity, group delay, Single mode fibers.					
MODULE-II				**8Hrs**	
Optical Transmitters and Receivers: Introduction, LASER diodes, LEDs, Photodetectors: Device Types, Principles, Absorption co-efficient, Quantum Efficiency, Responsivity, Photodiodes without internal gain, Avalanche Photodiodes.					
MODULE-III				**8 Hrs**	
Fiber Couplers and Connectors: Introduction, Fibre Alignment and joint loss, single mode fibre joints, fibre splices, fibre connectors and fibre couplers.					
MODULE-IV				**8 Hrs**	
Fundamental concepts in Optical communications: Optical receiver: Introduction, Optical Receiver operation, Digital signal transmission, error sources, Analog Receiver sensitivity. **Analog and Digital Links:** Analog Links-Introduction, Overview of analog links, CNR, multichannel transmission techniques, Digital Links-Introduction, point-point links, System Considerations, link and rise time power budget analysis.					
MODULE-V				**8 Hrs**	
Introduction to optical networks: Operational principles of WDM,2x2 fiber coupler and connector, Optical Amplifiers, Erbium -Doped fiber amplifier, SONET/SDH, Optical Interfaces.					

Text books:

1.Optical Fiber Communications: Gerd Keiser, III edition,Tata McGraw Hill

2.Optical Fiber Communications: Principles and Practice – 3rd Edition, by John.M.Senior, Publisher: PHI

Reference books:

1.**Fiber optic Communication Systems:** G.P. Agrawal, John Wiley and sons, Fourth Edition, 2011

2.**Optical Fiber Communication Systems with MATLAB and Simulink Models,** 2e, Le Nguyen Binh, Huawei Technologies Co., Ltd, CRC Press, Inc., 2015

3.**Harold Kolimbris-** Fiber Optics Communication, 2nd Ed., 2004, PEI

E- References:

1. Fiber Optics Communication by SL Kakani (CBS PUBLISHERS AND DISTRIBUTORS

PVT LTD; First Edition) https://www.amazon.in/Fiber-Optics-Communication-SL-Kakani-ebook/dp/B07TJXKPBN
MOOCs: 1.Fiber Optics By Prof. Vipul Rastogi IIT Roorkee https://onlinecourses.nptel.ac.in/noc20_ph07/preview 2.Fiber-Optic Communication Systems and Techniques, IIT Kanpur, Dr. Pradeep Kumar K https://nptel.ac.in/courses/108104113 3. https://nanohub.org/courses/FOC

Course Outcomes:

At the end of the course, the student will have the ability to,

CO1	**Define, understand and explain** the concepts of Optical Fiber communication system	
CO2	**Apply** the knowledge of physics, electronics and communication theory to study the components of Optical Fiber communication system, ray theory and EM theory of wave propagation and optical networks	PO1(3)
CO3	**Analyse** analog and digital links using link design and rise time budget analysis for a given Optical Fiber communication link	PO2(2)
CO4	Make an **oral presentation** of the application and developments in Optical fibre communication with respect to standards, applications, challenges and impacts	PO10(1)

Course Title	COMPUTER ARCHITECTURE				
Course Code	22ET5PE1CA	Credits	3	L-T-P	3:0:0

Pedagogy: 40 Lectures

Prerequisites: Digital Circuits

Objectives:

1. To understand the architecture of computers
2. To understand memory optimization and protection
3. To understand and analyse the instruction level parallelism, data level parallelism and thread level parallelism

MODULE-I	8Hrs

Fundamentals of Quantitative Design and Analysis: Introduction , Classes of Computers , Defining Computer Architecture , Trends in Technology , Trends in Power and Energy in Integrated Circuits , Trends in Cost , Dependability , Measuring, Reporting, and Summarizing Performance , Quantitative Principles of Computer Design , Putting It All Together: Performance, Price, and Power

MODULE-II	8Hrs

Memory Hierarchy Design: Introduction, Ten Advanced Optimizations of Cache Performance, Memory Technology and Optimizations, Protection: Virtual Memory and Virtual Machines, Crosscutting Issues: The Design of Memory Hierarchies

MODULE-III	8Hrs

Instruction-Level Parallelism and Its Exploitation: Instruction-Level Parallelism: Concepts and Challenges, Data Dependences and Hazards, Control Dependences, Basic Compiler Techniques for Exposing ILP, Reducing Branch Costs with Advanced Branch Prediction, Overcoming Data Hazards with Dynamic Scheduling, Hardware based speculation

MODULE-IV	8Hrs

Data-Level Parallelism in Vector, SIMD, and GPU Architectures: Introduction, Vector Architecture, SIMD Instruction Set Extensions for Multimedia, Graphics Processing Units, Similarities and Differences between Vector Architectures and GPUs

MODULE-V	8Hrs

Thread-Level Parallelism: Introduction, Multiprocessor Architecture: Issues and Approach, Challenges of Parallel Processing, Centralized Shared-Memory Architectures, Performance of Symmetric Shared-Memory Multiprocessors

Text books:

1.	Computer Architecture, John L Hennessy, David A Patterson, 6th Edition, Elsevier Publications

Reference books:
1.Digital Design and Computer Architecture, David Money Harris, Sarah L. Harris 2. Advanced Computer Architecture: Parallelism, Scalability, Programmability, Kai Hwang, Tata McGraw-Hill, 2008
E- References:
1.http://www.csitsun.pub.ro/courses/cn2/Digital_design_book/Digital%20Design%20and%20Computer%20Architecture.pdf 2. https://www.cse.iitd.ac.in/~srsarangi/archbook/archbook.pdf
e–Learning :
1.https://onlinecourses.nptel.ac.in/noc23_cs67/preview 2.https://archive.nptel.ac.in/courses/106/105/106105163/

Course Outcomes:

At the end of the course, the student will have the ability to,

CO1	**Define, understand** and **explain** concepts of computer Architecture	-
CO2	**Apply the knowledge of** hardware and software to enhance the throughput	PO1(3)
CO3	**Analyse** some of the design issues for optimizing the performance parameters	PO2(2)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**Total**
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	**3**	-	-	-	-	-	-	-	-	-	-	-	**3**
CO3	-	**2**	-	-	-	-	-	-	-	-	-	-	**2**

Course Title	C++ AND DATA STRUCTURES				
Course Code	22ET5PE1DS	Credits	3	L-T-P	3:0:0
Pedagogy: 40 Lectures					

Prerequisites:

Introduction to C Programming

Objectives:

Ability to learn programming concepts
Ability to implement mathematical concepts using programming
Ability to learn data structures

MODULE-I	8 Hrs

Introduction to C++ & its Features

Principles of object oriented programming, Beginning with C++, Tokens, Expressions and Control structures, Functions in c++, Classes and Objects

MODULE-II	8Hrs

Constructors, Destructors, Operator Overloading, Console I/O operations

Parameterized constructors, Multiple constructors in a class, Constructors with default arguments, Dynamic initialization of objects, Copy constructor, Dynamic constructors, Destructors, Overloading unary and binary operators, Stream classes, Formatted and Unformatted I/O operations, Manipulators

MODULE-III	8 Hrs

Inheritance, Polymorphism, Templates, Exception handling

Derived classes, Single/Multilevel/Multiple/Hierarchical/Hybrid Inheritance, Virtual base class, Pointer to Object, This pointer, Virtual/Pure virtual function, Virtual constructor and destructor, Class templates, Function templates , Exception handling

MODULE-IV	8 Hrs

Data structures

Single linked lists and operations, Stacks, Queues- array and linked representation, skip lists, hash table, Binary tree and traversal mechanisms.

MODULE-V	8 Hrs

Applications of data structures

Heap sort, tower of Hanoi, parenthesis matching, bin sort – algorithms and programming

Lab Experiments:

1. Program to implement classes and objects
2. Program to implement inline functions
3. Program to implement friend and virtual functions
4. Program to implement Constructors, parameterized constructors, multiple constructors in a class, copy constructor, dynamic constructors, and destructors.
5. Program to implement Operator overloading and type conversions: Overloading unary and binary operators, overloading using friends, rules for overloading
6. Program to implement public, private and protected inheritance. Types of inheritance: Single,

Multilevel, multiple, hierarchical, hybrid. 7. Program to implement Pointers, virtual functions and polymorphism. 8. Program to implement Class templates, function templates, overloading template functions 9. Program to implement stacks and ques using data structures 10. Program to implement hashing and trees using data structures
Text books:
1. Object Oriented Programming with C++, E. Balaguruswamy, TMH, 6th Edition, 2013. 2. Data structures, Algorithms, and applications in C++, SartajSahni, Universities Press, 2nd Edition, 2005.
Reference books:
1. Object Oriented Programming using C++, Robert Lafore, Galgotia publication 2010. 2. D.S. Malik, Data structures using C++, India edition, CENGAGE Learning, 2003.
E- References:
1.https://www.pdfdrive.com/introduction-to-c-and-c-programming-e4331665.html 2.https://www.pdfdrive.com/principles-of-data-structures-using-c-and-c-e19847224.html
e–Learning :
1.Programming in C++ , NPTEL https://archive.nptel.ac.in/courses/106/105/106105151/ **2.**Introduction to data structures and algorithms, NPTEL https://nptel.ac.in/courses/106102064

Course Outcomes

At the end of the course, the student will have the ability to,

CO1	Ability to **understand** the programming concepts for data structures	--
CO2	Ability to **apply** the knowledge of Engineering mathematics and programming skills to develop efficient codes in C++	PO1
CO3	Ability to **analyze** abstract object and real object using class	PO2
CO4	Ability to **design** programming solutions with operator overloading and memory management	PO3
CO5	Ability to work as an individual and thereby **conduct experiments** using any C compiler for a given application/problem statement.	PO5 PO9
CO6	Develop, test, analyze and demonstrate applications using C++ and Data structures through an **Open-Ended Experiment**	PSO3

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	Tota l
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3
CO3	-	2	-	-	-	-	-	-	-	-	-	-	2
CO4	-	-	1	-	-	-	-	-	-	-	-	-	1
CO5	-	-	-	-	1	-	-	-	1	-	-	-	1
CO6	-	-	-	-	-	-	-	-	2	-	-	2	2

Course Title	MINI PROJECT-1				
Course Code	22ET5PWMP1	Credits	2	L:T:P	0:0:2

General Instructions:

1.A team of two to four students shall be permitted to work on a single mini project.

2.The mini project shall comprise of hardware component.

3.Students shall be evaluated on regular and continuous basis as per the prevailing rubrics.

4.The team shall ensure that the project is in working condition during final demonstration.

5.The student is required to submit a report, one page poster and 3 minutes video based on the project work carried out.

Course Outcomes

At the end of the course, the student will have the ability to,

CO1	Engage in relevant survey and identify the project to be implemented with desired specifications	**PO2 (3)** **PO12 (3)**	**PSO1 (3)** **PSO2 (3)** **PSO3 (2)**
CO2	Identify the essential concepts, and identify the design for the project implementation	**PO1 (3)** **PO2 (3)** **PO3 (2)**	
CO3	Implement and analyse the designed project, to match the specifications	**PO4 (2)** **PO5 (3)**	
CO4	Prepare the project report, three minute video and the poster of the work	**PO10 (3)**	
CO5	Engage in team work towards implementation of project relevant to society	**PO6 (1)** **PO9 (1)** **PO11 (1)**	
CO6	Ability to demonstrate compliance to the prescribed standards/ safety norms and abide by the norms of professional ethics	**PO8(3)**	

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	Tota l
CO1	-	3	-	-	-	-	-	-	-	-	-	3	3
CO2	3	3	3	-	-	-	-	-	-	-	-	-	3
CO3	-	-	-	2	3	-	-	-	-	-	-	-	3
CO4	-	-	-	-	-	-	-	-	-	3	-	-	3
CO5	-	-	-	-	-	1	-	-	1	1	-	-	1
CO6	-	-	-	-	-	-	-	3	-	-	-	-	3

Course Title	Effective Negotiation With Emotional Intelligence				
Course Code	22ET5NCENI	Credits	NC	L:T:P	0:0:0

Objectives:

- Equip students with the necessary skills and knowledge to navigate professional and personal negotiations successfully.
- Introduce the concept of emotional intelligence and its importance in negotiation
- Illustrate how emotional intelligence can be integrated into negotiation strategies for better outcomes.
- Explore how empathy, self-awareness, and social skills can enhance communication and relationship-building during negotiations
- Empower students with the skills and mindset necessary to navigate diverse and complex negotiation scenarios in the engineering field.

Course Outcomes

At the end of the course, the student will have the ability to,

CO1	Apply emotional intelligence competencies, such as self-awareness, self-regulation, empathy, and social skills, in negotiation scenarios.	**PO6(3)**	
CO2	Ability to demonstrate a thorough understanding of fundamental negotiation principles, including preparation, communication, collaboration, and problem-solving.	**PO9(3)**	
CO3	Ability to exhibit an understanding of ethical considerations in negotiations, demonstrating integrity, honesty, and professionalism throughout the negotiation process.	**PO8(3)**	

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	Tota l
CO1	-	-	-	-	-	-	-	**3**	-	-	-	-	**3**
CO2	-	-	-	-	-	**3**	-	-	-	-	-	-	**3**
CO3	-	-	-	-	-	-	-	-	-	**3**	-	-	**3**

VI Semester

Course Title	FUNDAMENTALS OF VLSI				
Course Code	22ET6PCVLS	Credits	4	L:T:P	3:0:1
Pedagogy: 40 Lectures+ 10 Laboratory sessions					

Prerequisites:
Analog and Linear Circuits, Digital Circuits

Objectives: The purpose of the course is to facilitate the learners to:

- To use mathematical methods and circuit analysis models in analysis of CMOS digital electronics circuits, including logic components and their interconnect.
- To implement models of CMOS circuits that realize specified digital functions.
- To design static CMOS combinational and sequential logic at the transistor level, including mask layout.
- To analyze the general steps required for processing of CMOS integrated circuits.
- To estimate and optimize combinational circuit delay using RC delay models and logical effort.

MODULE I	8Hr

Basic MOS technology: Enhancement and depletion mode MOS transistors. nMOS fabrication, pMOS fabrication, CMOS fabrication: p-well process, n-well process, Twin-tub process, BiCMOS fabrication in n-well process. Thermal aspects of processing.

Circuit design processes: MOS layers. Stick diagrams: CMOS design style. Basic physical design of simple logic gates, nMOS design for inverter.

HDL Programming: Switch Level modeling of CMOS circuits

MODULE II	8Hr

CMOS logic structures : Complementary Logic, Pseudo-nMOS Logic, Dynamic CMOS Logic, Clocked CMOS Logic, Pass Transistor Logic, CMOS Domino Logic, Cascaded Voltage Switch Logic (CVSL), BiCMOS Logic, The Transmission Gate, Tri-state Inverter. HDL programming of special CMOS circuits.

MODULE III	8Hr

Basic circuit concepts: Sheet resistance, Area capacitance, Rise time and fall time calculations, nMOS inverter transfer characteristic.

CMOS subsystem design: Architectural issues, General considerations, Switch logic, Gate logic, Design example of Multiplexer, Process illustration: Design of Combinational Bidirectional Shifter.

MODULE IV	8Hr

CMOS subsystem design implementation: Design of: Inverting shift register and non-inverting shift register using Pass Transistor logic/Transmission gate logic, 4X4 crossbar switch and 4X4 Barrel shifter.

Adders: Manchester Carry chain, Carry Select Adders, Carry Skip adders, Carry Look-ahead adder. HDL programming of adders.

Multipliers: Serial-Parallel multiplier, Booth's Multiplier, Modified Booth's multiplier, Wallace tree

multiplier.

MODULE V	8Hr

Memory, registers, and clock: Timing considerations of memory cells.3T dynamic RAM cell, 1T dynamic memory cell, Pseudo-static register cell.

Testability: Performance parameters, Ground rules for design, Sensitized path testing, Practical DFT methodologies.

Laboratory Component:

Part – A: HDL programming of VLSI circuits

1. CMOS Inverter
2. nMOS Inverter
3. Transmission gate
4. CPL
5. Tri-state Logic
6. Dynamic logic
7. Pseudo-nMOS logic
8. Flip flops
9. Adders

Part – B: Verification of parameters for different circuits using VLSI tools.

Design a circuit with given specifications, and completing the following design flow:

a. Draw the Schematic and verify the DC analysis and Transient analysis

b.Draw the layout and verify DRC

TEXT BOOKS:

1. Douglas A. Pucknell and Kamran Eshraghian, "**Basic VLSI Design**" PHI 3rd Edition, 2005.
2. John P. Uyemura, "**Introduction to VLSI Circuits and Systems**", Wiley Publications, 2002.
3. Nazeih Botros, **HDL with Digital Design VHDL and Verilog** – Mercury Learning and Information, 2015.

REFERENCE BOOKS:

1. **Neil H. E. Weste and K. Eshragian**," CMOS VLSI Design – A Circuits and Systems Perspective," 3rd edition, Pearson Education Pvt. Ltd.
2. **Sung Mo Kang and Yosuf Leblebici,** "CMOS Digital Integrated Circuits: Analysis and Design", Tata McGraw-Hill, Third Edition**.**

MOOCs:

1. https://onlinecourses.nptel.ac.in/noc19_ee25/
2. https://swayam.gov.in/nd1_noc19_cs74/preview

Course Outcomes

At the end of the course, the student will have the

CO1	Ability to **define, understand** and **explain** concepts of nMOS and CMOS technology.	--
CO2	Ability to **apply** the knowledge of VLSI to fabricate the MOS circuits, **illustrate** different CMOS logic structures, subsystems and memory elements, **calculate** rise time and fall time estimations.	PO1(3) PSO3(3)
CO3	Ability to **analyze** the monochrome layout and stick diagrams of MOS technology and CMOS logic structures and subsystems, **deduce** appropriate testability vectors for the given parameters.	PO2(3) PSO3(3)
CO4	Ability to **conduct experiments** using VLSI tools for a given application/problem statement.	PO4(3) PO5(3) PO9(3)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**Total**
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	**3**	-	-	-	-	-	-	-	-	-	-	-	**3**
CO3	-	**3**	-	-	-	-	-	-	-	-	-	-	**3**
CO4	-	-		**3**	**3**	-	-	-	**3**	-	-	-	**3**

Course Title	WIRELESS AND CELLULAR NETWORKS				
Course Code	22ET6PCWCN	Credits	4	L-T-P	3:0:1
Pedagogy: 40 Lectures+ 10 Laboratory sessions					

Prerequisites: Digital communication

Objectives:

- To understand the evolution of wireless communication systems from 1G to 5G
- To study the different types of Mobile radio propagation and its impact on the signal loss
- To understand various concepts and architecture of cellular networks

MODULE-I	8 Hrs

Evolution of wireless Communication Systems: Introduction, Historical Trend of Wireless Communications, Paging system, Cordless telephone system, Cellular telephone system, Advantages and disadvantages of mobile communications, Comparison of 3G, 4G and 5G networks, applications of wireless communications.

The Cellular Concept-System Design fundamentals: Introduction, Frequency reuse, Channel assignment strategies, Handoff Strategies, interference, and system capacity Improving coverage and capacity in cellular systems

MODULE-II	8Hrs

Mobile Radio Propagation: Large scale Path loss-Introduction to radio wave propagation, free space propagation model, The three basic propagation mechanisms, Reflection, ground reflection model, Diffraction, Scattering **Outdoor propagation models:** Okumura model and Hata model, introduction to small scale fading, equalization and diversity techniques.

MODULE-III	8 Hrs

GSM: System overview, the Air interface, Logical and physical channels, Synchronization. Establishing a connection and handover, Examples of Different Kinds of Handovers- Handover between BTSs Belonging to the same BSC, Handover between Two BTSs that are Controlled by Different BSCs & the Same MSC. Services and Billing

MODULE-IV	8 Hrs

LTE-Introduction and Background: Introduction to Multi Access, Frequency Division Multi Access, Time Division Multi Access, Space Division Multi Access, The Context for the Long Term Evolution of UMTS, Need for LTE, Requirements and Targets for the Long-Term Evolution, Technologies for the Long Term Evolution, High-Level Architecture of LTE(From UMTS to LTE)

MODULE-V	8 Hrs

Introduction to 5G: What is 5G? 5G New Radio (NR), 5G – requirements and capabilities, Drivers for 5G-Evolution of LTE Technology to Beyond 4G, 5G Roadmap, 10 Pillars of 5G, Spectrum allocation and Dynamic spectrum sharing, Spectrum for 5G, 5G Architecture, 5G use cases

Lab Experiments

1. Simulate simple BSS with transmitting nodes in wireless LAN and determine the performance with respect to transmission of packets.
2. Simulate simple Wi-fi and Wimax with transmitting nodes in wire-less LAN by simulation and determine the performance with respect to transmission of packets.
3. MANET (Mobile Adhoc Networks) simulation using Omni-directional Antenna model and Analysis
4. Setting up of optical analog link
5. Setting up of optical digital link
6. To find various Fibre losses of the given optical fibre

Text books:

1. Wireless communications- Principles and Practice, Theodore S Rappaport, Pearson, 2nd Edition

2.Wireless Communications, Andreas F Molisch, Wiley, 2012

3.LTE – The UMTS Long Term Evolution From theory to practice, Stefania Sesia, Issam Toufik, Matthew Baker, 2nd edition, Wiley publications

4.5G Technology, Harri Holma and Antti Toskala,Takehiro Nakamura Wiley, 2020

Reference books:

1.D. Tse and P. Viswanath, "Fundamentals of Wireless Communications," Cambridge Univ Press, 2005

2.LTE- The UMTS long term Evolution: From Theory to Practice Stefania, ISSan Toufik and Mathew Baker 2009 , John Wiley and Sons Ltd

3.Fundamentals of 5G Mobile Networks, Jonathan Rodriguez, 1st edition, Wiley 2015

E- References:

1.	WIRELESS COMMUNICATIONS, Andrea Goldsmith, Cambidge University Press, 2005

e–Learning :

1.Wireless Communication https://nptel.ac.in/courses/117/102/117102062/
2.Introduction to wireless and cellular communication :https://nptel.ac.in/courses/106/106/106106167/

Course Outcomes

At the end of the course, the student will have the

CO1	Ability to **define, understand** and **explain** concepts related to wireless communication and cellular network	-
CO2	Ability to **apply** the knowledge of communication to wireless and cellular networks	PO1
CO3	Ability to **analyze** the cellular concepts, different propagation models and architecture of wireless networks	PO2
CO4	Ability to conduct **experiments** to demonstrate wireless concepts using the engineering tool such as QUALNET / MATLAB	PO5 PO9
CO5	Ability to perform in a team to prepare a report and make an effective **oral presentation** of the study on topics related to Wireless Networks, radiation hazards and use of 5G in healthcare, Security vulnerabilities/aspects	PO6 PO7 PO8 PO9 PO10 PO12

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**Tota l**
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	**3**	-	-	-	-	-	-	-	-	-	-	-	**3**
CO3	-	**3**	-	-	-	-	-	-	-	-	-	-	**3**
CO4	-	-	**1**	-	-	-	-	-	-	-	-	-	**1**
CO5	-	-	-	-	**3**	-	-	-	**3**	-	-	-	**3**

Course Title	TRANSMISION LINES AND ANTENNAS				
Course Code	22ET6PCTLA	Credits	3	L-T-P	2:1:0
Pedagogy: 26 Lectures+ 10 Tutorial sessions					

Prerequisites: Engineering Mathematics , Electromagnetics

Objectives:

- Familiarise with the concepts of transmission lines and wire and broadband antennas
- Understand, apply and analyse the transmission line relates concepts using Smith chart
- Analyse radiated fields and radiation resistance for dipole and loop antennas
- Make simple wire antenna considering gain, directivity, power, bandwidth, cost

MODULE-I	8 Hrs

TRANSMISSION – LINE THEORY: Line of Cascaded T sections, The transmission Line-general solution, The infinite line, The distortion less Line, Reflection on a Line not terminated in Z0, reflection coefficient, Open and short circuited Lines, Standing waves; nodes; standing-wave ratio, Reflection factor, Reflection loss, Insertion loss, T and PI sections equivalent to Lines.

MODULE-II	8Hrs

THE LINE AT RADIO FREQUENCIES: Line parameters: Parameters of the open-wire line at high frequencies, Parameters of the coaxial line at high frequencies Input impedance of the dissipation less line, Input impedance of open-and short-circuited lines, The quarter-wave line; impedance matching, The half-wave line, Single stub impedance matching on a line, the Smith circle diagram, Application of the Smith Chart, Single-stub matching with the Smith chart.

MODULE-III	8 Hrs

ANTENNA BASICS: Introduction, basic Antenna parameters, patterns, beam area, radiation intensity, beam efficiency, directivity and gain, antenna apertures, effective height, radio communication link, radiation efficiency, fields from oscillating dipole, Antenna field zones,

Point sources, power patterns, power theorem, radiation intensity, field patterns, phase patterns. Array of two isotropic point sources, non-isotropic but similar point sources, principles of pattern multiplication, non-isotropic and dissimilar point sources, linear array of n isotropic point sources of equal amplitude and spacing.

MODULE-IV	8 Hrs

WIRE ANTENNAS: The short electric dipole, the fields of a short dipole, Radiation resistance of short electric dipole, The thin linear Antenna, Radiation resistance of the lambda /2 antenna, small loop, comparison of far fields of small loop and short dipole, loop antenna general case, far field patterns of circular loop antenna, Radiation Resistance of loops, Directivity of circular loop antenna. Application of moment method.

MODULE-V	8 Hrs
BROADBAND AND FREQUENCY INDEPENDENT ANTENNAS: Broad band basics, Infinite and finite bicolical antennas, directional biconicals, conical, disk cones and Bow ties, The frequency independent concept: Rumsey's Principle, the frequency-independent Planar log spiral antenna, log periodic antenna	
Lab Experiments: 1. Study the parameters of the transmission line 2. Study the Antenna parameters 3. To create dipole antenna and measure its parameters using HFSS 4. Study the parameters of dipole using Matlab 5. Make simple wire antenna	
Text books:	
1.	Network Lines and Fields - John D Ryder, 2e, PHI, 2003.
2.	Antennas, John D. Krauss, III (SEI) edition, McGraw-Hill International edition, 2006.
Reference books:	
1.	Antenna Theory Analysis and Design - C A Balanis, 2nd ED, John Wiley, 1997.
2.	Antennas – fundamentals, design , measurement, Lamont V Blake, Maurice W Long, third edition, SCITECH publishing , Inc Raleigh, NC
E- References:	
1	Antennas: Theory and Practice – S A Schelkunoff, J Wiley 1952
2	https://www.google.co.in/books/edition/Electromagnetic_Field_Theory_and_Transmi/tGk8BAAAQBAJ?hl=en&gbpv=1&dq=transmission+lines&printsec=frontcover
e–Learning :	
1.	https://archive.nptel.ac.in/courses/117/101/117101056/
2.	https://onlinecourses.nptel.ac.in/noc22_ee22/

Course Outcomes

At the end of the course on **Transmission Lines and antennas**, the student will have the ability to

CO1	**Apply** different properties/laws/theorems/ to **solve/derive** problems related to transmission lines and wired antennas	PO1 PSO3
CO2	A**nalyze** the given specifications of different types of transmission lines and/or antennas in various configurations.	PO2 PSO3
CO3	**Design** solutions to meet the given specifications of transmission lines and antennas.	PO3 PSO3
CO4	**conduct experiments** to analyze concepts related to transmission lines and antennas using Matlab/HFSS	PO5 PSO3
CO5	Perform in **a team** to prepare a report and make an **effective oral presentation** of the study on topics from research papers related to transmission lines/ antenna applications/ radiation hazards/ broadcast standards/ EMC-EMI/ any other.	PO6 PO7 PO8 PO10 PO12 PSO3

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	Total
CO1	**3**	-	-	-	-	-	-	-	-	-	-	-	**3**
CO2	-	**2**	-	-	-	-	-	-	-	-	-	-	**2**
CO3	-	-	**1**	-	-	-	-	-	-	-	-	-	**1**
CO4	-	-		-	**1**	-	-	-	-	-	-	-	**1**
CO5	-	-	-	-	-	**1**	**1**	**1**	-	**1**	-	**1**	**1**

Course Title	INTELLECTUAL PROPERTY RIGHTS AND CYBER LAW				
Course Code	22ES6HSIPL	Credits	2	L-T-P	2:0:0
Pedagogy: 40 Lectures					

MODULE-I	5 Hrs

Basic principles of IP laws & Patents: Introduction, Concept of property, Constitutional aspects of IP, Evolution of the patent system in UK, US and India, Basis for protection, Origin and meaning of the term patent, Objective of a patent law, principles underlying the patent law in India, the legislative provisions regulating patents, Non – patentable inventions.

MODULE-II	6Hrs

Procedure for obtaining patent: Submission of application, Filing provisional and complete specification, Examination of the application, advertisement of the acceptance, opposition, Grant and sealing of patent, Term of the patent, compulsory license.

Provisional and complete specification: Definition of Specification, Kinds of specification, provisional specification, complete specification, Claims, Conditions for amendment.

Rights conferred on a patentee: Patent rights, Exception and limitations, Duties of a Patentee.

Transfer of patent: Forms of transfer of Patent rights, Assignment, kinds of assignment, License, kinds of license, Rights conferred on a licensee, Transmission of patent by operation of law.

Infringement of patents: Construction of claims and infringement, patents held to be infringed, patents held to be not infringed.

Action for Infringement: Where a suit is to be instituted, procedure followed in the suit, Onus of establishment infringement, Defence by the defendant, The Relief's, Injunction, Damages or account of profits, patent agents.

MODULE-III	6 Hrs

Copy Right: Meaning and characteristics of copy right, Indian copy right law, requirement of copy right, Illustrations copy right in literary work, Musical work, Artistic work, work of architecture, Cinematograph film, sound recording.

Author and Ownership of copy right: Ownership of copy right, Contract of service, Contract for service, rights conferred by copy right, terms of copy right, license of copy right.

Infringement of copy right: Acts which constitute infringement, general principle, direct and indirect evidence of copying, Acts not constituting infringements, Infringements in literary, dramatic and musical works, Remedies against infringement of copy right.

Trade Marks: Introduction, Statutory authorities, procedure of registration of trademarks, rights conferred by registration of trademarks, licensing in trade mark, infringement of trade mark and action against infringement

MODULE-IV	5 Hrs

Cyber Law: An introduction, Definition, why cyber law in India, Evolving cyber law practices- for corporates, privacy in Indian cyber space. Terrorism & Cyber Crime. Cyber theft and Indian telegraph

act, Cyber Stalking	
MODULE-V	**4 Hrs**
Indian Cyber law: Protecting Indian children online, Spam, contempt in cyber space, Indian consumers & cyber space, E-courts of India.	
Text Books: 1. Dr. T Ramakrishna, "Basic principles and acquisition of Intellectual Property Rights", CIPRA, NSLIU -2005. 2. Dr.B.L.Wadehhra, "Intellectual Property Law Handbook", Universal Law Publishing Co. Ltd., 2002. 3. Cyberlaw-The Indian perspective by Pavan Duggal, 2009 Edition.	
Reference books: 1. Dr. T Ramakrishna, "Ownership and Enforcement of Intellectual Property a. Rights", CIPRA, NSLIU -2005. 2. "Intellectual Property Law (Bare Act with short comments)", Universal Law a. Publishing Co. Ltd. 2007. 3. "The Trademarks Act 1999 (Bare Act with short comments)", Universal Law Publishing Co. Ltd., 2005.	
MOOC course: 1. https://nptel.ac.in/courses/110/105/110105139/ 2. https://nptel.ac.in/courses/109/106/109106137/	

Course outcomes

At end of the course on Intellectual Property Rights and Cyber Law, the student will be able to:

CO-numbers	Course Outcomes	POs
CO1	Ability to understand and commit to professional ethics and responsibilities to obtain Intellectual property Rights like Patents, Copyright & Trademarks	PO8
CO2	Understand the impact of Patents, Copyright & Trademarks and demonstrate the knowledge of Cyber Law for the societal and environmental context	PO7
CO3	Ability to use IPRs and Cyber Law to access societal, health, safety & Cultural issues	PO6
CO4	Ability to work in multiple teams to effectively communicate IP & Cyber Law.	PO9, PO10

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	Tota l
CO1	-	-	-	-	-	-	-	1	-	-	-	-	1
CO2	-	-	-	-	-	-	2	-	-	-	-	-	2
CO3	-	-	-	-	-	2	-	-	-	-	-	-	2
CO4	-	-	-	-	-	-	-	-	2	2	-	-	2

Course Title	EMBEDDED SYSTEM DESIGN				
Course Code	22ET6PE2ES	Credits	3	L-T-P	3:0:0

Pedagogy: 40 Lectures

Prerequisites: Digital Circuits, Microcontrollers

Objectives:

- To understand the Concepts of Embedded system design
- To study the hardware and software components required for developing embedded system

MODULE-I	8Hrs

A System Engineering Approach to Embedded Systems Design: Introduction to Embedded Systems Architecture, The Embedded Systems Models, Embedded Hardware building blocks, Reading a Schematic.

MODULE-II	8Hrs

Embedded Processors & Memory: ISA Architecture Models: Application specific, Internal Processor Design, Processor Performance, Reading Processor's Datasheet, ROM, RAM, Cache Memory, Cache mapping techniques, Memory Management of External Memory, Board Memory and Performance

MODULE-III	8Hrs

Board I/O & Buses: Managing Data: Serial vs. Parallel I/O, Interfacing the I/O Components, I/O and Performance, Bus Arbitration and Timing, I2C, SPI, USB, CAN & PCI protocols, integrating the Bus with Other Board Components, Bus Performance.

MODULE-IV	8Hrs

Embedded Software: Device Drivers: Device Drivers for Interrupt-Handling, Memory Device Drivers, On-board Bus Device Drivers, Board I/O Driver. Embedded Operating Systems: Multitasking and Process Management, Memory Management, I/O and File System Management, OS Standards Example: POSIX, OS Performance Guidelines, OSs and Board Support Packages (BSPs).

MODULE-V	8Hrs

Middleware and Application Software: Introduction to Middleware, Applications with Examples, Application Layer Software Examples. Implementing the Design: Main Software Utility Tool: Writing Code in an Editor or IDE, Interpreters, Compilers, and Linkers, Debugging Tools, System Boot-Up.

Text books:

1	Embedded Systems Architecture: A Comprehensive Guide for Engineers and Programmers, Tammy Noergaard

Reference books:

1	Computer Organization and Embedded Systems. 6th Edition. By Carl Hamacher and Zvonko Vranesic and Safwat Zaky and Naraig Manjikian 3. James K Peckol, "Embedded Systems – A contemporary Design Tool", John Weily, 2008
2	Embedded system Design –Steve Heath , second edition
3	James K Peckol, "Embedded Systems – A contemporary Design Tool", John Weily, 2008.

E- References:	
1.	https://ptolemy.berkeley.edu/books/leeseshia/releases/LeeSeshia_DigitalV2_2.pdf
2.	https://mobileelectron.files.wordpress.com/2011/07/embedded-system-design-marwedel.pdf
e–Learning :	
1.	https://onlinecourses.nptel.ac.in/noc23_cs54/preview
2.	https://archive.nptel.ac.in/courses/106/105/106105193/

Course Outcomes

At the end of the course, the student will have the ability to

CO1	Apply the embedded system models, features of processors, memory and I/O systems in developing embedded System.	PO1
CO2	Analyse the embedded OS functionality and device drivers used in multitasking embedded applications.	PO2
CO3	Design embedded applications using given specifications and concepts of development process.	PO3
CO4	Implement mini projects to demonstrate applications of embedded systems.	PO5, PO9, PO10, PO12

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**Total**
CO1	**3**	-	-	-	-	-	-	-	-	-	-	-	**3**
CO2		**3**	-	-	-	-	-	-	-	-	-	-	**3**
CO3	-		**2**	-	-	-	-	-	-	-	-	-	**2**
CO4					**1**				**1**	**1**		**1**	**1**

Course Title	SATELLITE COMMUNICATION				
Course Code	22ET6PE2SC	Credits	3	L-T-P	3:0:0
Pedagogy: 40 Lectures					
Pre requisites: Communication Systems **Objective**: To study and understand the principles of Satellite communication and different subsystems of Satellite system					
MODULE-I				**8 Hrs**	
Orbits and Launching methods: Overview of satellite systems, Kepler's Laws, Orbital elements, Orbital perturbations, Inclined orbits, Sun synchronous orbits, The Geostationary Orbit-Antenna look angles, Sun transit outage, launching orbits					
MODULE-II				**8Hrs**	
The Space Segment and the Earth Segment: Power supply, Attitude control, Station keeping, Thermal control, TT&C subsystem, Transponders, Antennas subsystem, **Earth segment:** Transmit receive earth station**.**					
MODULE-III				**8 Hrs**	
The Space Link: EIRP, Transmission losses, The link power budget equation, system noise, carrier to noise ratio, Uplink, Downlink, Combined uplink and downlink C/N ratios and C/I ratio, Intermodulation noise.					
MODULE-IV				**8 Hrs**	
Satellite Access: FDMA, TDMA – pre assigned and demand assigned, switched TDMA, CDMA, satellite links and TCP					
MODULE-V				**8 Hrs**	
Satellite Applications: Direct Broadcast satellite services, Satellite mobile services, VSATs, Radarsat, GPS, Orbcomm, Indian Satellites, ITU Regulations, Standards					
Text books:					
1	**Satellite Communications:** Dennis Roddy, Tata McGraw Hill				
2	**Satellite Technology Principles and Applications: 3rd Edition,** by Anil K Maini, Varsha Agrawal, Publisher: John Wiley & Sons				

Reference books:	
1	**Satellite Communication:** Timothy Pratt, Second Edition, John Wiley and sons.
2	Satellite Communication Systems Engineering – Louis J Ippolito Jr, Wiley Publishers
3	Satellite Communication: Concepts and Applications, K N Raja Rao, PHI Learning Pvt Ltd. 2013
E- References:	
1.	International Journal of Satellite Communication and Networking - https://onlinelibrary.wiley.com/journal/15420981
e–Learning :	
1.	https://www.ansys.com/en-in/products/missions/ansys-stk
2.	https://orbitron.software.informer.com/

Course outcomes:

At the end of the course on **Satellite Communication**, the student will have the ability to

CO1	**Apply** the knowledge of science and engineering concepts to study the satellite communication systems	PO1(3)
CO2	**Analyze** orbital parameters and satellite communication link to arrive at a suitable conclusion.	PO2(2)
CO3	Function effectively as **an individual or as a team member** to make an effective oral presentation and prepare the report of the study that can be done through simulation of concepts or on topics related to advances in satellite technology.	PO5 (1), PO9(1)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**Tota l**
CO1	**3**	-	-	-	-	-	-	-	-	-	-	-	**3**
CO2	-	**2**	-	-	-	-	-	-	-	-	-	-	**2**
CO3	-	-	-	-	**1**	-	-	-	**1**	-	-	-	**1**

Course Title	INTERNET OF THINGS				
Course Code	22ET6PE2IT	Credits	3	L-T-P	3:0:0
Pedagogy: 40 Lectures					
MODULE-I				**8 Hrs**	
Introduction to IoT, Introduction, physical design of IoT, Logical Design of IoT, IoT enabling technology, IoT levels and deployment templates					
MODULE-II				**8Hrs**	
Smart Objects: The "Things" in IoT: Sensors, Actuators, and Smart Objects, Sensor Networks, Connecting Smart Objects, Communications Criteria, **IoT Access Technologies:** IEEE 802.15.4, IEEE 802.15.4g and IEEE 802.15.4e					
MODULE-III				**8 Hrs**	
IoT Access Technologies: IEEE1901.2a, IEEE 802.11ah, LoRaWAN, NB-IOT and other LTE variations **IP as the IoT Network Layer:** The Business Case for IP, The need for Optimization, Optimizing IP for IoT, Profiles and Compliances					
MODULE-IV				**8 Hrs**	
Application Protocols for IoT: The Transport Layer, IoT Application Transport Methods: Generic Web Based Protocols, IoT Application Layer Protocols **IoT Platforms Design Methodology:** Introduction, IoT Design Methodology , Case study on IoT system for weather Monitoring; **IoT Systems – Logical Design using Python:** Introduction, Python Data Types and Data structures					
MODULE-V				**8 Hrs**	
IoT Systems – Logical Design using Python: Control flow, functions, Modules, Packages, File Handling, Data/Time operations **IoT Physical Devices and End points:** what is an IoT Devices Exemplary Device: Raspberry Pi, About the Board, Linux on Raspberry Pi, Raspberry Pi Interfaces					
TEXT BOOKS: 1. Internet of Things, A Hands-on Approach , Arshdeep Bahga, Vijay Madisetti, Universities Press 2. "IoT Fundamentals: Networking Technologies, Protocols and Use Cases for the Internet of Things", David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton and Jerome Henry, 1st Edition, Pearson Education (Cisco Press Indian Reprint), ISBN: 978-93-868-7374-					
REFERENCE BOOKS:					

1. “Internet of Things”, Srinivasa K. G., CENGAGE Leaning India, 2017.

2. “Internet of Things: Architecture and Design Principles”, Raj Kamal, 1st Edition, McGraw Hill Education, 2017

Course outcomes:

At the end of the course on **Internet of Things**, the student will have the ability to

CO1	Ability to **understand, define** and **explain** the fundamental concepts of Internet of things and wireless sensor networks	--	**PSO3** (1)
CO2	Ability to **apply** the knowledge of communication, networks and coding to networks	PO1(2)	
CO3	Ability to **analyse** the given network parameters and arrive at suitable conclusions	PO2(1)	
CO4	Ability to implement and demonstrate the specified **mini-project** using suitable communication and sensor network parameters	PO3(2) PO5(2) PO9(1)	

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**Tota l**
CO1													
CO2	**2**												**2**
CO3		**1**											**1**
CO4			**2**		**2**				**1**				**5**

Course Title	OPERATING SYSTEMS				
Course Code	22ET6PE2OS	Credits	3	L-T-P	3:0:0
Pedagogy: 40 Lectures					

Prerequisites: Basics of C programming

Objectives:

- Students will learn the importance of an Operating System
- Students will learn difference between a process and a program
- Introduce the concepts of CPU Scheduling and explain the method of evaluations of various scheduling algorithms
- Explain and build applications using inter-process communication mechanisms.
- Understand the deadlocks between processes and how to build systems to avoid deadlocks.
- Learn about memory management, memory allocation by an OS to processes, virtual memory concepts including paging, segmentation and demand paging.
- Understand the concepts of files and directories and build systems around these constructions.

MODULE-I	**8 hrs**

Introduction: Abstract view of operating system, Goals of an OS, Operation of an OS; **Overview of Operating System** : OS and the Computer System, Efficiency, System Performance and User Convenience, Classes operating System

MODULE-II	**8hrs**

Scheduling: Preliminaries, Non-preemptive scheduling policies, Preemptive Scheduling policies, Real Time Scheduling

Memory Management: Memory allocation process, Reuse of Memory, Contiguous Memory allocation, Non-Contiguous Memory Allocation, Paging, Segmentation, Segmentation with Paging

MODULE-III	**8 hrs**

Virtual Memory: Virtual Memory Basics, Demand Paging – Overview of paging, Demand paging preliminaries, Page replacement; Page Replacement Policies **Process Concept:** Overview, Process Scheduling, Operations on Process, Inter Process Communications (IPC); **Multithreaded Programming:** Overview, Multithreading models, Thread Libraries.

MODULE-IV	**8 hrs**

Process Coordination: Synchronization, The critical section problem, Peterson's solution, Synchronization hardware, Semaphores, Classical problems of synchronization

Deadlocks: Definition of deadlock, Deadlock in Resource Allocation, Handling Deadlocks, Deadlock Detection and Resolution, Deadlock Prevention, Deadlock Avoidance

MODULE-V	**8 hrs**

File System: File Concept, Access Methods, Directory Structure, File system Mounting;

Implementing File Systems: File - System Structure, File - System Implementation, Directory implementation, Allocation Methods, NFS

Text books:	
1	"Operating Systems - A Concept based Approach", D. M. Dhamdhare, TMH, 3rd Ed, 2012.
2	" Operating System Principles" , Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Wiley, 7th Edition
Reference books:	
1	Operating System – Internals and Design Systems, Willaim Stalling, Pearson Education, 4th Ed, 2006
E- References:	
1.	https://www.e-booksdirectory.com/listing.php?category=26
e–Learning :	
1.	https://onlinecourses.nptel.ac.in/noc23_cs101/preview
2.	https://archive.nptel.ac.in/courses/106/105/106105214/#

Course outcomes

At the end of the course on **Operating system**, the student will have the ability to

CO1	Explain the fundamental concepts of operating systems	
CO2	Apply the concepts of mathematics and coding knowledge to obtain the solution for specified parameters	PO1(3)
CO3	Analyse the given systems parameters and arrive at suitable conclusions	PO2(2)
CO4	Implement and demonstrate the specified **mini-project** using suitable operating system algorithms	PO3(1) PO5(1) PO9(1)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**Tota l**
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	**3**	-	-	-	-	-	-	-	-	-	-	-	**3**
CO3	-	**2**	-	-	-	-	-	-	-	-	-	-	**2**
CO4	-	-	**1**	-	**1**	-	-	-	**1**	-	-	-	**1**

Course Title	COMPUTER COMMUNICATION NETWORKS				
Course Code	22ET6OE1CN	Credits	3	L-T-P	3:0:0
Pedagogy: 40 Lectures					
Prerequisites: Basics of Communication **Objectives:** Introduction to analysis and design of computer and communication networks through understanding the network layered architecture and the protocol stack and by conducting hands-on programming and lab activities.					
MODULE-I				**8 Hrs**	
Overview: Data communication , Networks, The Internet, Protocols and Standard; **Network Models**: Layered Tasks, The OSI Model, layers in the OSI model					
MODULE-II				**8Hrs**	
TCP/IP Protocol Suite**,** addressing; **Physical Layer:** Transmission media – Introduction, Guided media, Unguided Media- Wireless; Telephone networks, Cable TV networks, Cable TV for data transfer; **Data link Control: Framing,** Noiseless channels, Noisy channels					
MODULE-III				**8 Hrs**	
Data link Control :Multiple access: Random access, controlled access, channelization; **Data Link Layer: Wire LANs: Ethernet –** IEEE Standards, Standard Ethernet, Changes in standard					
MODULE-IV				**8 Hrs**	
Wireless LANs - Bluetooth; **Connecting LANs, Backbone networks and Virtual LANs:** Connecting Devices, Backbone Networks, Virtual LANs; **Network layer: Logical Addressing:** IPv4 addresses,IPv6 Addresses					
MODULE-V				**8 Hrs**	
Application layer: Domain Name system: Name space, Domain Name space, Distribution of name space, DNS in the internet, Resolution ; **Remote logging, Electronics mail and File transfer:** Electronic mail, File transfer ; **WWW and HTTP:** Architecture, web documents , HTTP					
Text books:					
1.	Data Communication and Networking, Behrouz Forouzan, 4th Edition, Tata Mcgraw Hill				
Reference books:					
2.	Computer Networks, Andrew S Tanenbaum, 3rd Edition, PHI				
3.	J.F. Kurose and K. W. Ross, "Computer Networking – A top down approach featuring the Internet", Pearson Education, 5th Edition				
e–Learning :					

1.	https://onlinecourses.nptel.ac.in/noc22_ee61/
2.	https://ocw.mit.edu/courses/6-263j-data-communication-networks-fall-2002/

Course outcomes

At the end of the course on **Computer Communication Networks**, the student will have the ability to

CO1	Explain the concepts of computer communication networks	-
CO2	Apply the concepts of communication fundamentals to obtain the solution for specified parameters	PO1(3)
CO3	Analyse the given network systems parameters and arrive at suitable conclusions	PO2(2)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**Total**
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	**3**	-	-	-	-	-	-	-	-	-	-	-	**3**
CO3	-	**2**	-	-	-	-	-	-	-	-	-	-	**2**

Course Title	DISTRIBUTED SYSTEMS				
Course Code	22ET6OE1DS	Credits	3	L-T-P	3:0:0
Pedagogy: 40 Lectures					
Prerequisites: Computer communication networks Objectives: Ability to learn distributed systems					
MODULE-I				**8 Hrs**	
Characterization of Distribution systems: Introduction, Examples of Distributed systems, Resource sharing and the Web, Challenges					
MODULE-II				**8Hrs**	
System Models: Introduction, Architectural models, Fundamental models					
MODULE-III				**8 Hrs**	
Networking and Internetworking: Introduction, Types of Network, Network Principles, Internet protocol					
MODULE-IV				**8 Hrs**	
Networking and Internetworking: Case studies: Ethernet, WiFi Inter Process Communication: Introduction, API for Internet Protocols, External Data Representation and Marshalling, Client – Server Communication, Group Communication					
MODULE-V				**8 Hrs**	
Distributed Multimedia systems: Introduction, Characteristics of Multimedia Data, Quality of Service Management, Resource management, Stream Adaptation, Caste study: The tiger video file server					
Text books:					
1	Distributed Systems Concepts and Design, George Coulouris, Jean Dollimore, Tim Kindberg, Pearson, 4th Edition				
2	Andrew S Tanenbaum: Distributed Operating Systems, 3rd edition, Pearson publication, 2007				
Reference books:					
1	SunitaMahajan, Seema Shan, Distributed Computing, Oxford University Press,2015				
2	Ajay D. Kshemkalyani and MukeshSinghal, Distributed Computing: Principles, Algorithms and Systems, Cambridge University Press, 2008				
E- References:					

1.	https://nnrg.edu.in/PDF/Course/cse/R18/IV/DS.pdf
2.	https://www.vturesource.com/vtu-syllabus/CS/2017/6/17CS654
e–Learning :	
1.	https://onlinecourses.nptel.ac.in/noc21_cs87/preview
2.	https://onlinecourses.nptel.ac.in/noc21_cs15/preview

Course outcomes

At the end of the course on **Distributed systems**, the student will have the

CO1	Ability to **understand** the distributed systems concepts	--
CO2	Ability to **apply** the knowledge of APIs for internet protocols	PO1
CO3	Ability to **analyze** External Data Representation and Marshalling	PO2
CO4	Ability to present a seminar based on distributed systems concepts.	PO9,PO10,PO12

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**Total**
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	**3**	-	-	-	-	-	-	-	-	-	-	-	**3**
CO3	-	**2**	-	-	-	-	-	-	-	-	-	-	**2**
CO4	-	-	-	-	-	-	-	-	**3**	**3**	-	**3**	**3**

Course Title	OPERATION RESEARCH				
Course Code	22ET6OE1OR	Credits	3	L-T-P	3:0:0

Pedagogy: 40 Lectures

Prerequisites: Engineering mathematics

Objective: To solve optimization problems for the management of resources using math, mind and tools.

MODULE-I	8 Hrs

LINEAR PROGRAMMING: Introduction, General system, Definition, mathematical formulation, standard form, graphical method: feasible, infeasible, multiple solution, unbounded solution and simplex method: feasible, infeasible, multiple solution, unbounded solution, Duality in LPP, Dual Simplex method.

MODULE-II	8Hrs

TRANSPORTATION PROBLEM: Formulation of transportation model, basic feasible solution using different methods, optimal solutions, degeneracy in transportation problems, unbalanced transportation problem

ASSIGNMENT PROBLEM: Formulation, balanced, unbalanced and maximization assignment problem, travelling salesman problem using Hungarian method.

MODULE-III	8 Hrs

QUEUING THEORY: Queuing system and their characteristics, Analysis of Markovian queues, M/M/1, M/M/K queuing system.

MODULE-IV	8 Hrs

PROJECT MANAGEMENT USING NETWORK ANALYSIS: Network construction, determination of critical path and duration, floats using CPM. PERT-Estimation of project duration, Variance and crashing of projects

GAME THEORY: Two persons - zero sum game, games with and without saddle point, graphical solution, dominance property.

MODULE-V	8 Hrs

COMPUTER BASED OR PROBLEM SOLVING

Solving Operations Research problems - Constraint programming problems - Linear programming problems - Integer programming problems, Traveling Salesman Problem - Vehicle Routing Problem - Graph algorithms - shortest paths. Solving optimization problems using SciPy. Mathematical modelling, Solving simple examples, Implementation of Simplex method, Travelling Salesman problem, simulation of queuing model.

Text books:

1. Operations Research and Introduction, Taha H A, Pearson Education, 9th Edition,2014
2. Introduction to Operation Research, F K Hiller and Liberman, McGraw hill Education Pvt. Ltd, 9th Edition, 2011

3. Operations Research –Principles and practice, Philips Ravindaran and Soleberg, Wiley Publication, 2nd Edition, 2007

Reference books:

1. Operations Research, S D Sharma, KedarNath, Ram Nath Publication, 2014
2. Operations Research, Kanthiswarup and others, Sultan Chand and sons, 2014
3. Operations Research Problems and Solutions, J K Sharma, McMillan Publishers, 3rd Edition, 2009.
4. Operations Research, P K Gupta and Hira, S Chand Publications, 2007
5. Introduction to linear optimization Dimitris Bertsimas
6. Convex optimization by Stephen Boyd and Lieven Vandenberghe

E- References:

1.	https://www.academia.edu/40241552/Operation_Research_Problems_Solving_in_Python

e–Learning :

1.	Introduction to Operations Research, IIT Madras, Prof. G. Srinivasan https://nptel.ac.in/courses/110106062
2.	Operations Research (1): Models and Applications by Ling –Chieh- Kung https://www.coursera.org/learn/operations-research-modeling

Course outcomes

At the end of the course on **Operation Research**, the student will have the

CO1	Ability to understand the resource management using optimisation techniques	--
CO2	Ability to **apply, analyse and classify** operations research problems and obtain a feasible solution	PO1,PO2
CO3	Ability to **design and model** optimisation problems	PO3
CO4	Ability to **conduct** investigation through implementation of the experiment using software tools like Excel/ Java and/ Python	PO4,PO5,PO6,PO7,PO12

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**Tota l**
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	**2**	**2**	-	-	-	-	-	-	-	-	-	-	**2**
CO3	-	-	**2**	-	-	-	-	-	-	-	-	-	**2**
CO4	-	-	-	**3**	**3**	**3**	**3**	-	-	-	-	**3**	**3**

Course Title	INTERNSHIP BASED SEMINAR				
Course Code	22ET6SRIN2	Credits	1	L-T-P	0:0:1

During semester breaks, students are encouraged to engage in community service, through an NGO or as an individual. The duration of the activity shall be of 4 to 6 week duration. The work carried out in the semester break is assessed through an oral seminar accompanied by a written report. It is expected that this association will motivate the student to develop simple Electronic (or other) products to make their life comfortable, through suitable projects in later semesters.

At the end of the course, the student will have the ability to,

CO1	Engage in community service	PO6
CO2	Prepare the project report, three minute video and the poster of the work	PO10
CO3	Identify and specify an engineering product that can make their life comfortable	PO2
CO4	Prepare a business plan for a commercial venture of the proposed product, together with complying to relevant norms	PO7 PO8 PO11
CO5	Identify the community that shall benefit from the product	PO6

Course Title	MINI PROJECT-2				
Course Code	22ET6PWMP2	Credits	2	L:T:P	0:0:2

General Instructions:

1. A team of two to four students shall be permitted to work on a single mini project.
2. The mini project shall comprise of hardware / software component.
3. Students shall be evaluated on regular and continuous basis as per the prevailing rubrics
4. The team shall ensure that the project is in working condition during final demonstration.
5. The student is required to submit a report based on the project work carried out.
6. The team needs to demonstrate their mini project developed at the end of semester having scope to be taken to next higher level in next semester will be encouraged.

At the end of the course, the student will have the ability to,

CO1	Engage in relevant survey and **identify** the standard to be implemented, together with listing the **desired specifications**	**PO2 (3)** **PO12 (3)**	**PSO3 (3)**
CO2	**Identify** the essential concepts, and identify the algorithm for the implementation	**PO1 (3)** **PO3 (3)**	
CO3	**Implement** and **analyse** the designed program, to match the specifications	**PO4 (2)**	
CO4	Calculate the **performance analysis** of the project	**PO11 (2)**	
CO5	Prepare the **project report**, three minute **video** and the **poster** of the work	**PO10 (3)**	
CO6	Engage in the **team** to document the business plan of the designed project, together with **complying** to **relevant norms**	**PO7 (2)** **PO8 (3)** **PO9 (3)**	
CO7	Identify the **community** that shall benefit from the project	**PO6 (1)**	

Course Title	PERSONALITY DEVELOPMENT, APTITUDE AND COMMUNICATION SKILLS				
Course Code	22ET6NCPDC	Credits	NC	L:T:P	0:0:0

This course introduces to the following components:

Personality development:

Communication Skills:

Soft skills: Emotional Intelligence, Adaptability, Team player attitude, openness to feedback, growth mindset, work ethics, active listening

Aptitude skills:

The contents of this is to be developed.

It is planned to offer this course with support from alumni, or faculty/students from other departments.

Course outcomes

At the end of the course, the student will have the ability to,

CO1	Demonstrate professional communication skills	**PO10 (3)**	
CO2	Demonstrate aptitude and reasoning skills	**PO4 (3)**	
CO3	Demonstrate balanced emotional quotient and interpersonal skills	**PO9 (3)**	

VII Semester

Course Code	Biology for Engineers	Course Name	22ES7BSBFE
Credits	01	L-T-P	1-0-0
Pedagogy: 15 Lectures			

MODULE - I

Sensing Techniques : Understanding of Sense organs working – Sensing mechanisms – Sensor Development issues – Physiological Assist Device: Artificial Organ Development: Kidney, Liver, Pancreas, heart valves – Design Challenges and Technological developments.

MODULE - II

Nature-bio-inspired mechanisms (qualitative): Echolocation (ultrasonography, sonars), Photosynthesis (photovoltaic cells, bionic leaf). Bird flying (GPS and aircrafts), Lotus leaf effect (Super hydrophobic and self-cleaning surfaces).

MODULE - III

Bio printing techniques and materials: 3D printing of ear, bone and skin. 3D printed foods. Electrical tongue and electrical nose in food science, DNA origami and Biocomputing, Bio imaging and Artificial Intelligence for disease diagnosis

MODULE - IV

Introduction to Radiation: Source and Types of Radiation, Types of Ionizing Radiation, X-rays for Medical Use and Generators Types of Electromagnetic Waves, Ionization of Radiation – Property of Ionizing Radiation **.** Penetrating Power of Radiation within the Body, Penetrating Power and Range of Effects on the Human Body.

MODULE - V

Radiation Effects on Human Body: Types of Effects, Exposure Modes and Effects Classification of Radiation Effects Deterministic Effects and Stochastic Effects, Mutation, Mechanism of Causing Effects on Human Body. Ionization due to Radiation, Damage and Repair of DNA. Radio sensitivity of Organs and Tissues.

Course Outcomes:

At the end of the course, students will have the ability

CO1	To understand biological concepts from an engineering perspective.
CO2	To familiarize the concepts of biological sensing, bio printing techniques and materials , Role of Artificial Intelligence for disease diagnosis
CO3	Understand the basics of radiation and its effects on Human Body

Reference books:

1.	Biology for Engineers, Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi S., and Jaganthan M.K., Tata McGraw-Hill, New Delhi, 2012.
2.	Biomedical Instrumentation, Leslie Cromwell, Prentice Hall 2011.
3.	Biomimetics: Nature-Based Innovation, Yoseph Bar-Cohen, 1st edition, 2012, CRC Press.
4.	Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies, D. Floreano and C. Mattiussi, MIT Press, 2008.

5.	3D Bioprinting: Fundamentals, Principles and Applications by Ibrahim Ozbolat, Academic Press, 2016
6.	Electronic Noses and Tongues in Food Science, Maria Rodriguez Mende, Academic Press, 2016
E-References	
1.	https://ocw.mit.edu/courses/20-010j-introduction-to-bioengineering-be-010j-spring-2006
2.	https://www.coursera.org/courses?query=biology
3.	https://onlinecourses.nptel.ac.in/noc19_ge31/preview
4.	https://www.classcentral.com/subject/biology
5.	https://www.futurelearn.com/courses/biology-basic-concept
e–Learning :	
1.	VTU EDUSAT / SWAYAM / NPTEL / MOOCS / Coursera / MIT-open learning resource https://nptel.ac.in/courses/121106008
2.	https://freevideolectures.com/course/4877/nptel-biology-engineers-other-non-biologists
3.	https://freevideolectures.com/course/4877/nptel-biology-engineers-other-non-biologists
4.	https://ocw.mit.edu/courses/20-020-introduction-to-biological-engineering-design-spring-2009

Course Title	Microwaves and Radar				
Course Code	22ET7PCMWR	Credits	4	L:T:P	3:0:1
Pedagogy: 40 Lectures+ 10 Laboratory sessions					
MODULE I					[8 hours]
Transmission Line, waveguide: Quarter wave transformer, Generator and Loadmismatch, coaxial line, waveguides, microstrip transmission lines					
MODULE II					[8 hours]
Microwave Network Analysis: Impedance and admittance matrix, Scattering matrix, Transmission matrix, signal flow graphs, matching with lumped elements, theory of small reflections, binomial multisection matching transformer					
MODULE III					[8 hours]
Power Dividers, Directional Couplers and Microwave filters: The T-Junction Power Divider, The Wilkinson Power Divider, The Quadrature Hybrid, Filter Design by the Insertion Loss Method, Two-Port Power Gains for amplifiers					
MODULE IV					[8 hours]
RADAR Basic Principles: Radar equation, Radar Cross section, CW Radar, FMCW Radar, PulsedRadar Principles, Clutter Analysis, MTI Improvement Factor, Pulsed Doppler Radar, Tracking Radar, Angular resolution, Monopulse Technique					
MODULE V					[8 hours]
Measurements with RADAR: Match Filtering, Radar Ambiguity Function, Imaging Radar: Resolution Concept, Pulse Compression, Synthetic Aperture Processing, ISAR Imaging, Probability of false alarm and Detection, Modified Radar Range Equation with Swerling Models, Ground PenetratingRadar for close sensing, EM hazards					

List Of Experiments:

1. **Measurement of Frequency and Wavelength** – Using a slotted line to determine frequency and guide wavelength in a rectangular waveguide.
2. **VSWR and Reflection Coefficient Measurement** – Using a directional coupler to measure standing wave ratio and calculate the reflection coefficient.
3. **Attenuation Measurement** – Measuring the attenuation of microwave signals using a variable attenuator.
4. **Radiation Pattern of Horn Antenna** – Determining the radiation characteristics and beam width of a horn antenna.
5. **Impedance Measurement** – Using a Smith chart and slotted line to measure unknown impedance.
6. **Directional Coupler Characteristics** – Measuring coupling factor, directivity, and isolation in a microwave directional coupler.
7. **Reflex Klystron Characteristics** – Studying the mode characteristics and tuning range of a reflex klystron.
8. **Magic Tee Characteristics** – Measuring the scattering parameters (S-parameters) of an H-plane Tee, E-plane Tee, and Magic Tee.
9. **Radar Signal Processing and Doppler Effect** – Simulating the effect of Doppler shift in radar signals and analyzing target velocity.
10. **Radar Range Equation and Target Detection** – Implementing the radar range equation in MATLAB and simulating the detection of a target at different distances.

Course Outcomes:

At the end of the course, students will have the ability to

CO1	Define and explain the operation of various microwave transmission lines, waveguides, and microwave sources used for high-frequency signal transmission, including RADAR applications.	PO1(3)	PSO2(3)
CO2	Apply the principles of electromagnetic theory and network analysis to analyze microwave propagation and RADAR communication.	PO2(3)	
CO3	Evaluate and analyze the characteristics and performance parameters of microwave components such as power dividers, directional couplers, and filters for efficient RF and RADAR system design.	PO3 (3)	
CO4	Design waveguide components and impedance-matching networks for various microwave and RADAR applications.	PO3 (3), PO5 (3)	
CO5	Conduct experiments to measure microwave component parameters such as power, VSWR, S-parameters, coupling factor, directivity, and isolation using a microwave bench or simulation tools.	PO4 (3), PO5 (3)	
CO6	Analyze and interpret RADAR signal processing techniques, including pulse compression, match filtering, and synthetic aperture radar (SAR) imaging.	PO4 (3)	
CO7	Engage in independent learning, submit technical reports, and use ICT tools for effective presentations on topics related to microwave link standards, radiation hazards, RADAR applications, and societal/environmental impact.	PO9 (3), PO10 (3)	

TEXT BOOKS:

1. Microwave Engineering, by David Pozar, Third edition, 2005, Wiley Publication
2. Microwave Engineering, by Annapurna Das and Sisir K Das, second edition, McGraw Hill
3. Introduction to RADAR systems: Merril I Skolnik, Second edition, McGraw Hill

REFERENCE BOOKS:

1. Microwave Devices and Circuits, Samuel Y Liao, Third Edition, PHI

MOOCs:

1. Microwave Engineering, By Prof. Ratnajit Bhattacharjee, IIT Guwahatihttps://swayam.gov.in/nd1_noc19_ee68/
2. Principles and Techniques of Modern Radar Systems, By Prof. Amitabha Bhattacharya, IITKharagpur, https://swayam.gov.in/nd1_noc19_ee58/

Course Title	SUSTAINABLE TELECOM NETWORKS				
Course Code	22ET7PCSTN	Credits	1	L:T:P	0:1:0

Objective: To comprehend the need of sustainability and its impact on fostering the expansion of the Telecommunications sector.

Sustainability: Definition, theory of sustainability, Human, Social, Economic and Environmental sustainability, drivers and challenges of sustainability, 5 sustainability initiatives in the Telecommunications industry.

Green Energy Technology (GET) for Telecom Applications: Introduction, The need of Clean or Green Energy, Telecom Industry and Green Energy, Green mobile networks, the role of telco AI in reducing network energy.

Regulatory Framework: Radio regulation, The Telecommunication Interconnection Usage Charges Regulations, Mobile number regulations, portability, interconnection issues,

Radiation standards: Introduction, RF and Microwave Radiation, Safety standards for personnel-CENELEC, IEEE and FCC standards, SAR for cell phones, radiation hazards, Myths and Realities, Biological Effects caused by RF energy, FCC guidelines for RF exposure, Specific Absorption Rate (SAR) value for a mobile phone, "hands-free" ear pieces for mobile phones to reduce exposure to RF emissions.

Innovative Business Models for Sustainable Telecoms Growth: Overview, Paradigm shift in strategic thinking, Sustainable subscriber growth, giving access to rural area, Providing Affordable Value-Added Services Service Differentiation, Key challenges for Service Providers

Text books:	
1.	The Telecommunications Handbook, Kornel Terplan, Patricia A. Morreale, 1st edition, CRC Press, 2000.
2.	Business Models for Sustainable Telecoms Growth in Developing Economies, Sanjay Kaul MBA in Marketing,, Dr Fuaad Ali, Subramaniam Janakiram, Wiley, 2008.
Reference books:	
1	Green Networking and Communications: ICT for Sustainability, Shafiullah Khan, Jaime Lloret Mauri, CRC press, 2014
e–learning:	
1	https://archive.nptel.ac.in/courses/110/105/110105073/

Course Outcomes:

At the end of the course, students will have the

CO1	Ability to understand and **explain** the need for sustainability, role of regulatory bodies, radiation hazards and revenue models for telecommunication networks	-
CO2	Ability to **apply** the knowledge of radiation to minimize its effect on human health and environment and finance management to arrive at effective business models for sustainable telecom growth.	**PO1, PO11**
CO3	Ability to engage in independent learning, submit a report and use ICT for **effective presentation** on the study on topics related to, Awareness on Mobile Tower Radiation & Its Impacts on Environment, human health and protection from radiation hazards	**PO9** **PO10** **PO12**

Course Title	SIGNAL INTEGRITY AND EMI/EMC				
Course Code	22ET7PCSIE	Credits	2	L-T-P	2:0:0
Pedagogy: 26 Lectures					

Prerequisites: Electromagnetic field theory, basic circuit analysis, Antenna and Communication Theory

Objectives: To study concepts of electromagnetic compatibility and interference and signal integrity.
To study the basics of EMC testing
To understand the effects of conducted emission and means of handling them
To make a test setup for conducted emission, measure and reduce them.

MODULE-I	5 hrs

INTRODUCTION TO SIGNAL INTEGRITY AND ELECTROMAGNETIC COMPATIBILITY:
EMC, Impact of non-compliance on products, Need for EMC, Qualifying Products for International Regulations, EMC Certification Standards, Basic Terminology: Source, Victim, Types of coupling - Capacitive, inductive, conducted and radiated with problems/examples, Testing Basics: Emission, Immunity and Transients,
SIGNAL INTEGRITY BASICS

EMC DESIGN- CAUSE FOR EMI PROBLEMS: Time varying Magnetic & Electric field, Cross talk due to Coupling, Resonance, Role of Discrete components RLC in EMC, Differential signals, Common mode noise and filtering,

MODULE-II	5 hrs

EMC Testing Basics: Units, formulas and conversions, Different test environments, Block diagram of Spectrum Analyser/Receiver, Detectors, Narrow band and Broadband measurements, Pre-compliance tests, Using Network Analyser and EMI Receivers

Test Setups, Regulation And Standards: Automotive & Commercial standards, Emission tests, Radiated Susceptibility, Conducted Immunity, Introduction to Automotive and Commercial transient tests, ESD, EFT and Surge, ISO pulse, EMC for EVs, EMC For wireless testing

MODULE-III	5 hrs

GROUNDING & BONDING: Need for grounding, Ground Symbols, Safety Ground, Earth ground, chassis ground, reference ground, Ground plane resonance & Ground loops ,Single point, multi point & hybrid ground, Importance of ground return in EMC, Slot in the ground plane and EMI due to Ground bounce, Bonding, Equivalent circuit, Type of bonds, EMS reduction by bonding , Related case studies

MODULE-IV	5 hrs

SHIELDING: Need for shielding, Usage of shielding, Ineffective shielding, Shielding Thickness, Near field & far field effect, skin depth, Reflection loss & Absorption loss, Shielding effectiveness, Magnetic shielding, Shielding electronic circuits, Apertures, shielding materials, Shielded windows & doors, gaskets, Shielded cables, Twisted pair, Coax, FRC etc., Shield Terminations: LF, HF, Video Shield terminations in Equipment Chassis, System Design & Housing, Introduction to Transient Suppression Design: ESD, EFT and Surge, EMI/EMC troubleshooting case studies

EMC For System Design: Cabling and Wiring guidelines

MODULE-V	4 hrs

PCB Layout Design- PCB Construction ,Prepreg and core, PCB layers, Foil based versus core-based PCB, Trace Impedance, PCB Layout planning, PCB Layer planning, PCB Layout – grounding, PCB Design Guidelines: Filtering at the entry of the PCB, Filtered and non-filtered regions, Eye of the needle principle, Signal routing: Cut in the ground plane, Analog & Digital ground interface, Traces in the edge of PCB, avoiding ground loops, High speed signal and clock traces: Routing Clock traces, Routing Signal lines, guard traces, PCB Guidelines for Crystals, Guidelines for Switching regulators and inductors, Guidelines for sensitive op amps, PCB Guidelines - Differential lines, Ethernet,
Case studies: ESD failures due to PCB design; Emission failure due to faulty SVR - PCB design
Introduction to computational Electromagnetics(CEM) and Features of any one 3D simulation tools
Practical: Making a simple set up using 3D simulation tools (HFSS or CST or SimYog – Comscope)

Lab Experiments:
Usage of Spectrum analyser and EMI Receiver
Conducted emission testing
3D simulation using HFSS

Text books:

1.	Henry W. Ott · "Electromagnetic Compatibility Engineering",2009
2.	E. Kreyszig: "Introduction To Electromagnetic Compatibility, 2nd Ed ", John Wiley & Sons, 10th Ed. (Reprint), 2016.
3.	Signal and Power Integrity simplified, Eric Bogatine, second edition, Prentice Hall

Reference books:

1.	V.P.Kodali, ―Engineering EMC Principles, Measurements and Technologies‖, IEEE Press, Newyork, 1996.
2.	C.R. Pal, "Introduction to Electromagnetic Compatibility", Ny, John Wiley, 1992.

E- References:

1.	"Electromagnetic Interference and Compatibility", IMPACT series, IIT- Delhi, Modules 1-9.

2.	https://www.google.co.in/books/edition/Electromagnetic_Compatibility_Engineerin/
e–Learning :	
1.	https://archive.nptel.ac.in/courses/108/106/108106138/
2.	https://www.ul.com/resources/overview-india-emc-regulations-bis-and-tec

Course outcomes

At the end of the course on **Signal integrity and EMI/EMC**, the student will have the ability to:

CO1	**Apply** the principles of electricity and magnetism to **solve/derive** problems related to EMC-EMI and signal integrity	PO1(3) PSO3
CO2	A**nalyze** the given specifications and test results to arrive at suitable conclusion	PO2(1) PSO3
CO3	**conduct experiments** to analyze concepts related to conducted emission	PO5(1) PSO3

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	Tota l
CO1	**3**	-	-	-	-	-	-	-	-	-	-	-	**3**
CO2	-	**1**	-	-	-	-	-	-	-	-	-	-	**1**
CO3	-	-	-	-	**1**	-	-	-	-	-	-	-	**1**

Course Title	ASIC DESIGN				
Course Code	22ET7PE3AD	Credits	3	L:T:P	3:0:0

Pedagogy: 40 Lectures

MODULE - I

Introduction to ASICs

Types of ASICs**:--** Full Custom with ASIC, Standard Cell based ASIC, Gate array based ASIC, Channeled gate array, Channel less gate array, structured gate array, Programmable logic device, Field programmable gate array.

Design flow, ASIC cell libraries

MODULE - II

CMOS LOGIC

Data path Logic Cells**: -** Data Path Elements, Adders, Multiplier. I/O cell, Cell Compilers

ASIC LIBRARY DESIGN

Logical effort: - practicing delay, logical area and logical efficiency logical paths, multi stage cells, optimum delay, optimum no. of stages, library cell design.

MODULE - III

PROGRAMMABLE ASICS

The Antifuse, static RAM, EPROM and EEPROM Technology.

Programmable ASIC logic cells

MODULE - IV

Programmable ASIC I/O cells, Programmable ASIC interconnect.

MODULE - V

Low-level Design Entry: Schematic Entry: -Hierarchical design. The cell library, Names, Schematic Icons & Symbols, Nets, schematic entry for ASICs, connections, vectored instances and buses, Edit in place, attributes, Netlist screener, Back annotation.

Course outcomes:

At the end of the course on **ASIC DESIGN** , the student will have the ability to

CO1	Understand different types of ASICs, their architectures, and design flow	PO1
CO2	Apply knowledge of CMOS logic, data path logic cells, and ASIC library design in practical applications	PO2
CO3	Analyze programmable ASIC technologies, including antifuse, SRAM, EPROM, and EEPROM-based solutions	PO3
CO4	Evaluate the role of programmable ASIC I/O cells and interconnects in circuit design	PO5
CO5	Develop schematic entry for ASICs using hierarchical design principles, netlist screening, and back-annotation techniques	PO12

TEXT BOOKS:

1. M.J.S .Smith, - "**Application - Specific Integrated Circuits**" – Pearson Education, 2003

REFERENCE BOOKS:

1. Jose E.France, Yannis Tsividis, "Design of Analog-Digital VLSI Circuits for Telecommunication and Signal Processing", Prentice Hall, 1994.
2. Malcolm R.Haskard; Lan. C. May, "Analog VLSI Design - NMOS and CMOS" Prentice Hall, 1998.
3. Mohammed Ismail and Terri Fiez, "Analog VLSI Signal and Information Processing", McGraw Hill, 1994.

Course Title	COMPUTER VISION				
Course Code	22ET7PE3CV	Credits	3	L-T-P	3:0:0
Pedagogy: 40 Lectures					

Prerequisites: Signals and Systems: Analog, Signals and Systems: Digital

Objectives: To introduce students the fundamentals of image formation; To introduce students the major ideas, methods, and techniques of computer vision and pattern recognition; To develop an appreciation for various issues in the design of computer vision and object recognition systems; and To provide the student with programming experience from implementing computer vision and object recognition applications.

MODULE-I	**8 hrs**

Introduction to Computer Vision: Introduction, Fundamental steps in DIP, Components of DIP system, A simple image formation model, Image sampling and quantization, Basic relationship between pixels, Arithmetic and Logical operations on images, Image file formats.

MODULE-II	**8hrs**

Image Enhancement: Background, Point processing – Image negatives, Log transformations, Power law transformations, Contrast stretching, Gray level slicing, Bit plane slicing, Histogram processing – Histogram equalization. Spatial Domain Smoothening filters.

Enhancement in Frequency Domain: Properties of Gaussian filters, Gaussian LPF and HPF, Homomorphic filter.

MODULE-III	**8 hrs**

Image Restoration and De-noising: Image degradation/restoration model, Inverse filter, Pseudo Inverse filter, Noise models, Restoration using spatial filtering – Mean filters, Geometric mean filters, Harmonic mean filters, Median filter, Max & min filters, Midpoint filter, Wiener filter, Constrained Least squares filter.

Color Image Processing: Fundamentals of color image processing, Color models, Conversion of color models from one form to other form, Pseudo color image processing.

MODULE-IV	**8 hrs**

Feature extraction: Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners – Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH.

Morphological Image Processing: Preliminaries, Erosion and Dilation, Opening and Closing.

MODULE-V	**8 hrs**

Pattern Analysis: Clustering: K-Means, Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised; Classifiers: Bayes, KNN, ANN-models.

Laboratory Experiments:

1. Arithmetic and Logical Operations on an image
2. Image Enhancement algorithms

3. Gaussian Low Pass and High Pass filters 4. Inverse Filter and Pseudo Inverse filter 5. Wiener filter 6. Color histogram equalization 7. Pseudo – color image processing 8. Feature extraction algorithms 9. Pattern analysis operations	
Text books:	
1.	Computer Vision: Algorithms and Applications, Richard Szeliski, Springer-Verlag (London) Limited, 2011
2.	Digital Image Processing by Rafael C. Gonzalez & Richard E. Woods, Fourth Edition, Pearson education, 2018
Reference books:	
1.	Computer Vision: A Modern Approach, D. A. Forsyth and J. Ponce, Pearson Education, 2003
2.	Fu, Lee and Gonzalez., Robotics, control vision and intelligence-, McGraw Hill International, 2nd edition, 2007
E- References:	
1.	IEEE-T-PAMI (IEEE Transactions on Pattern Analysis and Machine Intelligence) https://www.computer.org/csdl/journal/tp
2.	IEEE-TIP (IEEE Transactions on Image Processing) https://signalprocessingsociety.org/publications-resources/ieee-transactions-image-processing
e–Learning :	
1.	https://www.coursera.org/learn/computer-vision-basics
2.	https://www.edx.org/course/computer-vision-and-image-analysis

Course outcomes

At the end of the course on **Computer Vision**, the student will have the ability to

CO1	Understand and explain concepts of Computer Vision and Image Processing	--
CO2	Apply the knowledge of different techniques to enhance the quality of gray scale and colour image, restore the degraded image, illustrate different segmentation principles, and solve problems based on different transforms.	PO1
CO3	Analyse the distance relationship between pixels, evaluate Histogram	PO2

	equalization on gray scale and colour image, deduce filter operations on the image, Analyse the patterns and features extracted.	
CO4	Conduct experiments as an individual using modern engineering tool MATLAB/PYTHON for a given problem statement.	PO4 PO5

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	Total
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	**3**	-	-	-	-	-	-	-	-	-	-	-	**3**
CO3	-	**3**	-	-	-	-	-	-	-	-	-	-	**3**
CO4	-	-	-	**1**	**1**	-	-	-	-	-	-	-	**1**

Course Title	Cryptography & Network Security				
Course Code	22ET7PE3NS	Credits	3	L-T-P	3:0:0
Pedagogy: 40 Lectures					

Prerequisites: Basics of communications

Objectives:

- Students will learn the importance of cryptography
- Introduce the concepts of encryption and decryption
- Understand the different theorems related to network security
- Learn about intruders and threats related to network

MODULE-I	8 hrs

Computer and Network Security concepts: Computer security concepts, The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, Fundamental Security Design Principles, Attack surface and attack trees, A model for network security **Symmetric Cipher: Classical Encryption Techniques:** Symmetric Cipher Model, Substitution Techniques, Transposition Techniques

MODULE-II	8hrs

Traditional Block Cipher Structure, Simplified DES, The Data encryption Standard, A DES example, The strength of DES, Block Cipher Design Principles, Block Cipher Operation: Multiple encryption and Triple DES, Electronic Code book, Cipher block chaining Mode, Cipher feedback mode, Output feedback Mode, Counter Mode

MODULE-III	8 hrs

Fermat's and Euler's theorem, Chinese Remainder Theorem , Principles of public key cryptosystems, The RSA algorithm, Diffe-Hellman key exchange, Elgamal Cryptographic system

MODULE-IV	8 hrs

Message Authentication code: Message Authentication requirements, Authentication functions, Message authentication codes, Hash functions, Security of hash functions and MAC. Digital Signatures, Digital Signature standard, Electronic Mail Security : Pretty Good Privacy,

MODULE-V	8 hrs

Intruders, Intruder detection, Password management, Viruses and related threats, Viruses and related threats, Firewalls design principles

Text books:	
1.	Cryptography and Network Security- Principles and Practice: William Stallings, 6th Edition
Reference books:	
1.	Data Communication and Networking, Behrouz Forouzan, 5th Edition,
2.	**Introduction to Cryptography and Network Security**- Behrouz A Forouzan, Mc-Graw Hill Higher Education, 1st Edition, 2008
E- References:	
1.	https://swayam.gov.in/nd1_noc20_cs02
e–Learning :	
1.	https://swayam.gov.in/nd1_noc20_cs21

Course outcomes

At the end of the course on **Cryptography and Network Security** the student will have the able

CO1	Explain and understand the fundamental concepts related to cryptography and network security	
CO2	Apply the concepts of basic mathematics and coding knowledge to obtain the solution for specified parameters	PO1(3)
CO3	Analyse the given security parameters and arrive at suitable conclusions	PO2(2)
CO4	Implement and demonstrate the specified **mini-project** using suitable encryption and decryption techniques	PO3(1) PO5(1) PO6(1) PO9(1) PO10(1)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**Total**
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	**3**	-	-	-	-	-	-	-	-	-	-	-	**3**
CO3	-	**2**	-	-	-	-	-	-	-	-	-	-	**2**
CO4	-	-	**1**	-	**1**	**1**	-	-	**1**	**1**	-	-	**1**

Course Title	Data Science				
Course Code	22ET7PE3DS	Credits	3	L-T-P	3:0:0

Prerequisites:

Basics of programming skills, Basic concepts of statistics

Objectives:

Ability to learn data science concepts

Ability to implement data science concepts using programming

Ability to learn machine learning algorithms

MODULE-I	8 hrs

Introduction to Data Science and Python Programming

What is data science, data sciencester, the basics of python: whitespace formatting, modules, arithmetic, functions, strings, exceptions, lists, tuples, dictionaries, sets, control flow, truthiness, sorting, list comprehensions, generators and iterators, randomness, regular expressions, object oriented programming, functional tools, enumerate, visualizing data: matplotlib, linear algebra: vectors and matrices

MODULE-II	8hrs

Statistics, Probability, Hypothesis and Inference

Describing single set of data, central tendencies, dispersion, correlation, Simpsons paradox, correlation and causation, dependence and independence, conditional probability, Bayes theorem, random variables, continuous distribution, the normal distribution, the central limit theorem, Statistical hypothesis testing, confidence intervals, P-hacking, Bayesian inference

MODULE-III	8 hrs

Gradient Descent, Working with Data

Idea behind Gradient descent, estimating the gradient, using the gradient, choosing the right step size, stochastic gradient descent, Exploring one dimensional data, two dimensions, many dimensions, cleaning and munging, manipulating data, rescaling, dimensionality reduction.

MODULE-IV	8 hrs

Introduction to Machine Learning-I

Modeling, what is machine learning, overfitting and underfitting, correctness, the bias variance trade offs, feature extraction and selection, k nearest neighbors, naive Bayes, spam filters, simple linear

regression, maximum likelihood estimation, Multiple regression.

MODULE-V	8 hrs

Introduction to Machine Learning-II

Logistic regression, logistic function, support vector machines, decision trees, entropy, entropy of a partition, creating a decision tree, random forests, Neural networks: perceptron, feed forward neural networks, back propagation, clustering, bottom up hierarchical clustering.

Lab Experiments:

1. Basics of python programming (unit 1)
2. Statistics, Bayes theorem and inference using python programming (unit 2)
3. Gradient descending using python (unit 3)
4. Working with multi-dimensional data using python (unit 3)
5. Feature extraction using python (unit 4)
6. KNN, Naïve Bayes and Regression using python (unit 4)
7. Logistic regression, Decision trees, SVM using python (unit 5)

Text books:

1.	Data science from scratch (first principles with python) by Joel Grus, Oreilly, April 2015, 1st edition
2.	Doing data science (straight talk from the front line) by Rachel Schutt and Cathy O Neil, Oreily, October 2013, 1st edition.

Reference books:

1.	Data Analysis From Scratch With Python: Beginner Guide using Python, Pandas, NumPy, Scikit, Peters Morgan, AI Sciences1st edition, 2018
2.	Python Data Analytics: Data Analysis and Science Using Pandas, matplotlib, and the Python, Fabio nelli , Apress,1st edition, 2015

E- References:

1.	https://www.pdfdrive.com/data-science-from-scratch-e33404966.html
2.	https://www.pdfdrive.com/data-analysis-from-scratch-with-python-beginner-guide-using-python-pandas-numpy-scikit-learn-ipython-tensorflow-and-matplotlib-e188610626.html
e–Learning :	
1.	https://nptel.ac.in/courses/106106139
2.	https://onlinecourses.nptel.ac.in/noc21_cs69/preview

Course outcomes

At the end of the course on, C++ and Data Structures the student will have the ability to

CO1	Ability to understand the data science concepts	--
CO2	Ability to apply the knowledge of Engineering mathematics and programming skills to develop efficient machine algorithms in data science	PO1
CO3	Ability to analyze the regression and classification models	PO2
CO4	Ability to design a solution for data science application	PO3
CO5	Ability to work as an individual and thereby conduct experiments using matlab/python for a given application/problem statement.	PO5 PO9
CO6	Develop, test, analyze and demonstrate applications using python through a mini-project	PO4,PO5,PO11

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	Total
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3
CO3	-	2	-	-	-	-	-	-	-	-	-	-	2
CO4	-	-	3	-	-	-	-	-	-	-	-	-	3
CO5	-	-	-	-	3	-	-	-	3	-	-	-	3
CO6	-	-	-	3	3	-	-	-	-	-	3	-	3

Course Title	Cryptography				
Course Code	**22ET7OE2CY**	**Credits**	**3**	**L-T-P**	**3:0:0**

Prerequisites: Basics concepts of communications

Objectives:

- Students will learn the importance of cryptography
- Introduce the concepts of encryption and decryption
- Understand the different techniques related to cryptography
- Learn about intruders and threats related to network

MODULE-I	**8 hrs**

Computer and Network Security concepts: Computer security concepts, The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, Fundamental Security Design Principles, Attack surface and attack trees, A model for network security

MODULE-II	**8hrs**

Introduction to Number Theory: Fermat's and Euler's Theorems, The Chinese Remainder Theorem

Symmetric Cipher: Classical Encryption Techniques: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques

MODULE-III	**8 hrs**

Block Ciphers and the Data Encryption Standard: Traditional Block Cipher Structure, S-DES, The Data Encryption Standard

Block Cipher Operation: Multiple Encryption and Triple DES, Electronic Codebook, Cipher Block Chaining Mode, Cipher Feedback Mode, Output Feedback Mode, Counter Mode

MODULE-IV	**8 hrs**

Random Bit Generation and Stream Ciphers: Principles of Pseudorandom number generation, Pseudorandom number generators, pseudorandom number generation using a block cipher, Stream Ciphers, RC4

MODULE-V	**8 hrs**

Asymmetric Ciphers: Public-Key Cryptography and RSA: Principles of Public-Key Cryptosystems, The RSA Algorithm, Diffie-Hellman Key Exchange, Elgamal Cryptographic system

Text books:

1.	**Cryptography and Network security: Principles and Practice**, William Stallings, 7th edition, Pearson Education
Reference books:	
1.	**Data Communication and Networking**, Behrouz Forouzan, 5th Edition
2.	**Introduction to Cryptography and Network Security**- Behrouz A Forouzan, Mc-Graw Hill Higher Education, 1st Edition, 2008
E- References:	
1.	1. https://swayam.gov.in/nd1_noc20_cs02
e–Learning :	
1.	https://swayam.gov.in/nd1_noc20_cs21

Course outcomes

At the end of the course on **Cryptography** the student will have the able

CO1	Explain and understand the fundamental concepts related to cryptography	
CO2	Apply the concepts of basic mathematics and coding knowledge to obtain the solution for specified parameters	PO1(3)
CO3	Analyse the given security parameters and arrive at suitable conclusions	PO2(2)
CO4	Implement and demonstrate the specified **mini-project** using suitable encryption and decryption techniques	PO3(1) PO5(1) PO6(1) PO9(1) PO10(1)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**Tota l**
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	**3**	-	-	-	-	-	-	-	-	-	-	-	**3**
CO3	-	**2**	-	-	-	-	-	-	-	-	-	-	**2**
CO4	-	-	**1**	-	**1**	**1**	-	-	**1**	**1**	-	-	**1**

Course Title	Communication in Healthcare				
Course Code	22ET7OE2CH	Credits	3	L-T-P	3:0:0

Objective:

To understand and analyse the role of communication in healthcare technologies.

MODULE-I	8hrs

Information Technology and Healthcare

Healthcare Informatics Developments, Different Definitions of Telemedicine, The Growth of E-health to M-health, Benefits of mHealth, Drawbacks and issues, Hot areas of research, data flow in health IT systems, Types of telecare, technology used to improve patient engagement and education, Connected World Between Human and Devices.

MODULE-II	8hrs

Communication Networks and Services

The Basics of Wireless Communications, Wired vs. Wireless, Types of Wireless Networks – Bluetooth, Infrared (IR) Wireless Local Area Network (WLAN) and Wi-Fi, ZigBee, Li-Fi, Cellular Networks, Broadband Wireless Access (BWA), M-health and Telemedicine Applications, The Outdoor Operating Environment, RFID in Telemedicine.

MODULE-III	8hrs

Information and Communications Technology in Health Monitoring

Body Area Networks, Emergency Rescue, Smart Ambulance, Network Backbone, Smart Hospital, Radiology Detects Cancer and Abnormality, Robot Assisted Telesurgery, Ward Management Using RFID, Electromagnetic Interference on Medical Instrument, Smart Wearable Integration, General Health Assessments

MODULE-IV	8hrs

Data Analytics and Medical Information Processing- Introduction, Non-invasive Health Data Collection, Body Temperature, Heart Rate, Blood Pressure, Respiration Rate, Blood Oxygen Saturation, Blood Glucose Concentration, Biosignal Transmission and Processing, Medical Imaging, Medical Image Transmission and Analysis, Patient Records and Data Mining Applications, Knowledge Management for Clinical Applications, Artificial Intelligence (AI) in Digital Health, Deep Learning, AI in Mobile Health, Virtual Reality (VR) and Augmented Reality (AR)

MODULE-V	8hrs

Digital Health for Community Care: Energy Conservation and Safety, Medical Radiation: Risks,

Myths, and Misperceptions, Prognostics in Telemedicine, Telecare, Telecare for Senior Citizens, Telemedicine in Physiotherapy, Faster Wireless Communications for Supporting Virtual Reality (VR) in Telemedicine, The Future of Telemedicine and Information Technology for Everyone, Healthcare Access for Rural Areas, Smart and Assistive Technologies	
Text books:	
	Telemedicine Technologies: Information Technologies in Medicine and Digital Health, Bernard Fong, A.C.M. Fong,C.K. Li, Wiley 2nd edition, 2020
Reference book:	
	Wearable Technology in Medicine and Health Care, Raymond K Y Tong, Elsevier Inc, 2018
E- Reference:	
	https://www.sciencedirect.com/book/9780128143094/fundamentals-of-telemedicine-and-telehealth
e–Learning:	
	https://www.coursera.org/learn/telehealth

Course outcomes

At the end of the course on Communication in Healthcare, the student will have the

CO1	Ability to **explain** different heath parameters and concepts of ICT in Healthcare	-
CO2	Ability to **apply** the knowledge of ICT in Telecare, Telemedicine and health monitoring	PO1, PO6
CO3	-Ability to a**nalyse** the role of data analytics, AR, VR, AI and digital health for community care	PO2, PO6

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**Total**
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	**3**	-	-	-	-	**3**	-	-	-	-	-	-	**3**
CO3	-	**3**	-	-	-	**3**	-	-	-	-	-	-	**3**

Course Title	Linear Algebra				
Course Code	22ET7OE2LA	Credits	3	L-T-P	3:0:0

Objective:

To provide students with a strong foundation in linear algebra concepts and their applications in engineering, including vector spaces, matrix theory, eigenvalues, and computational techniques. The course aims to enhance analytical and problem-solving skills required for various engineering disciplines, optimization, data science, and modern technological applications.

MODULE-I	8hrs

Vector Spaces and Linear Transformations

Definition and Examples of Vector Spaces, Subspaces, Basis, and Dimension, Linear Dependence and Independence, Rank and Nullity Theorem, Linear Transformations and their Properties, Matrix Representation of Linear Transformations

MODULE-II	8hrs

Matrices and Systems of Linear Equations

Types of Matrices and Matrix Operations, Elementary Row Operations and Row Echelon Form, Solution of Systems of Linear Equations – Gaussian and Gauss-Jordan Elimination, LU Decomposition, Applications of Systems of Linear Equations in Engineering

MODULE-III	8hrs

Eigenvalues, Eigenvectors, and Diagonalization

Characteristic Equation and Eigenvalues, Eigenvectors and Diagonalizability, Cayley-Hamilton Theorem, Applications of Eigenvalues in Stability Analysis and Engineering Problems, Singular Value Decomposition (SVD)

MODULE-IV	8hrs

Inner Product Spaces and Orthogonality

Inner Product, Norm, and Distance in Vector Spaces, Orthogonality and Orthonormal Bases, Gram-Schmidt Orthogonalization Process, Least Squares Approximation, QR Factorization and Applications in Engineering

MODULE-V	8hrs

Applications of Linear Algebra in Engineering

Linear Algebra in Computer Graphics and Image Processing, Markov Chains and Google's PageRank Algorithm, Optimization Techniques using Linear Algebra, Applications in Machine Learning and Data Science, Graph Theory and Network Analysis

Course outcomes

At the end of the course, the student will have the ability to

CO1	**Apply** the fundamental concepts of vector spaces, linear transformations, and matrix theory to solve complex engineering problems	PO1
CO2	**Analyze** and solve systems of linear equations using matrix operations and decomposition techniques, ensuring mathematical accuracy in engineering applications.	PO2
CO3	**Design** and implement computational methods involving eigenvalues, eigenvectors, and orthogonality for solving stability and optimization problems in engineering.	PO3
CO4	**Investigate** the applications of linear algebra in real-world problems such as image processing, Markov chains, and machine learning by utilizing advanced mathematical techniques.	PO4
CO5	**Demonstrate** knowledge of project management by applying linear algebra techniques in engineering modeling, simulations, and optimization.	PO11
CO6	**Engage** in continuous learning and research on emerging applications of linear algebra in modern engineering fields, fostering innovation and lifelong learning.	PO12

Text books:

1	**Gilbert Strang**, *Introduction to Linear Algebra*, 5th Edition, Wellesley-Cambridge Press, 2016.
2	**David C. Lay, Steven R. Lay, Judi J. McDonald**, *Linear Algebra and Its Applications*, 5th Edition, Pearson, 2016.

Reference book:

1	**Howard Anton, Chris Rorres**, *Elementary Linear Algebra: Applications Version*, 11th Edition, Wiley, 2013.

E- Reference:

	MIT OpenCourseWare: Linear Algebra - Gilbert Strang (MIT 18.06) https://web.mit.edu/18.06/www/

e–Learning:

	https://onlinecourses.nptel.ac.in/noc21_ma50/, Linear Algebra by Prof. Dilip Patil, IISc Bangalore

Course Title	PROJECT BASED ON IDENTIFIED RESEARCH WORK				
Course Code	22ET7PWRER	Credits	2	L:T:P	0:0:2

Course Outcomes		
CO1: Ability to engage in independent study to research literature, and identify the research work to be reproduced	**PO 12 (3)**	**PSO1 (2)** **PSO2 (2)** **PSO3 (3)**
CO2: Ability to prepare the Gantt Chart for scheduling the project , engage in budget analysis, and designate responsibility for every member in the team	**PO 11(3)**	
CO3: Ability to identify the community that shall benefit through the solution to the identified research work and also demonstrate concern for environment	**PO 6(3)** **PO 7(3)**	
CO4: Ability to identify and apply the mathematical concepts, science concepts, and engineering concepts necessary to reproduce the identified research work	**PO 1(3)** **PO 2(3)**	
CO5: Ability to identify and select the engineering tools /components required to reproduce the identified research work	**PO 5(3)**	
CO6: Ability to design, implement, analyse and interpret results of the study aimed at partial reproduction of the identified research work	**PO 3 (3)** **PO 4 (3)**	
CO7: Ability to engage in effective written communication through the project report, the one-page poster presentation, and preparation of the video about the project and and the four page IEEE format of the work	**PO 10 (3)**	
CO8: Ability to engage in effective oral communication through presentation of the project work, demonstration of the project	**PO 10 (3)**	
CO9: Ability to demonstrate compliance to the prescribed standards/ safety norms and abide by the norms of professional ethics	**PO 8 (3)**	
CO10: Ability to perform in the team, contribute to the team and mentor/lead the team	**PO 9(3)**	

Project Rubrics:

Parameter	**≥75%**	**≥25% to <75%**	**< 25%**
Literature Survey	Referred to more than TEN recent articles; appropriately summarized; includes recent references	Referred to more than SIX recent articles; appropriately summarized; NO recent references	NO references included
Project Scheduling and work delegation	Proposed and implemented Gantt chart included; with clear distribution of workload among the team members	Proposed Gantt chart included; without clear distribution of workload	Gantt chart NOT provided; NO distribution of workload
Contribution to society, concern for environment	The community that shall benefit clearly specified; ensures safety to environment	Community clearly specified; however safety measures not specified	Hazard to society and to environment

Identification of essential concepts	Clear list, description and justification of MOST essential Mathematical, Science, Engineering and Management Concepts included	SOME essential Mathematical, Science, Engineering and Management Concepts included, without necessary details/ justification	There is NO mention of any of the essential Concepts
The Modern Tool	Clear justification in selecting the TOOL/Components being used is provided	There is no justification for the tool/components being used	--
Design and Analyze the results	More than ONE design solution implemented, with comparison Included clear analysis, along with advantages and disadvantages	Only ONE design solution implemented Included analysis, without the advantages and disadvantages	NO design included NO analysis
Written Communication	The Project report is well organized, clear objectives and outcomes for every chapter The Poster is well designed and includes the aim, the outcome, the results and conclusion All necessary details are included and the IEEE paper is well organized	The Project report is NOT well organized The Poster is NOT well organized, and includes few details Only few details are included for IEEE paper and is NOT well organized	The Project report is NOT submitted by the deadline The Poster is NOT included The IEEE paper format NOT included
Oral Presentation	well organized, clear presentation, have equal participation	Slides are not well organized, presentation not clear	Poor organization, No equal role
Compliance to Standards	Clear statement of existing Standards/ Norms, with compliance	Clear statement, but does not include compliance	Standards/Norms NOT stated
Performance in the Team	Contributes and cooperates in the team, and mentors/leads the team	cooperates but does NOT contribute to the team	Does NOT cooperate

Synopsis Submission:
First Evaluation- within two weeks of semester commencement
(CO1, CO2; Evaluation of the Team 10 % weightage)
Second Evaluation: after 10 weeks of semester commencement
(CO3, CO4, CO5; Evaluation of the Team 20 % weightage)
Third Evaluation: during the last week of the semester
(CO6, CO9 – Evaluation of the Team 25 % weightage)
(CO7- Evaluation of the Team, 20 % weightage)
(CO8, CO10: Individual Evaluation of every member 25% marks)
The department constitutes a Project Evaluation Committee (PEC) that schedules, allocates the guides and evaluates certain components of the project

Course Title	MOOCS/ VIRTUAL LAB WITH CERTIFICATION				
Course Code	22ET7NCMC1	Credits	NC	L:T:P	0:0:0

Students need to have taken and successfully completed ONE MOOC course (of minimum four weeks duration), from any recognized online platform: NPTEL/SWAYAM/Coursera/Edx/ VirtualLabs or any other

The courses can be in the Engineering domain, Management domain, Science Domain, Sanskrit/Foreign Language, Art (music/dance/theatre any other), Journalism (media communication or any other), or any domain.

Students are awarded a Pass Grade on submission of the successful completion certificate, and needs to have taken the course any time after having joined the program.

Course Outcomes:

Ability to engage in independent study, take up an online course in a domain of personal choice and successfully complete the course (PO12 (3))

VIII Semester

Course Title	Innovation For Entrepreneurship				
Course Code	22ES8HSIFE	Credits	2	L:T:P	2:0:0

MODULE I

Ideation and Innovation: Problems and Pain Points, Ideation and Problem Solving, Design Thinking, Team importance and Leadership, Market Segmentation, Beachhead Market, Building End User Profile, Total Addressable Market (TAM) Size for the Beachhead Market, Profile the Persona, Full Lifecycle Use Case, High-Level Product Specification, Quantify the Value Proposition, Identify Your Next 10 Customers, Define Your Core, Chart Your Competitive Positio

MODULE II

Product Acquisition by customer: Determine the Customer's Decision Making Unit (DMU), Process to Acquire a Paying Customer, Mapping sale process, Total Addressable Market Size for Follow-on Markets

MODULE III

Business from Product :Design a Business Model, Set your Pricing Framework, Calculate the Lifetime Value (LTV) of an Acquired Customer, Map the Sales Process to Acquire a Customer, Calculate the Cost of Customer Acquisition (COCA)

MODULE IV

Designing, building and scaling of the product: Identify key Assumptions, Test Key Assumptions, Define and build Minimum Viable Product (MVP), Test with Customer, Repeat Cycle to Reach Product Market Fit.

MODULE V

Startup and Entrepreneurship in India: Starting company in India, IP landscape, Incubation, Government support, Taxation, Startup culture and leadership, Open innovation, Social Innovation, Intrapreneurship, entrepreneurship abroad.

Course Outcomes:

At the end of the course, students will have the ability to:

CO No	Course Outcomes	POs	PSOs
CO1	Apply new ideas of design thinking, methods, and ways of thinking	2	1
CO2	Able to formulate goals as an entrepreneur for a start-up defining your goals as an entrepreneur	3	
CO3	Able to identify business opportunities by performing market research and choosing target customers	2	

CO4	Engage with a range of stakeholders to deliver creative and sustainable solutions to specific problems, communicate effectively both orally and in writing	7,10	
CO5	Work effectively with peers with diverse skills, experiences, and be able to critically reflect on own practice	9	

REFERENCE BOOKS:

1. Disciplined Entrepreneurship: 24 Steps to a Successful Startup (Wiley, 1st Edition) Bill Aulet, ISBN: 1118692284, 2013

2. The Startup Owner's Manual: The Step-by-Step Guide for Building a great company by Steve Blank K&S Ranch Publishers, K&S Ranch, 2016

3. Innovator's Dilemma: When New Technologies Cause Great Firms to Fail by Christensen, Harvard Business Review Press, 2011

E Books:
https://segera-wisuda.blogspot.in/2016/05/46-ebooks-entrepreneurship-download-free.html

MOOCs:
https://ocw.mit.edu/courses/sloan-school-of-management/15-390-new-enterprises-spring2013/assignments/assignment-12/ https://www.edx.org/course/entrepreneurship-101-who-customer-mitx-15-390x

INDIAN KNOWLEDGE SYSTEMS (Theory) (Common to All UG Programs)						
Course Code	**:**	**25MA8HSIKL**		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	**1: 0: 0**		**SEE**	**:**	**50 Marks**
Total Hours	**:**	**15L**		**SEE Duration**	**:**	**02 Hours**

Course Learning Objectives: The students will be able to	
1	To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system.
2	To make the students understand the traditional knowledge and analyze it and apply it to their day-to-day life.

Unit-I	**05 Hrs**
Introduction to Indian Knowledge Systems (IKS): Overview, Vedic Corpus, Philosophy, Character scope and importance, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge vs. western knowledge.	
Unit – II	**05 Hrs**
Traditional Knowledge in Humanities and Sciences: Linguistics, Number and measurements-Mathematics, Chemistry, Physics, Art, Astronomy, Astrology, Crafts and Trade in India and Engineering and Technology.	
Unit -III	**05 Hrs**
Traditional Knowledge in Professional domain: Town planning and architecture-Construction, Health, wellness and Psychology-Medicine, Agriculture, Governance and public administration, United Nations Sustainable development goals.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Provide an overview of the concept of the Indian Knowledge System and its importance.
CO2:	Appreciate the need and importance of protecting traditional knowledge.
CO3:	Recognize the relevance of Traditional knowledge in different domains.
CO4:	Establish the significance of Indian Knowledge systems in the contemporary world.

Reference Books	
1	**Introduction to Indian Knowledge System- concepts and applications**, B Mahadevan, Vinayak Rajat Bhat, Nagendra Pavana R N, 2022, PHI Learning Private Ltd, ISBN-978-93-91818-21-0
	Traditional Knowledge System in India, Amit Jha, 2009, Atlantic Publishers and Distributors (P) Ltd., ISBN-13: 978-8126912230,
2	**Knowledge Traditions and Practices of India**, Kapil Kapoor, Avadesh Kumar Singh, Vol. 1, 2005, DK Print World (P) Ltd., ISBN 81-246-0334,
	Suggested Web Links:
1.	**https://www.youtube.com/watch?v=LZP1StpYEPM**
2.	**http://nptel.ac.in/courses/121106003/**
3.	http://www.iitkgp.ac.in/department/KS;jsessionid=C5042785F727F6EB46CBF432D7683B63 (Centre of Excellence for Indian Knowledge System, IIT Kharagpur)
4.	https://www.wipo.int/pressroom/en/briefs/tk_ip.html
5.	https://unctad.org/system/files/official-document/ditcted10_en.pdf
6.	http://nbaindia.org/uploaded/docs/traditionalknowledge_190707.pdf
7.	https://unfoundation.org/what-we-do/issues/sustainable-development-goals/?gclid=EAIaIQobChMInp-Jtb_p8gIVTeN3Ch27LAmPEAAYASAAEgIm1vD_BwE

ASSESSMENT AND EVALUATION PATTERN		
WEIGHTAGE	**50% (CIE)**	**50%(SEE)**
QUIZZES		
Quiz-I	Each quiz is evaluated for 05 Marks adding up to **10 Marks.**	*****
Quiz-II		
THEORY COURSE - (Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating)		
Test – I	Each test will be conducted for 25 Marks adding up to 50 marks. Final test marks will be reduced to **20 Marks**	*****
Test – II		
EXPERIENTIAL LEARNING	**20**	*****
Case Study-based Teaching-Learning	--	*****
Sector wise study & consolidation (viz., Engg. Semiconductor Design, Healthcare & Pharmaceutical, FMCG, Automobile, Aerospace and IT/ ITeS)	--	
Video based seminar (4-5 minutes per student)	--	
Maximum Marks for the Theory	---	**50 Marks**
Practical	--	--
Total Marks for the Course	**50**	**50**

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	-	-	-	-	-	-	3	-	-	-	1
CO2	-	-	-	-	-	2	-	-	-	-	-	-
CO3	-	-	2	2	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	3	2	-	-	-	-	-

Course Title	LOW POWER VLSI				
Course Code	22ET8PE4LV	Credits	3	L-T-P	3:0:0

MODULE-I	8 hrs

Introduction to Low Power Issues in VLSI: VLSI fundamentals, Low Power IC Design beyond Sub-20 nm Technology, Issues Related to Silicon Manufacturability and Variation, Issues Related to Design Productivity, Limitation Faced by CMOS, Different Groups of MOSFETs, Three MOS Types, Low Leakage MOSFET, Importance of Subthreshold Slope, Ultralow Voltage Operation, Low Power Analog Circuit Design, Fundamental Consequence of Lowering Supply Voltage

MODULE-II	8hrs

Combinational Circuit Design: Static CMOS Logic Gate Design, Complementary Properties of CMOS Logic, CMOS NAND Gate, CMOS NOR Gate, XOR or Non-equivalence Gate Using CMOS Logic, XOR–XNOR or Equivalence Gate Using CMOS Logic, And-Or-Invert and Or-And-Invert Gates, Full Adder Circuits Using CMOS Logic, Pseudo-nMOS Gates, Why the Name Is Pseudo-nMOS? Ratioed Logic, Operation of Pseudo-nMOS Inverter

MODULE-III	8 hrs

Other Combinational Circuit Design: Pass-transistor Logic, Complementary Pass Transistor Logic, Signal Restoring Pass Transistor Logic Design, Sizing of Transistor in CMOS Design Style, Introduction to Transmission Gate, Use of CMOS TG as Switch, 2:1 Multiplexer Using TG, XOR Gate Using TG, XNOR Gate Using TG, Transmission Gate Adders, Tristate Buffer, Transmission Gates and Tristates

MODULE-IV	8 hrs

Advanced Combinational Circuit Design: Implementation of Combinational Circuit Using DTMOS Logic for Ultralow Power Application, ECLR Structure examples: NAND/AND, NOR/OR, 2X2 multiplier, Multiplexers, Full adder, 4:2 compressor adder, Carry Look Ahead adder, 2X2 Vedic multiplier, Power Consumption, Propagation Delay

MODULE-V	8 hrs

Advanced Energy-reduced Sequential Circuit Design: Basics of Regenerative Circuits, Basic SR Flip-flop/Latch, Clocked JK Latch, Master–slave Flip-flop, D Latch, Master–slave Edge-triggered Flip-flops

Text books:

1.	Low Power VLSI Design, Angsuman Sarkar, Swapnadip De, Manash Chanda, Chandan Kumar Sarkar, Degruyter.

Reference books:

1.	Practical Low Power Digital VLSI Design, Gary Yeap, Springer Science
2.	Low Power VLSI circuits and systems, Ajit Pal, Springer, 2015

Course outcomes

At the end of the course on **Low Power VLSI**, the student will have the ability to

CO1	Understand and explain concepts of VLSI circuits for low power considerations	--
CO2	Apply the knowledge of different techniques to understand low power circuit operations in VLSI	PO1
CO3	Analyse the practical aspects of implementing low power VLSI circuits	PO2

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**Total**
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	**3**	-	-	-	-	-	-	-	-	-	-	-	**3**
CO3	-	**3**	-	-	-	-	-	-	-	-	-	-	**3**

Course Title	Adhoc and Sensor Networks				
Course Code	22ET8PE4SN	Credits	3	L-T-P	3:0:0

Prerequisites: Computer Networks

Objective: To introduce fundamental concepts of Adhoc and Sensor Networks, including architectures, protocols, security, and applications, and to equip students with the ability to design and analyze these networks for real-world challenges.

MODULE-I	8 hrs

Introduction to Adhoc Networks and Routing Protocols: Elements of Adhoc Wireless Networks, Issues in Adhoc Wireless Networks, Applications of Adhoc Networks, Adhoc Wireless Internet, Routing Protocols for Adhoc Networks, Classification of Routing Protocols, Proactive Routing Protocols (DSDV, OLSR), Reactive Routing Protocols (AODV, DSR), Hybrid Routing Protocols (ZRP).

MODULE-II	8hrs

Wireless Sensor Networks – Architectures and Design: Challenges in Wireless Sensor Networks, Applications of WSN, Enabling Technologies, Single-Node Architecture – Hardware Components, Energy Consumption and Optimization, Network Architecture – Sensor Deployment Strategies, Transceiver Design Considerations, Performance Metrics.

MODULE-III	8 hrs

Networking Concepts and Protocols in WSN: MAC Protocols for WSN, Low Duty Cycle Protocols and Wakeup Concepts – S-MAC, Mediation Device Protocol, Contention-Based MAC (PAMAS), Schedule-Based MAC (LEACH), IEEE 802.15.4 MAC, Routing Protocols – Energy-Efficient Routing, Hierarchical Routing, Challenges in Transport Layer Protocols.

MODULE-IV	8 hrs

Security in Wireless Sensor Networks: Security Requirements in WSN, Attacks in WSN – Jamming, Tampering, Black Hole, Wormhole, Sybil Attack, Countermeasures for WSN Security, Key Distribution and Management, Secure Routing Protocols – SPINS, Security Frameworks for WSN.

MODULE-V	8 hrs

Sensor Network Platforms, Tools, and Applications: Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-Level Software Platforms – TinyOS, nesC, ContikiOS, Sensor Network Simulators – NS2, COOJA, TOSSIM, Large-Scale WSN Applications, Cloud-Enabled IoT for Sensor Networks, Smart Cities and Industrial IoT Applications.

Course outcomes

At the end of the course ,the student will have the ability to

CO1	Explain the fundamental concepts, architectures, and characteristics of Adhoc networks, applying knowledge of mathematics, science, and engineering principles	PO1
CO2	Analyze different Adhoc network routing protocols, mobility models, and medium access control mechanisms using first principles of mathematics and engineering sciences.	PO2
CO3	Design efficient routing algorithms and network protocols for Adhoc networks, ensuring optimal performance while considering real-world constraints	PO3
CO4	Investigate the challenges and performance metrics of Adhoc networks through simulation and experimental analysis, interpreting data to draw valid conclusions.	PO4
CO5	Investigate the challenges and performance metrics of Adhoc networks through simulation and experimental analysis, interpreting data to draw valid conclusions.	PO5
CO6	Apply engineering and management principles to plan, design, and implement Adhoc network solutions in multidisciplinary environments.	PO11
CO7	Recognize the importance of continuous learning and staying updated with emerging trends in wireless and Adhoc networks for adapting to technological advancements.	PO12

Text books:

1	C. Siva Ram Murthy and B. S. Manoj, "Ad Hoc Wireless Networks: Architectures and Protocols," Pearson Education, 2004.
2	Holger Karl and Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks," John Wiley & Sons, 2005.

Reference books:

1	Kazem Sohraby, Daniel Minoli, Taieb Znati, "Wireless Sensor Networks: Technology, Protocols, and Applications," John Wiley & Sons, 2007.

2	Feng Zhao and Leonidas Guibas, "Wireless Sensor Networks: An Information Processing Approach," Morgan Kaufmann, 2004.
E- References:	
1.	**MIT OpenCourseWare – Wireless Communication & Sensor Networks** https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/
e–Learning :	
1.	NPTEL Course on "Adhoc and Wireless Sensor Networks" by IIT Kharagpur (https://nptel.ac.in/courses/106105160)

Course Title	Block Chain and Cyber Security				
Course Code	22ET8PE4BS	Credits	3	L-T-P	3:0:0

Prerequisites: Basics concepts of communications

Objectives:

- Students will learn the importance of block chain
- Introduce the concepts of block chain
- Understand the different categories of cyber security

MODULE-I	8 hrs

INTRODUCTION TO CRYPTOCURRENCIES: Cryptographic Hash Functions, Hash Pointers and Data Structures, Digital Signatures, Public Keys as Identities, a Simple Crypto currency. HOW BIT COIN ACHIEVES DECENTRALIZATION: Centralization vs. Decentralization, Distributed Consensus, Consensus without Identity: the Block Chain, Incentives and Proof of Work, Putting It All Together

MODULE-II	8hrs

MECHANICS OF BITCOIN:Bitcoin Transactions, Bitcoin Scripts, Applications of Bitcoin Scripts, Bitcoin Blocks, TheBitcoin Network, Limitations & Improvements. STORE &USAGE:How to Store and Use Bitcoins, Hot and Cold Storage, Splitting and Sharing Keys, Online Wallets and Exchanges, Payment Services, Transaction Fees, Currency Exchange Markets.

MODULE-III	8 hrs

INTRODUCTION: Cyber Security, Cyber Security policy, Domain of Cyber Security Policy, Laws and Regulations, Enterprise Policy, Technology Operations, Technology Configuration, Strategy Versus Policy, CYBER SECURITY EVOLUTION: Productivity, Internet, E-commerce, Counter Measures and Challenges..

MODULE-IV	8 hrs

CYBER SECURITY OBJECTIVES: Cyber Security Metrics, Security Management Goals, Counting Vulnerabilities, Security Frameworks, E-Commerce Systems, Industrial Control Systems, Personal Mobile Devices, Security Policy Objectives.

GUIDANCE FOR DECISION MAKERS: Tone at the Top, Policy as a Project, Cyber Security Management, Arriving at Goals, Cyber Security Documentation. THE CATALOG APPROACH:Catalog Format, Cyber Security Policy Taxonomy.

MODULE-V	8 hrs

CYBER SECURITY POLICY CATALOG: Cyber Governance Issues, Net Neutrality, Internet Names and Numbers, Copyright and Trademarks, Email and Messaging, Cyber User Issues, Malvertising, Impersonation, Appropriate Use, Cyber Crime, Geolocation, Privacy, Cyber Conflict Issues, Intellectual property Theft, Cyber Espionage, Cyber Sabotage, Cyber Welfare.

Text books:

1.	Narayanan, A., Bonneau, J., Felten, E., Miller, A., &Goldfeder, S. (2016). Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press.

2.	Jennifer L. Bayuk, J. Healey, P. Rohmeyer, Marcus Sachs, Jeffrey Schmidt, Joseph Weiss "Cyber Security Policy Guidebook" John Wiley & Sons 2012
Reference books:	
1.	Andreas M. Antonopoulos Mastering Bitcoin: Unlocking Digital Cryptocurrencies, O'Reilly Media; 1st edition
2.	Blockchain Basics: A Non-Technical Introduction in 25 Steps, Daniel Drescher, Apress
3.	Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Nina Godbole and SunitBelpure, Publication Wiley.
4.	Dan Shoemaker Cyber security The Essential Body of Knowledge, 1st ed. Cengage Learning 2011
E- References:	
1.	https://onlinecourses.nptel.ac.in/noc23_cs127/preview
e–Learning :	
1.	https://onlinecourses.nptel.ac.in/noc22_cs44/preview

Course outcomes

At the end of the course on **Blockchain and Cyber Security** the student will have the able

CO1	Explain and understand the fundamental concepts related to block chain and cyber security	
CO2	Apply the concepts of different types of cybercrime and coding knowledge to obtain the solution for specified parameters	PO1(3)
CO3	Analyse the given security parameters and arrive at suitable conclusions	PO2(2)
CO4	Implement and demonstrate the specified **mini-project** using suitable encryption and decryption techniques	PO3(1) PO5(1) PO6(1) PO9(1) PO10(1)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	Tota l
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3
CO3	-	2	-	-	-	-	-	-	-	-	-	-	2
CO4	-	-	1	-	1	1	-	-	1	1	-	-	1

Course Title	Machine Learning & Artificial Intelligence				
Course Code	22ET8PE4AI	Credits	3	L:T:P	3:0:0

To understand the AI foundations and applications.

- To describe the Problem types and characteristics of AI problems.
- To acquire knowledge about agents and its types.
- To Study agent environment and architecture.
- To study different classifiers, supervised and unsupervised learning

MODULE - I

Introduction:
Artificial Intelligence, Application of AI, AI Problems, Problem Formulation, Intelligent Agents, Types of Agents, Agent Environments, PEAS representation for an Agent, Architecture of Intelligent agents. Reasoning and Logic, Prepositional logic, First order logic, Using First-order logic, Inference in First-order logic, forward and Backward Chaining

MODULE - II

Search Strategies: Solving problems by searching, Search- Issues in The Design of Search Programs, Un-Informed Search- BFS, DFS; Heuristic Search Techniques: Generate-And Test, Hill Climbing, Best-First Search, A* Algorithm, Alpha beta search algorithm, Problem Reduction, AO*Algorithm, Constraint Satisfaction, Means-Ends Analysis

MODULE - III

Artificial Neural Networks : Introduction, Activation Function, Optimization algorithm Gradient decent, Networks Perceptrons, Adaline, Multilayer Perceptrons , Backpropogation Algorithms Training Procedures, Tuning the Network Size

MODULE - IV

Applications of ML,Data Mining Vs Machine Learning vs Big Data Analytics. Supervised Learning Naïve Base Classifier, Classifying with k-Nearest Neighbour classifier, Decision Tree classifier, Naive Bayes classifier.
Unsupervised Learning - Grouping unlabeled items using k-means clustering, Association analysis with the Apriori algorithm Introduction to reinforcement learning

MODULE - V

Forecasting and Learning Theory : Non-linear regression, Logistic regression, Random forest, Baysian Belief networks, Bias/variance tradeoff, Tuning Model Complexity, Model Selection Dilemma Clustering
: Expectation-Maximization Algorithm, Hierarchical Clustering, Supervised Learning after Clustering, Choosing the number of clusters, Learning using ANN

Course Outcomes (COs):

At the end of the course, students will be able to:

CO No	Course Outcome	PO(s)
CO1	Understand the fundamental concepts of Artificial Intelligence, intelligent agents, and problem formulation.	PO1
CO2	Apply various search strategies and heuristic techniques to solve AI problems.	PO2
CO3	Analyze and implement artificial neural networks and optimization algorithms for learning.	PO5, PO12
CO4	Compare and implement different supervised and unsupervised learning techniques for data classification and clustering.	PO4
CO5	Evaluate and apply machine learning models for forecasting and predictive analytics.	8, 10

Textbooks:

1. **Stuart Russell, Peter Norvig**, *Artificial Intelligence: A Modern Approach*, Pearson Education, 4th Edition, 2021.
2. **Tom Mitchell**, *Machine Learning*, McGraw Hill, 1st Edition, 1997.

Reference Books:

1. **Ethem Alpaydin**, *Introduction to Machine Learning*, MIT Press, 4th Edition, 2020.
2. **Ian Goodfellow, Yoshua Bengio, Aaron Courville**, *Deep Learning*, MIT Press, 2016.

E-References:

1. **Google AI** - https://ai.google/research/
2. **MIT OpenCourseWare on AI** - https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-034-artificial-intelligence-fall-2010/

E-Learning Platform:

- **Coursera:** *Machine Learning by Andrew Ng* - https://www.coursera.org/learn/machine-learning

Course Title	Network Security				
Course Code	22ET8OE3NS	Credits	3	L-T-P	3:0:0

Prerequisites: Basics concepts of communications

Objectives:

- Students will learn the importance of network security
- Introduce the concepts of encryption and decryption
- Understand the different techniques related to cryptography
- Learn about intruders and threats related to network

MODULE-I	8 hrs

Computer and Network Security concepts: Computer security concepts, The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, Fundamental Security Design Principles, Attack surface and attack trees, A model for network security

MODULE-II	8hrs

Symmetric Cipher: Classical Encryption Techniques: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Steganography

Digital Signatures: Digital signatures, Elgamal Digital signature scheme, Schnorr digital signature scheme, NIST digital signature algorithm

Message authentication Codes: Message authentication requirement, Message authentication functions, requirements for MAC, Security of MACs, MACs based on hash functions (HMAC)

MODULE-III	8 hrs

Symmetric key distribution using symmetric encryption, Symmetric key distribution using asymmetric encryption, distribution of public keys

Transport level security : web security considerations, secure socket layer, Transport layer security,HTTPS, SSH

Electronic mail security : PGP

MODULE-IV	8 hrs

Network Access Control and Cloud Security: Network Access Control, Extensible Authentication Protocol, IEEE 802.1X Port-Based Network Access Control, Cloud Computing, Cloud Security Risks and Countermeasures, Data Protection in the Cloud, Cloud Security as a Service, Addressing Cloud Computing Security Concerns

MODULE-V	8 hrs
Message Authentication Codes: Message Authentication Requirements, Message Authentication Functions Pseudo-Random-Sequence Generators and Stream Ciphers: Principles of Pseudorandom number generation , Pseudorandom number generator, Linear Congruential Generators , blum blum shub generator	
Text books:	
1.	**Cryptography and Network security: Principles and Practice**, William Stallings, 6th edition, Pearson Education
Reference books:	
1.	Data Communication and Networking, Behrouz Forouzan, 5th Edition,
2.	**Introduction to Cryptography and Network Security**- Behrouz A Forouzan, Mc-Graw Hill Higher Education, 1st Edition, 2008
E- References:	
1.	https://swayam.gov.in/nd1_noc20_cs02
e–Learning :	
1.	https://swayam.gov.in/nd1_noc20_cs21

Course outcomes

At the end of the course on **Network Security**, the student will have the able

CO1	Explain and understand the fundamental concepts related to cryptography	
CO2	Apply the concepts of basic mathematics and coding knowledge to obtain the solution for specified parameters	PO1(3)
CO3	Analyse the given security parameters and arrive at suitable conclusions	PO2(2)
CO4	Implement and demonstrate the specified **mini-project** using suitable encryption and decryption techniques	PO3(1) PO5(1) PO6(1) PO9(1) PO10(1)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	Total
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3
CO3	-	2	-	-	-	-	-	-	-	-	-	-	2
CO4	-	-	1	-	1	1	-	-	1	1	-	-	1

Course Title	Principles of Satellite Communication				
Course Code	22ET8OE3SC	Credits	3	L-T-P	3:0:0

Prerequisites: Basic Electronics

Objectives:

to study the principles and concepts of satellites.

to study the communication techniques adopted in Satellite communication.

to study the vast applications of satellite communication.

MODULE-I	8 hrs

Introduction to satellite: Basic principles , satellite orbits**,** Orbital parameters **,** Injection Velocity and Resulting Satellite Trajectories ,Launch Sequence **,** Orbital perturbations **,** Look angles **,** Earth Coverage and Ground Tracks

MODULE-II	8hrs

Satellites Hardware: Satellite subsystems, Mechanical structure, Propulsion subsystem, Thermal control subsystem, Attitude and orbit control, Telemetry, tracking and command subsystem, payload, Antenna subsystem.

MODULE-III	8 hrs

Communication techniques: Types of information signals, AM**,** FM**,** Pulse communication**,** Digital modulation techniques**,** Multiplexing technique, multiple access techniques- FDMA, TDMA, CDMA, Networking protocols-TCP**.**

MODULE-IV	8 hrs

Satellite link design fundamentals: Transmission equation, Satellite Link Parameters, Link Design procedure, Link Budget**,** Earth station- types, architecture, satellite tracking.

MODULE-V	8 hrs

Satellite Applications: Communication satellites , Remote sensing satellite , Weather satellite, Navigation satellites,

Text books:	
1.	**Satellite Technology Principles and Applications: 3rd Edition,** by Anil K Maini, Varsha Agrawal, Publisher: John Wiley & Sons
2.	**Satellite Communications:** Dennis Roddy, Tata McGraw Hill
Reference books:	
1.	**Satellite Communication:** Timothy Pratt, Second Edition, John Wiley and sons.
2.	Satellite communication Systems engineering – louisJ Ippolito Jr, Wiley Publishers
E- References:	
1.	International Journal of Satellite Communication and Networking - https://onlinelibrary.wiley.com/journal/15420981
e–Learning :	
1.	https://www.ansys.com/en-in/products/missions/ansys-stk
2.	https://orbitron.software.informer.com/

Course outcomes:

At the end of the course on **Satellite Communication**, the student will have the ability to

CO1	**Apply** the knowledge of science and engineering concepts to study the satellite communication systems and applications.	PO1(3)
CO2	**Analyze** orbital parameters and satellite communication link to arrive at a suitable conclusion.	PO2(2)
CO3	Function effectively as **an individual or as a team member** to make an effective oral presentation and prepare the report of the study that can be done through simulation of concepts or on topics related to advances in satellite technology.	PO5, PO9(1)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**Tota l**
CO 1	**3**	-	-	-	-	-	-	-	-	-	-	-	**3**
CO 2	-	**2**	-	-	-	-	-	-	-	-	-	-	**2**
CO 3	-	-	-	-	**1**	-	-	-	**1**	-	-	-	**1**

Course Title	Numerical Methods				
Course Code	22ET8OE3NM	Credits	3	L:T:P	3:0:0
Pedagogy: 40 Lectures					

MODULE - I

PROBABILITY AND STATISTICS

Probability; Bayes Theorem; Discrete Probability distributions; Continuous Probability distributions;

MODULE - II

NUMERICAL INTEGRATION AND DIFFERENTIATION

Methods of Numerical integration; Numerical differentiation; Identification of the problem and application of the numerical technique

MODULE - III

CONTINUOUS TIME LTI SYSTEMS

The Laplace Transform; The Fourier Transform; The system Transfer function; The frequency response; Pole-zero plot; Design of analog systems to meet specifications; Analyze analog LTI systems

MODULE - IV

DISCRETE LTI SYSTEMS

The Z- Transform; The Fourier Transform; The system Transfer function; The frequency response; Pole-zero plot; Design of digital systems to meet specifications; Analyze digital LTI systems

MODULE - V

DATA COMPRESSION

The wavelet Transform; Application for de-nosing; application for data compression; rate conversion; application for both one-dimensional and two-dimensional data sets;

Course Outcomes:

At the end of the course, students will have the

CO1	Ability to **define** and **explain** various numerical techniques	**---**	
CO2	Ability to **obtain** the specified parameter/representation for the given numerical task	**PO1 (3)**	
CO3	Ability to **analyse and classify** the given analog/digital LTI system	**PO2(3)**	
CO4	Ability to **design** analog/digital systems to meet given	**PO3(2)**	

	specifications		
CO5	Ability to formulate the problem, develop the Python code to implement and demonstrate an application of the identified numerical technique	**PO3(2)** **PO4(2)** **PO5(2)**	

TEXT BOOKS:

1. '**Intelligent Computing Techniques in Biomedical Imaging'**, Chapter 3 in the Book; Elsevier Publication; eBook ISBN: 9780443160004; Paperback ISBN:978044159992; May 2024
2. 'Digital signal Processing Concepts using Python', B Kanmani, ISTE-WPLP, ISBN: 978-81-89731-26-7; December 2023

Course Title	SEMINAR-BASED ON INTERNSHIP				
Course Code	22ET8SRIN3	Credits	2	L:T:P	0:0:2

During semester breaks, students are encouraged to engage in community service, through an NGO or as an individual. The duration of the activity shall be of 4 to 6 week duration. The work carried out in the semester break is assessed through an oral seminar accompanied by a written report. It is expected that this association will motivate the student to develop simple Electronic (or other) products to make their life comfortable, through suitable projects in later semesters.

At the end of the course, the student will have the ability to,

CO1	Engage in community service	**PO6 (2)**
CO2	Prepare the project report, three minute video and the poster of the work	**PO10 (3)**
CO3	Identify and specify an engineering product that can make their life comfortable	**PO2 (1)**
CO4	Prepare a business plan for a commercial venture of the proposed product, together with complying to relevant norms	**PO7 (2) PO8 (3) PO11 (2)**
CO5	Identify the community that shall benefit from the product	**PO6 (2)**

Course Title	MAJOR PROJECT					
Course Code	22ET8PWMPJ	Credits	5	L:T:P	0:0:5	

CO1: Ability to engage in independent study to research literature in the identified area	PO12 (3)	PSO 1(3) PSO 2(3) PSO 3(3)
CO2: Ability to consolidate the literature search to identify and formulate the engineering problem	PO2 (3)	
CO3: Ability to prepare the Gantt Chart for scheduling the project , engage in budget analysis, and designate responsibility for every member in the team	PO11 (3)	
CO4: Ability to identify the community that shall benefit through the solution to the identified research work and also demonstrate concern for environment	PO6 (3) PO7 (3)	
CO5: Ability to identify and apply the mathematical concepts, science concepts, and engineering concepts necessary to implement the identified engineering problem	PO1 (3) PO2 (3)	
CO6: Ability to identify and select the engineering tools /components required to reproduce the identified project	PO5 (3)	
CO7: Ability to design, implement, analyse and interpret results of the implemented project	PO3 (3) PO4 (3)	
CO8: Ability to engage in effective written communication through the project report, the one-page poster presentation, and preparation of the video about the project and the four page IEEE format of the work	PO10 (3) PO10 (3)	
CO9: Ability to engage in effective oral communication through presentation of the project work, demonstration of the project	PO10 (3)	
CO10: Ability to demonstrate compliance to the prescribed standards/ safety norms and abide by the norms of professional ethics	PO8 (3)	
CO11: Ability to perform in the team, contribute to the team and mentor/lead the team	PO9 (3)	
CO12: Ability to clearly specify the outcome of the project work (leading to start-up/ product/ research paper/ patent)	PO11 (3)	

Parameter	**≥75%**	**≥25% to <75%**	**< 25%**
Literature Survey	Referred to more than TEN recent articles; appropriately summarized; includes recent references	Referred to more than SIX recent articles; appropriately summarized; NO recent references	NO references included
Identification of essential concepts	Clear list, description and justification of MOST essential Mathematical, Science, Engineering and Management Concepts included	SOME essential Mathematical, Science, Engineering and Management Concepts included, without necessary details/ justification	There is NO mention of any of the essential Concepts
Project Scheduling and work	Proposed and implemented Gantt chart included; with clear distribution of workload	Proposed Gantt chart included; without clear distribution of workload	Gantt chart NOT provided; NO distribution of

delegation	among the team members		workload
Contribution to society, concern for environment	The community that shall benefit clearly specified; ensures safety to environment	Community clearly specified; however safety measures not specified	Hazard to society and to environment
Identification of essential concepts	Clear list, description and justification of MOST essential Mathematical, Science, Engineering and Management Concepts included	SOME essential Mathematical, Science, Engineering and Management Concepts included, without necessary details/ justification	There is NO mention of any of the essential Concepts
The Modern Tool	Clear justification in selecting the TOOL/Components being used is provided	There is no justification for the tool/components being used	--
Design and Analyze the results	More than ONE design solution implemented, with comparison Included clear analysis, along with advantages and disadvantages	Only ONE design solution implemented Included analysis, without the advantages and disadvantages	NO design included NO analysis
Written Communication	The Project report is well organized, clear objectives and outcomes for every chapter The Poster is well designed and includes the aim, the outcome, the results and conclusion All necessary details are included and the IEEE paper is well organized	The Project report is NOT well organized The Poster is NOT well organized, and includes few details Only few details are included for IEEE paper and is NOT well organized	The Project report is NOT submitted by the deadline The Poster is NOT included The IEEE paper format NOT included
Oral Presentation	well organized, clear presentation, have equal participation	Slides are not well organized, presentation not clear	Poor organization, No equal role
Compliance to Standards	Clear statement of existing Standards/ Norms, with compliance	Clear statement, but does not include compliance	Standards/Norms NOT stated
Performance in the Team	Contributes and cooperates in the team, and mentors/leads the team	cooperates but does NOT contribute to the team	Does NOT cooperate
Outcome of the Project	Clearly specified the outcome of the project and also successfully implemented the	Clearly specified the outcome of the project however was NOT	NOT specified the outcome of the project.

	same.	successful in its implementation.		
Synopsis Submission: First Evaluation- within two weeks of semester commencement (CO1, CO2, CO3; Evaluation of the Team 10 % weightage) Second Evaluation: after 10 weeks of semester commencement (CO4, CO5, CO6; Evaluation of the Team 20 % weightage) Third Evaluation: during the last week of the semester (CO7, CO10, CO12 – Evaluation of the Team 25 % weightage) (CO8- Evaluation of the Team, 20 % weightage) (CO9, CO11: Individual Evaluation of every member 25% marks) The department constitutes a Project Evaluation Committee (PEC), that schedules, allocates the guides and evaluates certain components of the project				

Course Title	MOOCS/ VIRTUAL LAB WITH CERTIFICATION				
Course Code	22ET8NCMC2	Credits	NC	L:T:P	0:0:0

Students need to have taken and successfully completed ONE MOOC course (of minimum four weeks duration), from any recognized online platform: NPTEL/SWAYAM/Coursera/EDx/ Virtual Labs or any other

The courses can be in the Engineering domain, Management domain, Science Domain, Sanskrit/Foreign Language, Art (music/dance/theatre any other), Journalism (media communication or any other), or any domain.

Students are awarded a Pass Grade on submission of the successful completion certificate, and needs to have taken the course any time after having joined the program.

Ability to engage in independent study, take up an online course in a domain of personal choice and successfully complete the course (PO12 (3))