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 2022 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 2022 onwards)

Curricular Component/Semester	I	II	III	IV	V	VI	VII	VIII	Total
Basic science Course(BS)	8	8	4	3					23
Engineering Science Course(ES)	9	9	3	3					24
Professional Core Course(PC)			14	14	14	10	6		58
Professional Elective Course(PE)					3	3	3	3	12
Open Elective Course(OE)						3	3	3	9
Project/Mini-Project(PW)					2	2	7		11
Internship (Re/Ru/ln)								6	6
Humanities and Social sciences, Management Course(HS)	1	1			3(RM,EVS)		1		6
Ability Enhancement Course/SDC(AEC)	2	2	1	1		4			10
UHV Courses				1					1
Non-Credit Mandatory Course(NCMC)	-	-	NC	NC	NC	NC	-	-	
Total credits	20	20	22	22	22	22	20	12	160

III Semester Scheme

Course Code	Course Title	Type	LT:P	Credits	Hours	CIE	SEE	Total
23MA3BSTFN	Transform Calculus, Fourier Series and Numerical Techniques	BS	2:1:0	3	5	50	50	100
23ET3ESCDS 23ET3ESOS3	C++ and Data Structures Operating Systems	ES	3:0:0	3	3	50	50	100
23ET3PCSSA	Signals and Systems: Analog	PC	2:1:0	3	4	50	50	100
23ES3PCNAL	Network Analysis	PC	2:1:0	3	4	50	50	100
23ES3PCDEC	Digital Electronic Circuits	PC	3:0:1	4	5	50	50	100
23ET3PCALC	Analog and Linear Circuits	PC	3:0:1	4	5	50	50	100
23ES3BSBFE	Biology for Engineers	BS	1:0:0	1	1	50	50	100
23ET3AEASP	Analog Signal Processing using Python	AE	0:0:1	1	2	50	50	100
23NCMC3NS1	National service scheme-1	NCMC	0:0:0	P/NP	0	P/NP	P/NP	P/NP
23NCMC3YG1	Yoga-1							
23NCMC3PE1	Physical Education-1							
Total			**16:3:3**	**22**	**29**	**400**	**400**	**800**

IV Semester Scheme

Course Code	Course Title	Type	L:T:P	Credits	Hours	CIE	SEE	Total
23MA4BSCPS	Complex Analysis, Probability and Statistical Methods	BS	2:1:0	3	4	50	50	100
23ET4PCHDL	Verilog HDL	PC	2:0:1	3	4	50	50	100
23ET4PCSSD	Signals and Systems: Digital	PC	2:1:0	3	4	50	50	100
23ES4PCAPP	ARM Processor and Programming	PC	3:0:1	4	5	50	50	100
23ET4PCCS1	Communication Systems-1	PC	3:0:1	4	5	50	50	100
23ES4ESCST	Control Systems	ES	2:1:0	3	4	50	50	100
23MA4AEUHV	Universal Human Values	AE	0:1:0	1	2	50	50	100
23ET4AEDSL	Digital Signal Processing Laboratory	AE	0:0:1	1	2	50	50	100
23NCMC4NS2	National service scheme-2	NCMC	0:0:0	P/NP	0	P/NP	P/NP	P/NP
23NCMC4YG2	Yoga-2							
23NCMC4PE2	Physical Education-2							
Total			**14:4:4**	**22**	**30**	**400**	**400**	**800**

V Semester Scheme

Course Code		Course Title	Type	L:T:P	Credits	Hours	CIE	SEE	Total
23ET5PCEMC		Electromagnetics	PC	3:1:0	4	5	50	50	100
23ET5PCCS2		Communication Systems 2	PC	3:0:1	4	5	50	50	100
23ET5PCMMC		Multimedia Communication	PC	2:0:0	2	2	50	50	100
23ET5PCFLI		Fundamentals of VLSI	PC	3:0:1	4	5	50	50	100
23ET5PE	1DD	Digital System Design	PE	3:0:0	3	3	50	50	100
	APP	Advanced Python Programming							
	ASP	Introduction to Audio and Speech processing							
	CPY	Cryptography							
23ET5PWMPR		Mini Project	PW	0:0:2	2	4	50	50	100
23ES5HSPMF		Project management and finance (Common to EEE, ECE, EIE, ETE & MD)	HS	2:0:0	2	2	50	50	100
23CV5HSEVS		Environmental Studies	HS	1:0:0	1	1	50	50	100
23NCMC5NS3		National service scheme-3	NCMC	0:0:0	P/NP	0	P/NP	P/NP	P/NP
23NCMC5YG3		Yoga-3							
23NCMC5PE3		Physical Education-3							
Total				**17:1:4**	**22**	**27**	**400**	**400**	**800**

VI Semester Scheme

Course Code		Course Title	Type	L:T:P	Credits	Hours	CIE	SEE	Total
23ET6PCITC		Information Theory and Coding	PC	2:1:0	3	4	50	50	100
23ET6PCCCN		Computer Communication Networks	PC	3:0:1	4	5	50	50	100
23ET6PCMWA		Microwave and Antenna	PC	3:1:0	4	5	50	50	100
23ET6PE	ESD	Embedded System design	PE	3:0:0	3	3	50	50	100
	2AI	Artificial Intelligence							
	ASP	Applied Signal Processing							
	2NS	Network Security							
23ET6OE	CHC	Communication in Healthcare	OE	3:0:0	3	3	50	50	100
	DSP	Digital Speech Processing							
23ET6PWPJ1		Project work -1	PW	0:0:2	2	4	50	50	100
23ES6AERMI		Research Methodology and IPR (Common to EEE,ECE,EIE,ETE &MD)	AE	2:0:0	2	2	50	50	100
23ET6AESIL		Simulation Lab	AE	0:0:1	1	2	50	50	100
23NCMC6NS4		National service scheme-4	NCMC	0:0:0	P/NP	0	P/NP	P/NP	P/NP
23NCMC6YG4		Yoga-4							
23NCMC6PE4		Physical Education-4							
Total				**16:2:4**	**22**	**28**	**400**	**400**	**800**

VII Semester Scheme

Course Code		Course Title	Type	L:T:P	Credits	Hours	CIE	SEE	Total
23ET7PCSGC		Signal Integrity and EMI/EMC	PC	2:0:0	2	2	50	50	100
23ET7PCWCN		Wireless and Cellular Networks	PC	3:0:1	4	5	50	50	100
23ET7PE	ASC	ASIC Design	PE	3:0:0	3	3	50	50	100
	3ML	Introduction to Machine Learning							
	OFC	Optical Fiber Communication							
	IOT	Internet of Things							
23ET7OE	MCS	Mobile Communication and Sustainable Networks	OE	3:0:0	3	3	50	50	100
	IDS	Introduction to Data Science							
25MA7HSIKL		Indian Knowledge systems	HS	1:0:0	1	1	50	50	100
23ET7PWPJ2		Project work -2	PW	0:0:7	7	14	50	50	100
Total				**12:0:8**	**20**	**28**	**300**	**300**	**600**

VIII Semester Scheme

Course Code		Course Title	Type	L:T:P	Credits	Hours	CIE	SEE	Total
23ET8PE	LVS	Low Power VLSI	PE	3:0:0	3	3	50	50	100
	DSC	Data Science							
	4MP	Machine learning based image Processing							
	BCS	Block Chain & Cyber Security							
23ET8OE	PSC	Principles of Satellite Communication	OE	3:0:0	3	3	50	50	100
	CNS	Cryptography & Network Security							
23ET8SRINT		Internship	INT	0:0:6	6	12	50	50	100
Details of 100 AICTE Activity Points Earned									
Total				**6:0:6**	**12**	**18**	**150**	**150**	**300**

Program Electives

Program Elective-1 (V Sem)	**Program Elective-2 (VI Sem)**	**Program Elective-3 (VII Sem)**	**Program Elective-4 (VIII Sem)**
Digital System Design 23ET5PE1DD	Embedded System design 23ET6PEESD	ASIC Design 23ET7PEASC	Low Power VLSI 23ET8PELVS
Advanced Python Programming 23ET5PEAPP	Artificial Intelligence 23ET6PE2AI	Introduction to Machine Learning 23ET7PEMLP	Data Science 23ET8PEDSC
Introduction to Audio and Speech processing 23ET5PEASP	Applied Signal Processing 23ET6PEASP	Optical Fiber Communication 23ET7PEOFC	Machine learning based image Processing 23ET8PE4MP
Cryptography 23ET5PECPY	Network Security 23ET6PE2NS	Internet of Things 22ET7PEIOT	Block Chain & Cyber Security 23ET8PEBCS

Open Electives

Program Elective-1 (VI Sem)	**Program Elective-3 (VII Sem)**	**Program Elective-4 (VIII Sem)**
Communication in Health care 23ET6OECHC	Mobile Communication and Sustainable Networks 23ET7OEMCS	Principles of Satellite Communication 23ET8OEPSC
Digital Speech Processing 23ET6OEDSP	Data Science 23ET7OEDSC	Cryptography & Network Security 23ET8OECNS

III Semester

Course Title	Transform Calculus, Fourier Series and Numerical Techniques				
Course Code	23MA3BSTFN	Credits	3	L:T:P	2:1:0
(COMMON TO ALL BRANCHES EXCEPT CS STREAM)		Contact Hours:39 Hours			

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; that 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 develop students' theoretical and applied mathematical skills.
- State the need for Mathematics with Engineering Studies and provide real-life examples.

Encourage the students for group learning to improve their creative and analytical skills

MODULE - I

LAPLACE TRANSFORMS: [08 hours]

Definition and Laplace transform of standard 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 / PowerPoint Presentation

MODULE - II

FOURIER SERIES: [08 hours]

Introduction to trigonometric polynomial, trigonometric series. Dirichlet's conditions. Fourier series of periodic functions with period 2π and arbitrary period. Complex Fourier series. Practical harmonic analysis.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

MODULE - III

FOURIER TRANSFORMS: [08 hours]

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 / PowerPoint Presentation

MODULE - IV

NUMERICAL SOLUTION OF PDE: [07 hours]

Classification of second-order partial differential equations, finite difference approximation of derivatives. Solution of one-dimensional heat equation by Schmidt and Bendre-Schmidt explicit formulae. Solution of one-dimensional wave equation using finite difference method.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

MODULE - V

CALCULUS OF VARIATIONS: [08 hours]

Definition, Variation of a functional, Euler-Lagrange equation, variational problems.

Applications: Hanging cable problem, Brachistochrone problem.

Z-TRANSFORMS:

Definition, Standard Z-transforms, Damping rule, Shifting rule. Inverse Z-transform and applications – Solution of difference equations.

Teaching-Learning Process	Chalk and talk method / PowerPoint 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
23MA3BSTFN	CO 1	Apply the concepts of Series, Transform Techniques, Calculus of Variation and Finite Difference Methods to solve engineering problems.	1	3
	CO 2	Apply the concepts of Transform Techniques, Calculus of Variation and Finite Difference Methods in engineering using modern IT tools.	1 & 5	3

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	
SEE	End Exam	100		50	

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. S. Pal & S. C. Bhunia, "Engineering Mathematics" Oxford University Press, 3rd Reprint, 2016.
3. N. P. Bali and M. Goyal, "A textbook of Engineering Mathematics", Laxmi Publications.
4. C. R. Wylie, L. C. Barrett, "Advanced Engineering Mathematics", McGraw–Hill Book Co. New York, 6th Edition.
5. C. B.Gupta, S. R. Singh and M. Kumar, "Engineering Mathematics for Semester I and II", Mc-Graw Hill Education (India) Pvt. Ltd 2015.
6. H. K. Dass and R. Verma, "Higher Engineering Mathematics", S. Chand Publication (2014).
7. J. 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	C++ and Data Structures				
Course Code	23ET3ESCDS	Credits	3	L:T:P	3:0:0

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

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

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

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

Stacks and Queues

Single linked lists and operations, Stacks, Queues- array and linked representation

MODULE - V

Hash table and Binary tree

Skip lists, hash table, Binary tree and traversal mechanisms.

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 on, C++ and Data Structures 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

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**Total**
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	**3**	-	-	-	-	-	-	-	-	-	-	-	**3**
CO3	-	**2**	-	-	-	-	-	-	-	-	-	-	**2**
CO4	-	-	**1**	-	-	-	-	-	-	-	-	-	**1**
CO5	-	-	-	-	**1**	-	-	-	**1**	-	-	-	**1**
CO6	-	-	-	-	-	-	-	-	**2**	-	-	**2**	**2**

Course Title	Operating Systems				
Course Code	23ET3ESOS3	Credits	3	L-T-P	3:0:0

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
- 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 structures of operating system

MODULE-I	8 hrs

Introduction: Abstract view of operating system, Goals of an OS, Operation of an OS; **Overview of Operating System:** Efficiency, System Performance and User Convenience, Classes of operating systems: Batch processing system, Multi programming systems, Time sharing systems, Real time operating systems, distributed operating systems. **(Textbook – 1)**

MODULE-II	8hrs

Scheduling: Preliminaries, Non-preemptive scheduling policies, Preemptive Scheduling policies, Real Time Scheduling **(Textbook – 1)**
Process Management: Process- Process Concept, Process Scheduling Operations on Process **(Textbook – 2)**

MODULE-III	8 hrs

Memory Management: Memory allocation process**,** Reuse of Memory, Contiguous Memory allocation, Non-Contiguous Memory Allocation
Virtual Memory : Virtual Memory Basics, **Demand Paging** – Overview of paging, Demand paging preliminaries, Page replacement ; Page Replacement Policies **(Textbook – 1)**

MODULE-IV	8 hrs

Message Passing: Overview of message passing, Implementing message passing, Mailboxes **Deadlocks**: Definition of deadlock, Deadlock in Resource Allocation, Handling Deadlocks, Deadlock Detection and Resolution, Deadlock Prevention, Deadlock Avoidance **(Textbook – 1)**

MODULE-V	8 hrs

File System: File Concept, Access Methods, Directory Structure, File system Mounting; **Structure Of The Operating Systems:** Operation of an O.S, Structure of an operating system, Operating system with monolithic structure, layered design of operating system,

Kernel based operating systems and Microkernel based operating systems. **(Textbook – 1)**	
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
2	Modern Operating System - Andrew S Tanenbaum, Herbert Bos, Person Education, 4th Ed
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 able

CO1	Explain the fundamental concepts of operating systems	
CO2	Apply the concepts of basic 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	Signals and Systems: Analog				
Course Code	23ET3PCSSA	Credits	3	L:T:P	2:1:0
Pedagogy: 25 Lectures+ 15 Tutorial sessions					

MODULE - I

SIGNALS

Signal definition; signal classification; Elementary signals; Signal transformation of independent and dependent variable;

SYSTEMS

System definition; system classification; The Linear Time Invariant (LTI) system;

MODULE - II

SIGNALS: Time Domain Representation

Impulse response; Properties of impulse response;
The convolution integral; Methods of evaluating the convolution integral;
Correlation; Auto- correlation; Cross-correlation;

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; Energy Spectral Density; Power Spectral Density;

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;

Course Outcomes:

At the end of the course, students will have the

CO1	Ability to **define** and **explain** continuous time signals and systems	**---**	**PSO1(3)** **PSO3(3)**
CO2	Ability to **obtain** the specified parameter/representation for the given continuous time signal/system	**PO1 (3)**	
CO3	Ability to **analyse and classify** the given signal/system	**PO2(3)**	

CO4	Ability to **design** analog Butterworth filters to meet given specifications	**PO3(2)**	
CO5	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 Wiely 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

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:

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

Course Title	Network Analysis				
Course Code	23ES3PCNAL	Credits	3	L:T:P	2:1:0
Pedagogy: 40 Lectures+ 10 Tutorial sessions					
MODULE - I					
Basic Concepts: Active and passive elements, ideal and practical sources. Source transformation and Source shifting, Super-Mesh and Super node analysis. Analysis of networks using star-deltatransformation, Mesh and Node voltage methods for AC and DC circuits with independent anddependent sources, concept of Duality.					
MODULE - II					
Network Theorems: Super Position theorem, Reciprocity theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem.					
MODULE - III					
Resonant Circuits: Analysis of simple series RLC and parallel RLC circuits under resonances. Problems on Resonant frequency, Bandwidth and Quality factor at resonance					
MODULE - IV					
Laplace Transformation: Laplace transformation (LT), LT of Impulse, Step, Ramp and sinusoidal functions, LT of shifted functions, Waveform synthesis, Initial and Final value theorems, Solutions for RL, RC networks for DC excitation. **Transient Analysis**: Transient analysis of RL and RC circuits under DC excitations: Behaviour of circuit elements under switching action ($t = 0$ and $t = \infty$), Evaluation of initial conditions.					
MODULE - V					
Two Port Network and its Parameters: Definition, Open circuit impedance, short circuit admittance, hybrid and Transmission parameters. Relationship between different parameters.					
TEXT BOOKS: 1. "Network Analysis", Van Valkenburg M.E., Prentice Hall India, 2014. 2. "Engineering Circuit Analysis", Hayt, Kemmerly and Durbin, 8th Edition, 2014, TataMcGraw-Hill. 3. "Circuit Theory Analysis and Synthesis", Chakrabarti, A., Dhanpat Rai & Co., 7thRevised Edition, 2018.					

Reference Books:

1. "Network Analysis and Synthesis", Franklin F. Kuo, Wiley.
2. "Analysis of Linear Systems", David K. Cheng, 11th reprint, 2002, Narosa PublishingHouse.
3. "Network Analysis and Synthesis", Anand Kumar, 2019, PHI learning.

E books and online course materials:

1. https://www.pdfdrive.com/introduction-to-electrical-circuit-analysis-e195167204.html

MOOCs:

1. http://elearning.vtu.ac.in/06ES34.html
2. https://www.coursera.org/course/circuits

Course Outcomes:

At the end of the course, students will have the

CO1	**Apply** basic circuit laws and network theorems to linear electrical networks	PO1(3)	PSO3(3)
CO2	**Analyze** linear circuits in time and frequency domain	PO2(3)	
CO3	**Simulate** linear circuits using appropriate tools	PO5(2)	

Course Title	Digital Electronic Circuits (Common for EEE,EIE,ETE and MD)				
Course Code	23ES3PCDEC	Credits	4	L:T:P	3:0:1
Total Hours of Pedagogy :40Hrs					

MODULE - I

Introduction:

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

MODULE - II

Combinational Logic Circuits:

Introduction, Parallel Adders (Carry Look Ahead Adder and Ripple carry adder), Decimal Adder, Code conversion, Magnitude Comparator, Decoders, Multiplexers, Read Only memories (ROM), Programmable Logic Arrays (PLAs).

MODULE - III

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, Shift Registers, Ripple Counters, Synchronous Counters.

MODULE - IV

Sequential systems: Analysis of Clocked Sequential circuits, State Reduction and Assignment, Design Procedure, Design with State Equations, Sequence detector.

MODULE - V

Logic Families:

Characteristic of Digital ICs, Transistor – Transistor Logic (NOT, NAND, NOR), Complementary MOS Logic (NOT, NAND, NOR), Comparison of TTL and CMOS families

Course Outcomes:

At the end of the course, students will have the

CO1	**Apply** the knowledge of logic functions to realize basic building blocks in digital logic circuits.	**PO1 (3)**	**PSO1(3) PSO3(3)**
CO2	**Analyze** and realize logic functions to reach substantiated conclusion.	**PO2(3)**	
CO3	**Design** a digital circuit for a given specification.	**PO3(3)**	
CO4	**Conduct** experiments using digital ICs and simulation tools for a given problem statement.	**PO4(3)**	
CO5	**Work individually/in a team** to demonstrate an open-ended experiment and document the same.	**PO5(2)**	

Text Books:

1. Digital Logic and Computer Design- M. Morris Mano, Prentice Hall – Pearson Education.
2. Digital Principles and Design- Donald Givone, Tata McGraw Hill
3. Verilog HDL-A Guide to Digital Design and Synthesis, Sameer Palnitkar, 2nd Edition, Pearson Edition 2003.

Reference Books:

1.Fundamental of Logic Design- Charles Roth Jr., Thomas Learning.

2.Fundamentals of Digital Logic with Verilog Design", Stephan Brown and Zvonk Vranesic, 2nd Edition, McGraw-Hill, 2008.

Online courses:

1.https://nptel.ac.in/courses/108105113/
2.https://nptel.ac.in/courses/106105185/

E-Books:

1.https://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/

List of Experiments: – To realize	
1.	Half/full adder and half subtractor using logic gates.
2.	Parallel adder/subtractor and magnitude comparator using IC 7483
3.	Code converters using MUX & DEMUX
4.	Decoder to Drive Seven Segment Display& Implementation of Priority Encoder
5.	Flip-flops
6.	Asynchronous Counters
7.	Synchronous Counters

Course Title	Analog and Linear Circuits				
Course Code	23ET3PCALC	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, Amplification in AC Domain, BJT Transistor Modeling-re transistor model, CE fixed bias configuration, Voltage Divider Bias configuration.

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.

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, instrumentation amplifiers, current and voltage sources, Precision Rectifiers, comparators.

MODULE - V

DAC-weighted resistor and R-2R ladder, ADC-Successive approximation type applications, Dual slope ADC,Delta-Sigma 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) 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 Code	Biology for Engineers	Course Name	23ES3BSBFE
Credits	01	L-T-P	1-0-0
Pedagogy: 15 Lectures			

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.

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).

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

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.

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

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 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	Analog Signal Processing using Python				
Course Code	23ET3AEASP	Credits	1	L:T:P	0:0:1

Laboratory 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)

Week 1: Introduction to Numpy of Python, Use of Python as calculator;

Week 2: Introduction to Matplotlib of Python, Use of Python to plot functions;

Week 3: Defining Functions in Python; The Text Editor; Generate random sequence; Plot Sinusoidal signals with additive noise; Create functions for basic signals and signal transformations

Week 4: Multisim experience for simple RLC circuits

Week 5: Representation of LTI systems – Transfer function; Pole-zero plot;

Week 6: Representation of LTI systems – Transfer function; Frequency response; Impulse response

Week 6: Examples in Fourier series

Week 7: Examples in Fourier Transform

Week 8: Design of Butterworth filters in Multisim

Week 9: Design of Butterworth filters in Python

Week 10: Application of filters

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 **design and analyse** the analog Butterworth filter using Multisim and Python	**PO3(3)** **PO4(3)** **PO5(3)**	
CO4	Build the analog signal processing tool box	**PO3(3)** **PO5(3)** **PO11(3)**	

IV Semester

Course Title	Complex Analysis, Probability and Statistical Methods				
Course Code For Batch 2018-19	**23MA4BSCPS**	**Credits**	**3**	**L:T:P**	**2:1:0**
Pedagogy: 39 contact hours					

COURSE OBJECTIVES: The goal of the course is to:

- Appreciate the importance of Complex Analysis, Special Functions, Probability and Statistics in Engineering.
- Acquire the knowledge of Complex Analysis, Special Functions, Probability and Statistics applied 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, that 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 skill.

MODULE - I

COMPLEX ANALYSIS **[08 hours]**

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

Conformal mapping: $w = z^2$ and $w = z + \frac{k^2}{z}\ (z \neq 0)$.

Chalk and Board, Problem based learning / Presentation	

MODULE - II

SPECIAL FUNCTIONS: **[08 hours]**

Introduction, Ordinary and Singular Points, Series solution of Bessel's differential equation leading to $J_n(x)$, Bessel's function of the first kind, Properties, generating function for

$J_n(x)$. Series solution of Legendre's differential equation leading to $P_n(x)$. Legendre polynomials, Rodrigue's formula (without proof) - Problems.

Chalk and Board, Problem based learning / Presentation	

MODULE - III

STATISTICAL METHODS: **[07 hours]**

Curve Fitting: Fitting the straight line, parabola and geometric curve ($y = a\,x^b$) by the method of least squares.

Correlation and regression - Karl Pearson's coefficient of correlation and rank correlation. Lines of regression, angle between two regression lines.

Chalk and Board, Problem based learning / Presentation	

MODULE - IV

PROBABILITY DISTRIBUTIONS: **[08 hours]**

Review of basic probability theory. Random variables (discrete and continuous), probability mass and density functions. Mathematical expectation, mean and variance. Poisson and normal distributions.

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

MODULE - V

STATISTICAL INFERENCE: **[08 hours]**

Sampling Theory: Introduction to sampling distributions, standard error, Type-I and Type-II errors. Test of hypothesis for means (single mean and difference between two means), student's t-distribution (single mean and difference between two means), Chi-square distribution-goodness of fit.

Chalk and Board, Problem-based learning / Presentation	

TEXT BOOKS:

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

REFERENCE BOOKS:

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

WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. http://nptel.ac.in/courses.php?disciplineID=111
2. http://www.class-central.com/subject/math(MOOCs)
3. http://academicearth.org/
4. http://www.bookstreet.in.
5. VTU EDUSAT PROGRAMME – 20

Course outcomes

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

Course Code	CO	COURSE OUTCOME (CO)	PO	Strength
23MA4BSCPS	CO 1	Apply the concepts of complex variables, special functions, probability and statistics to solve engineering problems.	1	3
	CO 2	Apply the concepts of complex variables, special functions and statistical methods using modern IT tools.	1 & 5	3

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	
SEE	End Exam	100		50	

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, 4, 5 and two questions each from Unit 1 and Unit 3.

Course Title	Verilog HDL				
Course Code	23ET4PCHDL	Credits	3	L:T:P	2:0:1

MODULE - I

Overview of Digital Design with Verilog HDL: Evolution of CAD, emergence of HDLs, typical HDL-flow, why Verilog HDL? Trends in HDLs.

Hierarchical Modeling Concepts: Top-down and bottom-up design methodology, differences between modules and module instances, parts of a simulation, design block, stimulus block.

MODULE - II

Basic Concepts: Lexical conventions, data types, system tasks, compiler directives.

Modules and Ports: Module definition, port declaration, connecting ports, hierarchical name referencing

MODULE - III

Gate-Level Modeling:

Modeling using basic Verilog gate primitives, description of and/or and buf/not type gates, rise, fall and turn-off delays, min, max, and typical delays.

Dataflow Modeling:

Continuous assignments, delay specification, expressions, operators, operands, operator types.

MODULE - IV

Behavioral Modeling:

Structured procedures, initial and always, blocking and non-blocking statements, delay control, generate statement, event control, conditional statements, Multiway branching, loops, sequential and parallel blocks

MODULE - V

Logic Synthesis with Verilog HDL: What is logic synthesis? Impact of Logic synthesis, Verilog HDL synthesis, Synthesis design Flow.

List of experiments:

1. Write a Verilog code for Half Adder, Full Adder, Half Subtractor, Full Subtractor using data flow modeling and Gate level modeling
2. Write a Verilog code for Multiplexer, Comparator, Decoder and Code converters using data flow modeling and Gate level modeling.
3. Write a Verilog code for D, T, JK and SR- FFs using Behavioral modeling
4. Write a Verilog code for counters and registers using behavioral modeling
5. Write a Verilog code for Asynchronous Counters using Gate-level modeling
6. Write a Verilog code for Synchronous Counters using Gate-level modeling

Course Outcomes:

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

CO1	Ability to **apply** the knowledge of Digital Electronics fundamentals to describe the VERILOG behaviour of a digital circuit using data flow, Behavioral , structural modelling and switch level modeling	**PO1**	
CO2	Ability to **analyse and design** a digital circuit through VERILOG for given specifications	**PO2**	
CO3	Ability to **synthesize** a digital circuit for given VERILOG behaviour	**PO3**	
CO4	Ability to **conduct experiments** using modern engineering CAD tool to: (i) perform simulation (ii) perform synthesis	**PO5, PO9**	

Text Book:

1. Samir Palnitkar, "**Verilog HDL: A Guide to Digital Design and Synthesis**", Pearson Education, Second Edition.

Reference Books:

1. Michael D. Ciletti, **"Advanced Digital Design with the Verilog HDL" ,** Pearson Education
2. Padmanabhan, Tripura Sundari, **"Design through Verilog HDL",** Wiley Publication
3. J.Bhaskar, **"A Verlog HDL Primer" -** BSPublications
4. Nazeih M.Botros **, "HDL Programming",** Dreamtech Press
5. Stephen Brown and Zvonko Vranesic," Fundamentals **of Digital logic with Verilog Design**", McGraw Hill publications

Course Title	Signals and Systems: Digital				
Course Code	**23ET4PCSSD**	**Credits**	**3**	**L:T:P**	**2:1:0**

Pedagogy: 25 Lectures+ 15 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); Gold Sequence; 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; Impulse response of a given difference equation; The convolution sum; Methods of evaluating the convolution sum; overlap-add; overlap-save; Linear Convolution; Circular Convolution; properties of convolution sum; Correlation; Auto- correlation; Cross-correlation;

MODULE - III

Signals: Frequency Domain Representation

The Discrete Time Fourier Transform (DTFT); Discrete Fourier Transform (DFT); Properties of DFT; Methods of evaluating the DFT; 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;

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;

Course Outcomes:

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

CO1	Ability to **define** and **explain** discrete time signals and systems, using time and frequency domain representation	**---**	
CO2	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)**	
CO3	Ability to **analyse and classify** the given signal/system using time domain, frequency domain and transform domain representation	**PO2(3)**	
CO4	Ability to **design** digital filters to meet given specifications, and use the filter for 1-dimensional signals, audio and 2-dimensional images	**PO3(3)**	**PSO1(3)** **PSO3(3)**
CO5	Ability to **conduct investigation** through implementation of the experiment, to represent/model the given signal/system	**PO4(1)** **PO5(2)**	
CO6	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)**	
CO7	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:

Sampling Theorem Part A: https://youtu.be/zJ-e3UxXSeo
Sampling Theorem Part B: https://youtu.be/Rbu7laRN6dM
Sampling Theorem Part C: https://youtu.be/sHCuHoibQAs
Sampling Theorem Part D: https://youtu.be/mtRwC1HPIno
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	ARM Processor and Programming				
Course Code	23ES4PCAPP	Credits	4	L:T:P	3:0:1

Pedagogy: 40 Lectures+ 10 Practical sessions

MODULE I

ARM Processor fundamentals –Basic Structure of computers- Von Neumann and Harvard Architecture,, Basic Processing Unit, Bus Structure, RISC and CISC Architecture, RISC and ARM Design philosophy, ARM core Dataflow model, programming model, processor states and operating modes, ARM pipeline

MODULE II

ARM Assembly Programming: load/store architecture, ARM instruction set, Assembler rules and Directives, ARM-THUMB interworking, Assembly Language Programs

MODULE III

Embedded C Programming

Basic C data types, Local variable types, C compiler, Optimization; C looping and structures, Registrar allocation, function calls, 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-Non Nested

MODULE V

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

List of Experiments:

Lab 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

Text books:	
1.	ARM System Developer's Guide, Sloss, Symes, WrightMorgan Kaufmann Publishers, Elsevier,2005
2.	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
3.	D. V. Hall, "Microprocessors & Interfacing", McGraw Hill Higher Education, 1991
E- References:	
1.	https://www.pdfdrive.com/embedded-systems-introduction-to-arm-cortextm-m-microcontrollers-e176014882.html
2.	https://www.pdfdrive.com/arm-microprocessor-systems-cortex-m-architecture-programming-and-interfacing-e157100364.html
e–Learning :	
1.	https://onlinecourses.nptel.ac.in/noc20_cs15
2.	https://nptel.ac.in/courses/117106111

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

CO1: Apply knowledge of functional blocks of computers in recognizing ARM Design approach	--
CO2: Analyse the Architectural features of 32-bit microprocessor with necessary Input/output and Memory Operations to build an embedded Controller	PO1
CO3: Design simple programming modules in machine and higher-level programming language using simulators to develop logical skills and testing skills	PO2
CO4: Select and implement appropriate Structured and modular programming using techniques such as subroutines, data stores, interrupt service routines and exception handling mechanisms	PO3
CO5: Build simple Embedded Applications using Input and output devices with ARM core and a controller	PO5

Course Title	Communication Systems-1				
Course Code	**23ET4PCCS1**	**Credits**	**4**	**L:T:P**	**3:0:1**

Pedagogy: 40 Lectures+ 10 Practical sessions

MODULE I

AMPLITUDE MODULATION: Introduction, AM: Time-Domain description, Frequency – Domain description. Generation of AM wave: square law 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: ring modulator. Coherent detection of DSBSC modulated waves. FOM of AM, DSBSC

MODULE II

SINGLE SIDE-BAND MODULATION (SSB): Hilbert Transform; in-phase and quadrature-phase components; Canonical representation of band pass signals. 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. FDM

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, Noise in FM receivers,

MODULE IV

Block Diagram of Digital Communication System, Sampling theorem, statement and proof, sampling of band-pass signals, Practical aspects of sampling, Reconstruction of message from its samples, TDM. Elements of PCM, Noise in PCM systems, Quantization, Companding.

MODULE V

Base-band Data transmission: Elements of binary PAM, Baseband shaping, Correlative coding, Baseband M-ary PAM, Adaptive equalization, Eye pattern, Examples: Line coding

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)**	

LAB Experiments : Using discrete components

- Analog filters;
- Generation and demodulation of AM, DSB-SC,
- Generation FM, pre-emphasis and de-emphasis
- Generation of SSB (using Multisim)
- Sampling Theorem verification
- Generation of PAM, PWM, PPM, PAM-TDM
- Pre emphasis and De emphasis

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

Course Title	Control systems				
Course Code	23ES4ESCST	Credits	3	L:T:P	2:1:0

MODULE I

Introduction:
Examples of Control Systems, open loop vs Closed loop Systems.
Mathematical Modeling of Linear Systems: Transfer functions of Electrical Systems, Block diagram, Signal Flow graph

MODULE II

Controllers & Time Response Analysis:

Step response of first order, second order systems, response specification, steady state error and error constants.

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 Stability Analysis using Bode plot

MODULE V

State Variable Analysis:

Concept of state variables, physical variable model, phase variable model, obtaining transfer function from state model.

At the end of the course, the student 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 Compensators and controllers to meet given (time/frequency domain) 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. 1. Modern control Engineering-Ogata, Prentice Hall
2. Automatic Control Systems- B.C Kuo, John Wiley and Sons

Course Title	UNIVERSAL HUMAN VALUES				
Course Code	23MA4AEUHV	Credits	1	L:T:P	0:1:0
CIE MARKS:50	SEE MARKS:50 TOTAL MARKS:100		EXAM HOURS:01		

Course objectives:

To develop a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence.

MODULE I	[3Hr]

Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

Purpose and motivation for the course, recapitulation from Universal Human Values-I

1. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration
2. Continuous Happiness and Prosperity- A look at basic Human Aspirations
3. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority
4. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
5. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking

MODULE II	[3Hr]

Understanding Harmony in the Human Being - Harmony in Myself!

1. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
2. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
3. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
4. Understanding the characteristics and activities of 'I' and harmony in 'I'
5. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail
6. Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease

MODULE III	[3Hr]

Understanding Harmony in the Family and Society- Harmony in Human- Human Relationship

1. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
2. Understanding the meaning of Trust; Difference between intention and competence
3. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
4. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
5. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives

MODULE IV	**[3Hr]**

Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

Understanding the harmony in the Nature Holistic perception of harmony at all levels of existence.

MODULE V	**[3Hr]**

Implications of the above Holistic Understanding of Harmony on Professional Ethics

1. Natural acceptance of human values
2. Definitiveness of Ethical Human Conduct

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. To discuss the conduct as an engineer or scientist etc.

TEXT BOOKS:

- Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

REFERENCE BOOKS:

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj – PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13.

Course outcomes (Course Skill Set): At the end of the course the student will be able to

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	PO7
CO3	Examine the role of a human being in ensuring harmony in society and nature	PO7, PO8, PO9,PO10, PO12
CO4	Apply the understanding of ethics in life and profession	PO7,PO8, PO9,PO10, PO12

Course Title	Digital Signal Processing Laboratory				
Course Code	23ET4AEDSL	Credits	1	L:T:P	0:0:1

Week 1: Plot of digital signals;

Week 2: Digital signal transformation

Week 3: Time domain representation and analysis of digital systems

Week 4: Representation and analysis of digital LTI systems

Week 5: Representation and analysis of digital LTI systems

Week 6: The Discrete Fourier Transform

Week 6: Design and Analysis of digital FIR Butterworth filters

Week 7: Design and Analysis of digital FIR Butterworth filters

Week 8: Design and Analysis of digital IIR Butterworth filters

Week 9: Design and Analysis of digital IIR Butterworth filters

Week 10: Application of digital filters

Course Outcomes:

At the end of the course, students will have the

CO1	Ability to **develop the Python code** for a given application	**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** to design, implement and analyse the digital filter	**PO3(3)** **PO4(3)** **PO5(3)**	
CO4	Build the digital signal processing tool box	**PO3(3)** **PO5(3)** **PO11(3)**	

V Semester

Course Title	ELECTROMAGNETICS				
Course Code	23ET5PCEMC	Credits	4	L:T:P	3:1:0

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. 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 on **Electromagnetics**, the student will have the

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)	

Course Title	COMMUNICATION SYSTEMS-2				
Course Code	23ET5PCCS2	Credits	4	L:T:P	3:0:1

Pedagogy: 40 Lectures+ 10 Practical sessions

MODULE I

RANDOM PROCESS: Random variables: Several random variables. Statistical averages: Function of Random variables, moments, Mean, Correlation and Covariance function: Central limit theorem, Properties of Gaussian process. Transmission of random signals through linear systems.
NOISE: Introduction, shot noise, thermal noise, white noise, Noise equivalent bandwidth, Noise Figure, Equivalent noise temperature.

MODULE II

RADIO RECEIVERS: Receiver types, Tuned radio frequency receiver, Super-heterodyne receiver. AM receiver. AM Receivers RF section and Characteristics, Frequency changing and tracking, Intermediate frequencies and IF amplifiers. Broadcast standards in India.

MODULE III

Gram-Schmidt orthogonalization procedure, Matched filters, Properties of matched filters.Band-pass data transmission: Time and frequency domain representation of ASK, FSK,PSK;generation and detection; Performance analysis: power and bandwidth, bit error rate.

MODULE IV

Band-pass data transmission:,Time and frequency domain representation of DPSK,QPSK; generation and detection; Performance analysis: power and bandwidth, bit error rate. Introduction to OFDM, MSK, GMSK, MQAM

MODULE V

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 : Using discrete components

Part A: Using suitable components

- Generation of ASK, PSK, FSK
- Demodulation of ASK, FSK, PSK

Part B: Using LabVIEW/MATLAB

- Sampling Theorem verification (Unit-I)
- Generation of Line-Codes (Unit-III)
- Obtaining the eye-pattern (Unit-III)
- Generation ASK, PSK, FSK, QPSK, (Unit-IV)
- PRBS sequence generation (Unit-V)
- Generation and demodulation of OFDM symbol (Unit-IV)

TEXT BOOKS:

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

4. Electronic Communication Systems. , Kennedy Davis,Fourth Edition,TMH,1999

REFERENCE BOOKS:

1. Digital and Analog Communication by K Sam Shanmugham, John Wiley

2. Analog and Digital communications by Simon Haykins –John Wiley

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

CO1	Ability to **define, understand and explain** concepts related to anlog and digital communication		**PSO2(3)**
CO2	Ability to **apply** the knowledge of mathematics and signal processing to various blocks of the analog and digital communication system	**PO1(3)**	
CO3	Ability to **analyze** the given block/waveform of the analog/digital communication system	**PO2(2)**	
CO4	Ability to **conduct experiments** to demonstrate concepts related to digital communication using discrete electronic components).	**PO5(3)**	
CO5	Ability to **conduct experiments** to demonstrate concepts related to digital communication using the engineering tool: LabVIEW/Matlab	**PO5(3)**	
CO6	Ability to perform in a team to build **the complete digital communication system** for transmitting and receiving the audio/data/image, and study the performance in added noise (using discrete components or an engineering tool)	**PO4(2)** **PO5(2)** **PO11(2)**	

Course Title	MULTIMEDIA COMMUNICATION				
Course Code	23ET5PCMMC	Credits	2	L:T:P	2:0:0

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 **5Hr**

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

MODULE - II **6Hr**

Text Representation and Compression: Text representation, unformatted text, formatted text, Hypertext, Code word generation of unformatted text, Adaptive Huffman coding, Arithmetic coding, LZW coding.

MODULE - III **5Hr**

Image Representation and Compression: Image representation, Graphics, Digitized documents, Digitized Pictures, Raster scan principles, three color image capture methods, Path length calculations, Complete JPEG Encoder, Basics of JPEG decoder, Introduction to Graphics Interchange Format, TIFF and JPEG 2000.

MODULE - IV **5Hr**

Audio Processing and Compression: PCM Speech, CD quality audio, Synthesized audio, MIDI, MIDI versus Digital Audio, Adaptive predictive coding, Linear predictive coding, Prediction error calculation for LPC, Dolby Audio coders.

MODULE - V **5Hr**

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

Animation: Pixels: Graph paper, Simple shapes, Grayscale color, RGB Color, Color Transparency.

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.

MOOCs:

1. http://nptel.ac.in/courses/117105083/
2. http://nptel.ac.in/downloads/117105083/

Course Outcomes: At the end of the course on **MULTIMEDIA COMMUNICATION**, the student will have the

CO1	Ability to **understand** and **explain** concepts of multimedia communication.	--	PSO3
CO2	Ability to **apply** knowledge of analog and digital communication to various multimedia data, networks and applications.	PO1	
CO3	Ability to **analyze** various communication networks, **derive** text encoding, **evaluate** different image compression schemes, **analyze** audio/speech/video frames.	PO2	
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.	PO4 PO5	

Course Title	FUNDAMENTALS OF VLSI				
Course Code	23ET5PCFLI	Credits	4	L-T-P	3:0:1

Objectives: 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	8 hrs

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.

MODULE-II	8hrs

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.

MODULE-III	8 hrs

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	8 hrs

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.

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

tree multiplier

MODULE-V	8 hrs

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: Verification of parameters for different circuits using Cadence Virtuoso tool

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 the DRC

Part – B: Verification of parameters for different circuits using Multisim tool

- nMOS Characteristics
- Transmission gate, CPL, Tri-state logic, C^2MOS logic, Dynamic logic, Domino logic, Pseudo-nMOS logic, BiCMOS logic

Text books:

3.	Douglas A. Pucknell and Kamran Eshraghian, "Basic VLSI Design" PHI 3rd Edition, 2005.
4.	John P. Uyemura, "Introduction to VLSI Circuits and Systems", Wiley Publications, 2002.

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.

e–Learning :

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 on **Fundamentals of VLSI**, the student will have the ability to

CO1	Define, understand and explain concepts of nMOS and CMOS technology.	--
CO2	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
CO3	Analyse the monochrome layout and stick diagrams of MOS technology and CMOS logic structures and subsystems, deduce appropriate testability vectors for the given parameters.	PO2
CO4	Conduct experiments using VLSI tools for a given application/problem statement.	PO4 PO5

Course Title	DIGITAL SYSTEM DESIGN				
Course Code	23ET5PE1DD	Credits	3	L:T:P	3:0:0

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	[7Hr]

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	[7Hr]

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	[7Hr]

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	[7Hr]

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	[7Hr]

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

Text Books:

1. Digital Design: with an introduction to Verilog HDL by M. Morris Mano and Mechael D.Ciletti, 5th Edition, Pearson Education, 2013
2. Digital system design using Verilog by Roth, John and Lee, 1st edition, Cengage learning, 2016.
3. Samir Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis", Pearson Education, Second Edition.

Reference Books:

1. Advanced Digital Design with the Verilog HDL by Michael D Ciletti, 2nd edition, Pearson education, 2017.
2. Fundamentals of Logic Design by Roth and Kinney. 7th edition, Cengage learning,2014
3. Stephen Brown and Zvonko Vranesic," Fundamentals of Digital logic with Verilog Design", McGraw Hill publications

E- References:

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

2.https://www.pdfdrive.com/arm-microprocessor-systems-cortex-m-architecture- programming-and-interfacing-e157100364.html
e–Learning :
1. https://onlinecourses.nptel.ac.in/noc22_cs94/ 2. https://onlinecourses.nptel.ac.in/noc21_ee97

Course Outcomes

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

CO1: Ability to **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: Ability to **analyse** the given specifications for a digital circuit to describe the behaviour in HDL	**PO 2**
CO3: Ability to **design** a digital circuit through HDL for given specifications	**PO3**
CO4: Ability to design and **conduct experiments** using modern engineering CAD tool to: (i) perform simulation (ii) perform synthesis	**PO5** **PO9**

Course Title	ADVANCED PYTHON PROGRAMMING				
Course Code	23ET5PEAPP	Credits	3	L-T-P	3:0:0

Prerequisites:

Introduction to C or Python Programming

Objectives:

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

MODULE-I	8 Hrs

Structure of Python Program

Writing and executing the first Python program, Understanding Python scripts, Variables and assignment, Functions, Strings, Control Structures.

MODULE-II	8Hrs

Data Structures and Functions

Creation and operations of Lists, Tuples and Sets. Creating and accessing Dictionaries, Importing Modules and Packages.

MODULE-III	8 Hrs

Object-Oriented Programming in Python

Classes and Objects, Constructors, Inheritance, Overriding, Polymorphism, Operator Overloading.

MODULE-IV	8 Hrs

File Handling and Exception Handling

File Handling and File methods, Excepting Handling using try, except and finally blocks, user-defined exceptions, working with CSV file.

MODULE-V	8 Hrs

Advanced Topics and Applications

Introduction to regular expressions, search, match, and replace operations, Introduction to NumPy and Pandas, creating simple GUI application

Text books:

1. Python Crash Course, 2nd Edition by Eric Matthes, no scratch press, 2019 2. Learning Python: Powerful Object-Oriented Programming 4th edition , O-Reilly
Reference books:
1. Python for Data Analysis, 2nd edition, by Wes McKinney, O'Reilly, 2017
E- References:
1. https://cfm.ehu.es/ricardo/docs/python/Learning_Python.pdf
e–Learning :
1.Joy of Computing in Python , NPTEL https://nptel.ac.in/courses/106106182

At the end of the course on **Advanced Python Programming,** the student will have the ability to

CO1: Ability to **Apply** core Python programming constructs including variables, functions, control structures, and strings to develop modular code.	**PO 1**
CO2: Ability to **Analyze** and implement data structures and object-oriented programming principles to solve moderately complex engineering problems.	**PO 2**
CO3: Ability to **Design** robust programs using file handling, exception mechanisms, and modular coding practices.	**PO3**
CO4: Create interactive and data-centric applications by integrating libraries like NumPy, Pandas, and GUI frameworks to address real-world challenges.	**PO5**

Course Title	INTRODUCTION TO AUDIO AND SPEECH PROCESSING				
Course Code	23ET5PEASP	Credits	3	L-T-P	3:0:0

Prerequisites:

Basics of signal processing

Basic concepts of mathematics

Objectives:

Ability to learn speech production and synthesis

Ability to implement speech processing concepts using programming

Ability to learn time and frequency domain processing methods of speech

MODULE-I	8 hrs

Speech Production & Auditory Perception

Introduction, The speech chain, Phonetic representation of speech, Models for speech production, Hearing and auditory perception, Perception of loudness, critical bands, Pitch perception, Auditory masking, Applications of digital speech processing

MODULE-II	8hrs

Short Time Analysis of Speech & Cepstrum

Short Time Analysis of Speech: Voiced/Unvoiced system model for speech, Short-Time Energy and Zero-Crossing Rate, Short-Time Autocorrelation Function (STACF), Short-Time Fourier Transform (STFT), sampling the STFT in Time and Frequency, The Speech Spectrogram, Relation of STFT to STACF, Short-Time Fourier Synthesis.

Cepstrum: Cepstrum and Complex Cepstrum, Short time Cepstrum, computation of Cepstrum

MODULE-III	8 hrs

Homomorphic Speech Analysis & LPC

Homomorphic Speech Analysis : Short time homomorphic filtering of speech, Application to pitch detection, Applications to Pattern Recognition: Compensation for Linear Filtering, Liftered Cepstrum Distance Measures, Mel-Frequency Cepstrum Coefficients

Linear Predictive Analysis(LPC): Linear Prediction and the Speech Model, Computing the Prediction Coefficients: The Covariance Method, The Autocorrelation Method, The Levinson–Durbin Recursion, LPC Spectrum, PARCOR Coefficients, Log Area Coefficients

MODULE-IV	**8 hrs**

Digital Speech Coding

Sampling and Quantization of Speech (PCM), Digital Speech Coding, **Closed-Loop Coders:** Predictive Coding, Delta Modulation, Adaptive Differential PCM Systems, Vector quantization, **Analysis-by-Synthesis Coding:** Basic Analysis-by-Synthesis Coding System, Perceptual Weighting of the Difference Signal, Generating the Excitation Signal, Multi-Pulse Excitation Linear Prediction (MPLP), Code-Excited Linear Prediction (CELP), **Open-Loop Coders:** The Two-State Excitation Model, Residual-Excited Linear Predictive Coding, Mixed Excitation Systems, **Frequency-Domain Coders:** Subband coder and decoder for speech

MODULE-V	**8 hrs**

Artificial Intelligence for Speech:

Understanding essential speech AI terms, foundational concepts, speech AI systems related to AI,ML and DL , Conversational AI, Speech AI concepts, Automatic speech recognition, Text to Speech synthesis system

Lab Experiments:

1. Speech recording or reading a speech file and plotting time domain waveform
2. Frequency spectrum of an audio signal
3. Spectrogram of an audio signal
4. Cepstrum analysis
5. Lpc analysis
6. Short time autocorrelation
7. Short time energy and ZCR

Text books:	
1	Introduction to Digital Speech Processing (Foundations and trends in signal processing 1:1-2, 2007), Lawrence R. Rabiner and Ronald W. Schafer , now Publishers Inc.,2007
2	Speech and Audio Signal Processing: Processing and Perception of Speech and Music Author(s): Ben Gold, Nelson Morgan, Dan Ellis First published:15 August 2011
Reference books:	
1	Digital processing of speech signals – L. R. Rabiner and R. W. Schafer, Pearson Education Asia, 2004.
2	Discrete time speech signal processing– T. F. Quatieri, Pearson Education Asia, 2004.
E- References:	
1	(For Module 5) https://developer.nvidia.com/blog/a-guide-to-understanding-essential-speech-ai-terms/ https://resources.nvidia.com/en-us-speech-ai-ebooks-gated/intro-to-speech-ai?nvid=nv-int-tblg-415752&ncid=no-ncid
2	https://www.pdfdrive.com/speech-and-audio-signal-processing-processing-and-perception-of-speech-and-music-second-edition-e183632947.html
3	https://www.pdfdrive.com/video-speech-and-audio-signal-processing-and-associated-standards-the-digital-signal-processing-handbook-second-edition-e184304478.html
e–Learning :	
1.	https://onlinecourses.nptel.ac.in/noc22_ee117/preview
2.	https://www.coursera.org/learn/audio-signal-processing

Course outcomes

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

CO1	Ability to understand the speech processing concepts	--
CO2	Ability to apply the knowledge of Engineering mathematics and programming skills to develop efficient speech processing algorithms	PO1
CO3	Ability to analyze the speech production and synthesis models	PO2
CO4	Ability to design a solution for audio 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	23ET5PECPY	Credits	3	L-T-P	3:0:0

Prerequisites: Basics of Communication

Objectives: Introduction to analysis and design of networks through the understanding the encryption and decryption mechanism.

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

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

Introduction to Number Theory: Divisibility and the Division Algorithm, Modular Arithmetic, Fermat's and Euler's Theorems, The Chinese Remainder Theorem

MODULE-III	8 hrs

Advanced Encryption Standard: AES Structure, AES Transformation Functions, AES Key Expansion

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

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

Cryptographic Hash Functions: Applications of Cryptographic Hash Functions.

Message Authentication Codes: Message Authentication Requirements, Message Authentication Functions, Requirements for Message Authentication Codes.

MODULE-V	8 hrs

Pseudo-Random-Sequence Generators and Stream Ciphers: Principles of Pseudorandom number generation , Pseudorandom number generator, Linear Congruential Generators , blum blum shub generator, Design and analysis of stream ciphers, Stream ciphers, Pseudorandom number generation using block cipher, RC4	
Text books:	
1.	Cryptography and Network security: Principles and Practice, William Stallings, 6th edition, Pearson Education
Reference books:	
1	Cryptography, Network Security and Cyber Laws – Bernard Menezes, Cengage Learning, 2010 edition
2	Introduction to Cryptography and Network Security- Behrouz A Forouzan, Mc-Graw Hill Higher Education, 1st Edition, 2008
e–Learning :	
1.	https://swayam.gov.in/nd1_noc20_cs02
2.	https://swayam.gov.in/nd1_noc20_cs21

Course outcomes

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

CO1	Explain the concepts of cryptographic functions	-
CO2	Apply the concepts of communication fundamentals and mathematics to obtain the solution for specified parameters	PO1
CO3	Analyse the given system security parameters and arrive at suitable conclusions	PO2
CO4	Demonstrate and Implement encryption and decryption concepts using suitable cryptography techniques	PO5, PO8 PO10, PO12

Course Title	MINI PROJECT				
Course Code	23ET5PWMPR	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.

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

Course Title	PROJECT MANAGEMENT AND FINANCE (COMMON TO EEE,ECE,EIE,ETE & MD)				
Course Code	23ES5HSPMF	Credits	2	L:T:P	2:0:0

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	**[5Hr]**
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.	

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

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	Choose projects and to implement project management methodologies ethically for successful project completion	**PO8, PO11**	
CO3	To identify the investment opportunities and to formulate the projects.	**PO2**	
CO4	Ability to choose projects which benefit the society and organization and apply	**PO6, PO7**	

Course Title	ENVIRONMENTAL STUDIES				
Course Code	23CV5HSEVS	Credits	1	L-T-P	1:0:0
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		

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.,

MODULE-I	5 Hours

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.
- Human activities - Food, Shelter, Economic & Social Security.
- Effects of Human activities on Environment: Agriculture, Housing, Industries, Mining and Transportation activities.
- Environmental Impact Assessment (E I A)

MODULE-II	4 Hours

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.

MODULE-III	3 Hours

Environmental pollution:

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

MODULE-IV	**3 Hours**

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.

Text books:

1.	Environmental studies by - Dr. Geethabalakrishanan (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)

Reference books:

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

E-References

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

e–Learning :

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

SEE PAPER PATTERN:

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 CIE 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**
Course outcomes At the end of the course on **Environmental Studies**, the student will have the
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.

VI Semester

Course Title	INFORMATION THEORY AND CODING				
Course Code	**23ET6PCITC**	**Credits**	**3**	**L:T:P**	**2:1:0**

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

- Appreciate the importance of probability and its application in Engineering Problems.
- Acquire the knowledge of different encoding and decoding techniques used to encrypt and decrypt the data
- Acquire the knowledge of convolutional coding used in most of the practical applications

MODULE I	5L+3T

INFORMATION THEORY: 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	**4L+2T**

SOURCE CODING: Encoding of the source output, Kraft inequality, Noiseless coding Theorem, Shannon‘s encoding algorithm, Shannon‘s Fano encoding algorithm. Huffman coding, problems.

MODULE III	**5L+2T**

COMMUNICATION CHANNELS: Discrete communication channels: Representation of channels, Channel Capacity, Shannon‘s Theorem on channel capacity, Channel efficiency, Binary channel, Binary symmetric channel, Binary Erasure channel, Cascaded channel, Problem

Continuous channels: Channel coding theorem, Differential entropy and mutual information for continuous ensembles, Channel capacity Theorem and its implications

MODULE IV	**5L+3T**

ERROR CONTROL CODING: Introduction, Types of errors, Types of codes : Linear Block Codes: Matrix description, Encoding and Syndrome calculating circuit, Hamming

Weights and Minimum distance, Error detection and correction, CRC Codes, Error Correcting Hamming Codes, Standard arrays and look up table for decoding, Decoding Circuit for Linear Block Code.

Binary Cyclic Codes: Algebraic structures of cyclic codes, Encoding using an (n-k) bit register, Syndrome calculation- Error Detection and Correction

MODULE V	**5L+2T**

CONVOLUTION CODES: Encoder for Convolution Codes: Using Time domain approach, Using Transform domain approach, State Diagram and code trees, Trellis Diagram and Viterbi Decoding, Introduction to Turbo Codes.

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

e-Learnings:

1.http://nptel.ac.in/courses/117101053/1
2.https://www.youtube.com/watch?v=nvmo9voRiSs

Course Outcomes: At the end of the course on **Information Theory and Coding**, the student will have the

CO1	Ability to define, understand and explain concepts related to information theory and coding	--	PSO3
CO2	Ability to apply the knowledge of probability and source encoding algorithms to obtain the information of analog and discrete message sources	PO1	
CO3	Ability to Analyse Convolution codec	PO2	
CO4	Ability to design the Block and Convolution codes for a given channel	PO3	
CO5	Ability to conduct experiments to demonstrate concepts related to information theory and coding using any engineering tool	PO5 PO9	
CO6	Ability design, formulate, implement and demonstrate an application of coding theory through an Open-Ended experiment for transmission of audio/data signal using any tool	PO5 PO9 PO10 PO11 PO12	

Course Title	COMPUTER COMMUNICATION NETWORKS				
Course Code	23ET6PCCCN	Credits	4	L-T-P	3:0:1

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

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

MODULE-II	8hrs

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

MODULE-III	8 hrs

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

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

MODULE-IV	8 hrs

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 hrs

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, **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.
   i) Total unicast message sent
   ii) Total unicast message received
   iii) UDP: broadcast throughput at transport layer
4. Study of network IP
5. Connect the computers in Local Area Network
6. Study of basic network command and Network configuration commands.
7. Configure a Network topology using software
8. Performing an Initial Switch Configuration
9. Performing an Initial Router Configuration
10. 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 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
CO3	Analyse the given network systems parameters and arrive at suitable conclusions	PO2
CO4	Design an network system to demonstrate networking concepts using the hardware and software engineering tool: Qualnet / Matlab/packet tracer	PO3, PO5 PO9
CO5	Demonstrate and Implement network concepts using suitable computer communication network parameters	PO5, PO8 PO10 PO12

Course Title	MICROWAVE AND ANTENNA				
Course Code	23ET6PCMWA	Credits	4	L-T-P	3:1:0

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.

MODULE-II	8Hrs

The line at radio frequencies: Line parameters: Parameters of the open-wire line and the coaxial line at high frequencies Input impedance of the dissipation less line, Input impedance of open-and short-circuited lines, Quarter wave line, Single stub impedance matching on a line, the Smith Chart, Single-stub matching with the Smith chart. Rectangular wave guides, strip lines.

MODULE-III	8 Hrs

Microwave Network Analysis: Impedance and admittance matrix, Scattering matrix, Transmission matrix, signal flow graphs,

Power Dividers, Directional Couplers and Microwave filters: The T-Junction Power Divider, directional coupler, Filter Design, Two-Port Power Gains for amplifiers.

MODULE-IV	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,

MODULE-V	**8 Hrs**

Antenna Arrays: Point sources, power theorem, Array of two isotropic point sources, non-isotropic but similar point sources, principles of pattern multiplication, linear array of n isotropic point sources of equal amplitude and spacing.

Wire antenna: the fields of a short dipole, Radiation resistance of short electric dipole, small loop, comparison of far fields of small loop and short dipole, Radiation Resistance of loops.

Experiments:

Following experiments can be conducted using any simulation tool (matlab/HFSS)

1. measurement of dipole antenna parameters
2. measurement of S-parameters :-E- plane and H-plane tee and Magic TEE
3. Radiation pattern of antenna array.

Make simple wire antenna considering gain, directivity, power, bandwidth, cost

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.
3. Microwave Engineering, by Annapurna Das and Sisir K Das, second edition, McGraw Hill

Reference books:

1	Antenna Theory Analysis and Design - C A Balanis, 2nd ED, John Wiley, 1997.
2	Microwave Engineering, by David Pozar, Third edition, 2005, Wiley Publication
3	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:

CO1	Ability to define, understand, and explain concepts of transmission lines, microwave components and antennas.	-
CO2	Ability to apply various concepts / laws of Electric and Magnetic Fields to obtain the specified parameters.	PO1(3)
CO3	Ability to analyse the given parameters of transmission lines/ antennas/ microwave devices to arrive at a suitable solution.	PO2 (2)
CO4	Ability to design a simple wire antenna considering the antenna parameters.	PO3(1) PO5(1) PO12(1)
CO5	Ability to engage in independent study and make an oral presentation on the antenna designed using any simulation tool	PO6(1) PO9(1) PO10(1) PO12(1) PSO3(1)

Course Title	EMBEDDED SYSTEM DESIGN				
Course Code	23ET6PEESD	Credits	3	L-T-P	3:0:0

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 **Embedded System Design** course, the student will have the

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	Ability to implement mini projects to demonstrate applications of embedded systems.	PO5, PO9, PO10, PO12

Course Title	ARTIFICIAL INTELLIGENCE				
Course Code	23ET6PE2AI	Credits	3	L-T-P	3:0:0

Prerequisites: Engineering Mathematics, Basic computer fundamentals

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 image processing applications through Machine Learning concepts.

MODULE-I	8 hrs

Introduction: What is AI? Foundations and History of AI

Intelligent Agents: Agents and environment, Concept of Rationality, The nature of environment, The structure of agents.

MODULE-II	8hrs

Problem-solving: Problem-solving agents, Example problems, Searching for Solutions Uninformed Search Strategies: Breadth First search, Depth First Search, Iterative deepening depth first search

MODULE-III	8 hrs

Informed Search Strategies: Heuristic functions, Greedy best first search, A*search. Heuristic Functions

MODULE-IV	8 hrs

Logical Agents: Knowledge–based agents, The Wumpus world, Logic, Propositional logic, Reasoning patterns in Propositional Logic

MODULE-V	8 hrs

First Order Logic: Representation Revisited, Syntax and Semantics of First Order logic, Using First Order logic.

Text books:

1	Stuart J. Russell and Peter Norvig , Artificial Intelligence, 3rd Edition, Pearson,2015
Reference books:	
1	Elaine Rich, Kevin Knight, Artificial Intelligence, 3rd edition,Tata McGraw Hill,2013
2	George F Lugar, Artificial Intelligence Structure and strategies for complex, Pearson Education, 5th Edition, 2011
E- References:	
1.	https://www.kdnuggets.com/2019/11/10-free-must-read-books-ai.html
e–Learning :	
1.	https://www.udacity.com/course/knowledge-based-ai-cognitive-systems--ud409
2.	https://nptel.ac.in/courses/106/105/106105077/

Course outcomes

At the end of the course on **Artificial Intelligence**, the student will have the ability to

CO1	Understand and explain concepts of Artificial Intelligence.	--
CO2	Apply knowledge of agent architecture, searching and reasoning techniques for different applications.	PO1
CO3	Analyse Searching and Inferencing Techniques.	PO2
CO4	Conduct experiments as an individual using modern engineering tool PYTHON for a given problem statement.	PO4 PO5

Course Title	APPLIED SIGNAL PROCESSING				
Course Code	23ET6PEASP	Credits	3	L-T-P	3:0:0

Prerequisites:

Basics of signal processing

Basic concepts of mathematics

Objectives:

Ability to learn applied signal processing

Ability to implement applied signal processing concepts using programming

Ability to learn time and frequency domain processing methods of audio signals.

MODULE-I	8 hrs

Speech processing in cell phones

Linear predictive processing of speech, The LP model of speech, the LP estimation algorithm, LP processing in practice, linear predictive coders

MODULE-II	8hrs

Sound processing in MP3 player

Subband and transform coding, perfect reconstruction filters, filter bank and lapped transforms, masking properties of human ear, audio coders

MODULE-III	8 hrs

Automatic speech recognition in a dictation machine

Statistical formalism of ASR, Markov models, hidden Markov model, training HMMs

MODULE-IV	8 hrs

Audio effects processor- Pitch shifting

Phase vocoder, DFT based signal processing, STFT based signal processing, perfect reconstruction, time scale modification with phase vocoder, pitch shifting with the phase

vocoder	
MODULE-V	**8 hrs**
Audio watermarking Audio watermarking seen as a digital communication problem, spread spectrum signals, communication channel design, informed watermarking	
Lab Experiments: 1. Simulation of audio processing in a cell phone conversation 2. Simulation of sound processing in a MP3 player 3. Automatic speech recognition system-HMM 4. Pitch shifting of audio 5. Audio watermarking	
Text books:	
1	Applied signal processing, a MATLAB based proof of concepts, Thierry dutoit, Ferran Marques, first edition, springer, 2009
2	**Fundamentals of Multimedia – Z. Li and M.S. Drew, Pearson Education Ltd., 2004**
Reference books:	
1	Introduction to Digital Speech Processing (Foundations and trends in signal processing 1:1-2, 2007), Lawrence R. Rabiner and Ronald W. Schafer , now Publishers Inc.,2007
2	Discrete time speech signal processing– T. F. Quatieri, Pearson Education Asia, 2004.
E- References:	

1.	https://www.pdfdrive.com/applied-signal-processing-a-matlab-based-proof-of-concept-e184989806.html
2.	https://www.pdfdrive.com/applied-digital-signal-processing-e11269044.html
e–Learning :	
1.	https://onlinecourses.nptel.ac.in/noc22_ee117/preview
2.	https://www.coursera.org/learn/audio-signal-processing

Course outcomes

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

CO1	Ability to understand the audio processing concepts	--
CO2	Ability to apply the knowledge of Engineering mathematics and programming skills to develop efficient audio processing algorithms	PO1
CO3	Ability to analyze the audio production and synthesis models	PO2
CO4	Ability to design a solution for audio applications	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 MATLAB through a mini-project	PO4,PO5,PO11

Course Title	NETWORK SECURITY				
Course Code	23ET6PE2NS	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, Requirements for Message Authentication Codes 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.	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) PO9(1)

Course Title	COMMUNICATION IN HEALTHCARE				
Course Code	23ET6OECHC	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:	
1	https://www.sciencedirect.com/book/9780128143094/fundamentals-of-telemedicine-and-telehealth
e–Learning:	
1	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

Course Title	DIGITAL SPEECH PROCESSING				
Course Code	23ET6OEDSP	Credits	3	L-T-P	3:0:0

Prerequisites:

Basics of signal processing

Basic concepts of mathematics

Objectives:

Ability to learn speech production and synthesis

Ability to implement speech processing concepts using programming

Ability to learn time and frequency domain processing methods of speech

MODULE-I	8 hrs

INTRODUCTION & TIME DOMAIN PROCESSING OF SPEECH SIGNAL

Mechanism of speech production, Acoustic phonetics, General discrete time model for speech production, Time dependent processing of speech, short-time energy and average magnitude, short-time average zero crossing rate, Speech vs. silence detection, short time autocorrelation function, Short time average magnitude difference function, pitch period estimation

MODULE-II	8hrs

FREQUENCY DOMAIN PROCESSING OF SPEECH SIGNAL

Definitions and properties: Fourier transforms interpretation and linear filter interpretation, sampling rates in time and frequency, Filter bank summation and overlap add methods for Synthesis of speech, Spectrographs, Phase vocoder, Channel vocoder.

MODULE-III	8 hrs

LINEAR PREDICTIVE CODING OF SPEECH

Basic principles of linear predictive analysis, Solution of LPC equations, Prediction error signal, Frequency domain interpretation, Relation between the various speech parameters,

Synthesis of speech from linear predictive parameters.	
MODULE-IV	**8 hrs**
HOMOMORPHIC SPEECH PROCESSING Introduction, Homomorphic systems for convolution, the complex Cepstrum of speech, pitch detection, formant estimation. The homomorphic vocoder.	
MODULE-V	**8 hrs**
Artificial Intelligence for Speech: Understanding essential speech AI terms, foundational concepts, speech AI systems related to AI,ML and DL , Conversational AI, Speech AI concepts, Automatic speech recognition, Text to Speech synthesis system	
Lab Experiments: 1.Speech recording or reading a speech file and plotting time domain waveform 2.Frequency spectrum of an audio signal 3.Spectrogram of an audio signal 4.Cepstrum analysis 5.Lpc analysis 6.Short time autocorrelation 7.Short time energy and ZCR	
Text books:	
1	**Digital processing of speech signals** – L. R. Rabiner and R. W. Schafer, Pearson Education Asia, 2004.
2	**Fundamentals of Multimedia – Z. Li and M.S. Drew, Pearson Education Ltd., 2004**
Reference books:	
1	Introduction to Digital Speech Processing (Foundations and trends in signal processing 1:1-2, 2007), Lawrence R. Rabiner and Ronald W. Schafer , now

	Publishers Inc.,2007
2	Discrete time speech signal processing– T. F. Quatieri, Pearson Education Asia, 2004.
E- References:	
1	(For Module 5) https://developer.nvidia.com/blog/a-guide-to-understanding-essential-speech-ai-terms/ https://resources.nvidia.com/en-us-speech-ai-ebooks-gated/intro-to-speech-ai?nvid=nv-int-tblg-415752&ncid=no-ncid
2	https://www.pdfdrive.com/speech-and-audio-signal-processing-processing-and-perception-of-speech-and-music-second-edition-e183632947.html
3	https://www.pdfdrive.com/video-speech-and-audio-signal-processing-and-associated-standards-the-digital-signal-processing-handbook-second-edition-e184304478.html
e–Learning :	
1.	https://onlinecourses.nptel.ac.in/noc22_ee117/preview
2.	https://www.coursera.org/learn/audio-signal-processing

Course outcomes

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

CO1	Ability to understand the speech processing concepts	--
CO2	Ability to apply the knowledge of Engineering mathematics and programming skills to develop efficient speech processing algorithms	PO1
CO3	Ability to analyze the speech production and synthesis models	PO2
CO4	Ability to design a solution for audio 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	PROJECT WORK-1				
Course Code	23ET6PWPJ1	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** **PO12**	**PSO3**
CO2	**Identify** the essential concepts, and identify the algorithm for the implementation	**PO1** **PO3**	
CO3	**Implement** and **analyse** the designed program, to match the specifications	**PO4**	
CO4	Calculate the **performance analysis** of the project	**PO11**	
CO5	Prepare the **project report**, three minute **video** and the **poster** of the work	**PO10**	
CO6	Engage in the **team** to document the business plan of the designed project, together with **complying** to **relevant norms**	**PO7** **PO8** **PO9**	
CO7	Identify the **community** that shall benefit from the project	**PO6**	

Course Title	**RESEARCH METHODOLOGY & IPR**				
Course Code	**23ES6AERMI**	**Credits**	**2**	**L-T-P**	**2:0:0**
CIE MARKS:50	**SEE MARKS:50** **TOTAL MARKS:100**	**EXAM HOURS:03**			
MODULE-I				**8 hrs**	
Meaning and sources of research problem, Objectives and Characteristics of research – Errors in selecting research problem, Research methods Vs Methodology - Types of research-Criteria of good research – Developing a research plan.					
MODULE-II				**8hrs**	
Investigations of a research problem - Selecting the problem - Necessity of defining the problem – Data collections-analysis- Importance of literature review in defining a problem - Survey of literature - Necessary instrumentations.					
MODULE-III				**8 hrs**	
How to write paper-conference articles-poster preparation, thesis report writing, inclusion of references, journal reviewing process, journal selection process, filling about journal template, developing effective research proposal-plagiarism-research ethics.					
MODULE-IV				**8 hrs**	
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. Procedure for obtaining patent, Provisional and complete specification, Rights conferred on a patentee, Transfer of patent, Infringement of patents, Action for Infringement, Geographical indications					
MODULE-V				**8 hrs**	
Copy Right: Introduction, Ownership of copy right, Rights conferred by copy right, Terms of copy right, License of copy right, Infringement of copy right, 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					
Reference books:					
	1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.				

	2. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International. 420p. 3. Anderson, T. W., An Introduction to Multivariate Statistical Analysis, Wiley Eastern Pvt., Ltd., New Delhi 4. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess Ess Publications. 5. Subbarau NR-Handbook of Intellectual property law and practice- S Viswanathan Printers and Publishing Private Limited 1998. 6. Basic Principles and Acquisition of Intellectual Property Rights", Dr. T. Ramakrishna, CIPRA, NSLIU-2005. 7. "Intellectual Property Law Handbook", Dr. B. L. Wadehhra, Universal Law Publishing Co. Ltd., 2002.
E- Reference:	
	chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/http://dl.saintgits.org/jspui/bitstream/123456789/1133/1/Research%20Methodology%20C%20R%20Kothari%20%28Eng%29%201.81%20MB.pdf

Course Title	SIMULATION LAB				
Course Code	23ET6AESIL	Credits	1	L:T:P	0:0:1

General Instructions:

1. Students shall work individually on every experiment.
2. Students shall be evaluated on regular and continuous basis as per the prevailing rubrics.
3. The student is required to submit a record based on the experiments carried out.

List of Experiments:

1. Basics of matrices
2. Polynomial multiplication and division
3. Shannon Fano encoding
4. Huffman Binary encoding
5. To calculate the different entropies for a given matrix
6. Linear block codes
7. Basic Image Transformations
8. Histogram and Histogram Equalization
9. Low Pass Filter of an Image
10. High Pass Filter of an Image
11. Inverse Filter
12. Failed Inverse Filter
13. Pseudo – Inverse Filter
14. Histogram of a Colour Image
15. Pseudo Colour Image Processing

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

CO1	Ability to work as an individual and thereby conduct experiments for a given application/problem statement.	**PO5** **PO9**	**PSO3**
CO2	Conduct experiments as an individual using modern engineering tool MATLAB for a given problem statement.	**PO4** **PO5**	

VII Semester

Course Title	SIGNAL INTEGRITY AND EMI/EMC				
Course Code	23ET7PCSGC	Credits	2	L-T-P	2:0:0

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

Objectives: To study concepts of signal integrity, electromagnetic compatibility and interference.

To understand the effects of conducted emission.

To study the basics of EMC testing and to make a test setup for conducted emission and measure them.

MODULE-I	5 hrs

INTRODUCTION TO SIGNAL INTEGRITY AND ELECTROMAGNETIC COMPATIBILITY:

Need for EMC, Impact of non-compliance on products, Qualifying Products for International Regulations, EMC Certification Standards, Basic Terminology: Source, Victim, Types of coupling - Capacitive, inductive, conducted and radiated with problems/examples, Emission, Immunity and Transients, Basics of signal Integrity.

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**:** Emission tests, Radiated Susceptibility, Conducted Immunity, Introduction to Automotive and Commercial standards. , 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 ,Prepare 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 3D simulation tools.	
Lab Experiments:	

Practical: Making a simple set up using 3D simulation tools (HFSS or CST or SimYog – Comscope) Practical: Make a test setup for conducted emission using current probe and voltage probe method and measure the conducted emission coming from an electronic product and try to reduce the emission Usage of Spectrum analyser and EMI Receiver.	
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_Enginee rin/
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 electromagnetics 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	Analyze concepts related to conducted emission through **conduction of suitable experiments.**	PO5(1) PSO3

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

Course Title	WIRELESS AND CELLULAR NETWORKS				
Course Code	**23ET7PCWCN**	**Credits**	**4**	**L-T-P**	**3:0:1**

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, Small scale multipath propagation, parameters of mobile multipath channels, types of 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, OFDM basics, Multiple Antenna Techniques, 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, 5G targets, 5G Technology Components, Drivers for 5G-Evolution of LTE Technology to Beyond 4G, 5G Roadmap, 10 Pillars of 5G, Spectrum for 5G, Spectrum allocation and spectrum sharing, 5G Architecture, 5G use cases	
Lab Experiments 1. Simulate a simple BSS with transmitting nodes in a wireless LAN and determine the performance with respect to the transmission of packets. 2. Simulate simple Wi-fi and WiMax with transmitting nodes in wireless LAN by simulation and determine the performance concerning the 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, handover in GSM, spectrum allocation and architecture of wireless networks	PO2
CO4	Ability to conduct **experiments** to demonstrate wireless concepts using the engineering tools 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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	Total
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3
CO3	-	3	-	-	-	-	-	-	-	-	-	-	3
CO4	-	-	-	-	3	-	-	-	3	-	-	-	3
CO5	-	-	-	-		1	1	1	1	1	-	1	1

Course Title	ASIC DESIGN				
Course Code	23ET7PEASC	Credits	3	L:T:P	3:0:0

MODULE - I

Introduction to ASICs

Types of ASICs**: --** Full Custom with ASIC, Standard Cell based ASIC, Gate array based ASIC, Channelled 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 the various design (Full-custom and Semi-custom) methodologies and programming technologies to implement a design	PO1
CO2	Design various data path elements	PO2
CO3	Analyse different Programmable logic cells, I/Os and cell libraries	PO3
CO4	Use CAD tools to demonstrate VLSI Circuits for Area, Speed and Power dissipation	PO5 PO9

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	INTRODUCTION TO MACHINE LEARNING				
Course Code	23ET7PE3ML	Credits	3	L-T-P	3:0:0

Prerequisites: Engineering Mathematics, Artificial Intelligence

Objectives: To introduce students the fundamentals of machine learning and understand the basic theory underlying machine learning; To differentiate supervised, unsupervised and reinforcement learning; and to provide the student with project experience from implementing machine learning based applications.

MODULE-I	8 hrs

Introduction: Well posed Learning problems, Perceptive and issues in Machine Learning, Need for Machine Learning, Explanation of Machine Learning, Machine Learning with respect to other fields, Types of ML, Challenges of Machine Learning.

Understanding Data – What is data? Big Data Analysis, Descriptive Statistics, Univariate data analysis, Bivariate data analysis, Multivariate Statistics.

MODULE-II	8hrs

Learning Theory: Basics of Learning theory, Design of a Learning system, Induction biases, Modelling in Machine Learning.

Similarity based Learning: Introduction, Nearest Neighbour learning, Weighted K – Nearest Neighbour, Nearest Centroid Classifier, Locally Weighted regression.

MODULE-III	8 hrs

Regression Analysis: Introduction to Linear regression, Validation of regression, Multiple linear regression, Logistic regression.

Decision Tree Learning: Introduction, Decision tree induction algorithms: ID3 Tree Constructions, C4.5 Constructions, Classification and Regression tree construction, Regression Trees, Validating and pruning decision trees.

MODULE-IV	8 hrs

Bayesian Learning: Bayes theorem, Classification using Bayes model, Naïve Bayes algorithm, Naïve Bayes for continuous attributes.

Support Vector Machines: Introduction, Hard margin Support Vector Machines, Soft margin Support Vector Machines.

MODULE-V	8 hrs

Artificial Neural Network: Introduction, Artificial Neurons vs Biological neurons, Perceptron and Learning theory, Types of Artificial Neural Network, Learning in multi-layer

perceptron.	
Text books:	
1	Machine Learning by Tom M. Mitchell, McGraw-Hill Education, 2013
2	Machine Learning by S. Sridhar, M Vijayalakshmi, Oxford ,2021
Reference books:	
1	Hands-on Machine Learning with Scikit-Learn &TensorFlow by Aurelien Geron, O'Reilly, Shroff Publishers and Distributors Pvt. Ltd 2019
2	Introduction to Machine Learning by Ethem Alpaydin, PHI Learning Pvt. Ltd, 2nd Ed., 2013
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.youtube.com/playlist?list=PL1xHD4vteKYVpaIiy295pg6_SY5qznc77
2.	https://nptel.ac.in/courses/106/106/106106139/

Course outcomes

At the end of the course on **Introduction to Machine Learning**, the student will have the ability to

CO1	**Understand** the concepts of Machine Learning and Concept Learning.	--
CO2	**Apply** the concept of Machine Learning to various classification methods.	PO1
CO3	**Analyse** various training models in Machine Learning algorithms.	PO2
CO4	**Implement** mini projects using modern engineering tool such as Python to demonstrate the applications of Machine Learning.	PO4, PO5, PO9

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	Total
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3
CO3	-	3	-	-	-	-	-	-	-	-	-	-	3
CO4	-	-	-	1	1	-	-	-	1	-	-	-	1

Course Title	OPTICAL FIBER COMMUNICATION				
Course Code	23ET7PEOFC	Credits	3	L:T:P	3:0:0
Pedagogy: 40 Lectures					
MODULE - I					
Fundamentals of Optical Fibers: Introduction to optical communication systems, Historical background and evolution of fiber optics, Advantages of optical fiber communication, Ray theory transmission, Electromagnetic mode theory, Step-index and graded-index fibers, Single-mode and multimode fibers, Numerical aperture, V-number, Cut-off wavelength, Mode field diameter, Dispersion and polarization, Fabrication techniques of optical fibers					
MODULE - II					
Transmission Characteristics and Optoelectronic Devices: Transmission characteristics of optical fibers, Attenuation: material absorption, scattering and bending losses, Dispersion: chromatic, intermodal and polarization-mode dispersion, Nonlinear effects: SPM, XPM, FWM, Optical sources: LEDs and laser diodes – principles, structures, modulation and characteristics, Optical detectors: PIN and APD – operation, quantum efficiency, responsivity, noise characteristics					
MODULE - III					
Fiber Connectors, Couplers and Receivers: Optical connectors and splices: types, characteristics, losses and mechanical considerations, Optical couplers and splitters, Fiber alignment and joint loss analysis, Optical receivers: basic operation, signal-to-noise ratio, noise sources in receivers, receiver sensitivity and bandwidth, Design considerations for analog and digital optical receivers					
MODULE - IV					
Link Design and System Performance: Link design and analysis: point-to-point digital links, Analog optical links: CNR, multichannel transmission, Link power budget and rise time budget, BER and system performance, Impact of dispersion and attenuation on link design, Eye diagrams and system penalties, Optical system design examples and case studies					
MODULE - V					
Optical Networks and Emerging Technologies: Optical networks: Introduction to optical networking, Wavelength Division Multiplexing (WDM) concepts, WDM components: MUX/DEMUX, couplers, filters, Optical amplifiers: EDFA, Raman amplifiers, Optical switches and cross-connects, SONET/SDH architecture and interfaces, Passive Optical Networks (PON), Future trends: elastic optical networks, all-optical networks, photonic integrated circuits					
TEXT BOOKS:					

1. "Optical Fiber Communications" – Gerd Keiser, 5th Edition, McGraw Hill

2. "Optical Fiber Communications: Principles and Practice" – John M. Senior, 3rd Edition, Pearson

REFERENCE BOOKS:

1. "Fiber-Optic Communication Systems" – G. P. Agrawal, 4th Edition, Wiley

2. "Optical Fiber Communication Systems with MATLAB and Simulink Models" – Le Nguyen Binh, 2nd Edition, CRC Press

3. "Fiber Optics Communication" – Harold Kolimbiris, 2nd Edition, Pearson

E Books:

1. Fiber Optic Communication Systems and Techniques – Prof. Pradeep Kumar K, IIT Kanpur
https://swayam.gov.in/nd1_noc19_ee67/preview

2. Fiber Optic Communications – Purdue University (edX)
https://www.edx.org/course/fiber-optic-communications

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 the concepts of optical fiber communication systems		PSO3(3)
CO2	Ability to apply principles of physics and communication theory to study fiber components, ray theory, EM propagation, and optical networks	PO1(3)	
CO3	Ability to analyse analog and digital links using link budget and rise time analysis for optical communication systems	PO2(3)	
CO4	Ability to interpret signal performance metrics and data transmission quality over fiber links	PO3(3) PO(3)	
CO5	Ability to work effectively as an individual or in a team to conduct experiments or simulations in fiber optic communication	PO9(3)	

Course Title	INTERNET OF THINGS (IOT)				
Course Code	23ET7PEIOT	Credits	3	L-T-P	3:0:0

Prerequisites: Basics of communications

Objectives:

- Students will learn the importance of networks
- Introduce the concepts of sensors

MODULE-I	8 hrs

Introduction to IoT, Introduction, physical design of IoT, Logical Design of IoT, IoT enabling technology, IoT levels and deployment templates **(Text Book – 1)**

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 **(Text Book – 2)**

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 **(Text Book – 2)**

MODULE-IV	8 hrs

Application Protocols for IoT: The Transport Layer, IoT Application Transport Methods: Generic Web Based Protocols, IoT Application Layer Protocols **(Text Book – 2)**

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 **(Text Book – 1)**

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 Book – 1)

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: 978-93-868-7374-3.
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
e–Learning :	
1.	https://onlinecourses.nptel.ac.in/noc19_cs65

Course outcomes

At the end of the course on **Internet of things** , the student will have the able

CO1	Explain and understand the fundamental concepts of Internet of things and wireless sensor networks	
CO2	Apply the concepts and basic knowledge of communication, networks and coding to networks	PO1(3)
CO3	Analyse given network parameters and arrive at suitable conclusions	PO2(2)
CO4	implement and demonstrate the specified **mini-project** using suitable communication and sensor network parameters	PO3(1) PO5(1) PO9(1)

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

Course Title	MOBILE COMMUNICATION AND SUSTAINABLE NETWORKS				
Course Code	23ET7OEMCS	Credits	3	L-T-P	3:0:0

Objective: To understand the evolution of mobile communication and the concepts of sustainable telecom networks

MODULE-I	8hrs

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.

MODULE-II	8hrs

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-III	8hrs

Radiation standards: Introduction, RF and Microwave Radiation, Safety standards for personnel, 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.

MODULE-IV	8hrs

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, Battery recycling

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

MODULE-V	8hrs

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.Wireless communications- Principles and Practice, Theodore S Rappaport, Pearson, 2nd Edition 2. The Telecommunications Handbook, Kornel Terplan, Patricia A. Morreale, 1st edition, CRC Press, 2000.
Reference book:
1.Green Networking and Communications: ICT for Sustainability, Shafiullah Khan, Jaime Lloret Mauri, CRC press, 2014
E- Reference:
Wireless Communications, Andrea Goldsmith, Cambidge University Press, 2005
e–Learning:
https://archive.nptel.ac.in/courses/110/105/110105073/

Course outcomes

At the end of the course on **Mobile Communication and Sustainable Networks**, the student will have the

CO1	Ability to **understand** and **explain** concepts related to wireless communication, hazards of radiation, the role of regulatory bodies and telecommunication companies in bringing sustainability in networks	-
CO2	Ability to **apply** the knowledge of communication to wireless and cellular networks and the knowledge of finance management to arrive at effective business models and revenue models for telecommunication networks	PO1(3)
CO3	Ability to **analyse** the Hazards of Radiation, and role of alternate renewable energy sources to minimize its effect on human health and environment	PO2(3)

Course Title	Introduction to Data Science				
Course Code	23ET7OEIDS	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

INDIAN KNOWLEDGE SYSTEMS (Theory) (Common to All UG Programs)						
Course Code	**:**	**25MA7HSIKL**		**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 Quiz-II	Each quiz is evaluated for 05 Marks adding up to **10 Marks.**	*****
THEORY COURSE - (Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating)		
Test – I Test – II	Each test will be conducted for 25 Marks adding up to 50 marks. Final test marks will be reduced to **20 Marks**	*****
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	PROJECT WORK-2					
Course Code	23ET7PWPJ2	Credits	7	L:T:P	0:0:7	

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				

VIII Semester

Course Title	LOW POWER VLSI				
Course Code	23ET8PELVS	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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	Total
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	**3**	-	-	-	-	-	-	-	-	-	-	-	**3**
CO3	-	**3**	-	-	-	-	-	-	-	-	-	-	**3**

Course Title	Data Science				
Course Code	23ET8PEDSC	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	MACHINE LEARNING BASED IMAGE PROCESSING				
Course Code	23ET8PE4MP	Credits	3	L-T-P	3:0:0

Prerequisites: Artificial Intelligence, Introduction to Machine Learning

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 image processing applications through Machine Learning concepts.

MODULE-I	8 hrs

Fundamentals of Image Processing: 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.

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 and Sharpening 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.

MODULE-IV	8 hrs

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-V	8 hrs

IP through Machine Learning: Clustering and Classifiers for Image Processing, Image

processing applications through Machine Learning	
Text books:	
1	Digital Image Processing by Rafael C. Gonzalez & Richard E. Woods, Fourth Edition, Pearson education, 2018
2	Machine Learning by S. Sridhar, M Vijayalakshmi, Oxford ,2021
Reference books:	
1	Practical Machine Learning and Image Processing by Himanshu Singh, Apress, 2019
2	Machine Learning for Audio, Video and Image Analysis by Francesco Camastra et.al., Springer, 2008
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 **Machine Learning based Image Processing**, the student will have the ability to

CO1	**Understand** and explain concepts of Image Processing and its application through Machine Learning	--
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 towards obtaining Machine Learning solutions.	PO1
CO3	**Analyse** the distance relationship between pixels, evaluate Histogram equalization on gray scale and colour image, deduce filter operations on the image, Analyse the patterns and features extracted and apply them for Machine Learning.	PO2

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

Course Title	BLOCK CHAIN AND CYBER SECURITY				
Course Code	23ET8PEBCS	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

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, Steganography

MODULE-II	8hrs

Fermat's and Euler's theorem Chinese Remainder Theorem , Principles of public key cryptosystems, The RSA algorithm, Diffe-Hellman key exchange, Elliptic Curve Arithmetic, Elliptic Curve cryptography

MODULE-III	8 hrs

Message Authentication and Hash Functions: 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-IV	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-V	8 hrs

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.	
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	William Stallings , "Cryptography and Network Security Principles and Practice", Pearson Education Inc., 6th Edition, 2014, ISBN: 978-93-325-1877-3
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.	Josh thompsons, block chain : the block chain for beginners- guide to block chain technology and leveraging block chain programming
4.	Cryptography and Network Security, Behrouz A. Forouzan, TMH, 2007
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 cyber crime 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	Perform as an individual, prepare a report and make an effective oral presentation on applications of network security protocols of communication system, satellite systems , any other.,	PO3(1) PO5(1) PO9(1)

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

Course Title	PRINCIPLES OF SATELLITE COMMUNICATION				
Course Code	23ET8OEPSC	Credits	3	L-T-P	3:0:0

Prerequisites: Basics of science

Objectives: To study the concepts of satellites and communication.

To understand the application of the concepts to serve mankind.

To study and analyse the communication link.

MODULE-I	8 hrs

Orbits and Launching methods: Overview of satellite systems, Basic principles, Orbital parameters, types of satellite orbits, Orbital perturbations, Station keeping, Look angles of satellite, earth coverage and ground track.

MODULE-II	7hrs

Satellite Hardware: Satellite subsystems , Propulsion subsystem , Thermal control, Power supply, Attitude control, TT&C subsystem, Transponders, Antennas subsystem,

MODULE-III	7 hrs

Communication Techniques: Types of information signals, AM, FM, Pulse communication, Digital modulation techniques, Multiplexing Techniques.

MODULE-IV	7 hrs

Multiple access Techniques: FDMA, TDMA, CDMA, SDMA, Transmission equation, Link design,

Earth station – types and architecture.

MODULE-V	7 hrs

Satellite Applications: communication satellites- satellite telephony, television and data communication services, Applications of remote sensing satellites, Navigation satellites -

GPS, weather satellites, Military 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.	PO1(3)
CO2	**Analyse** 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)

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

Course Title	CRYPTOGRAPHY & NETWORK SECURITY				
Course Code	23ET8OECNS	Credits	3	L-T-P	3:0:0

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, 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.	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 & 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) PO9(1)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	Total
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3
CO3	-	2	-	-	-	-	-	-	-	-	-	-	2
CO4	-	-	1	-	1	1	-	-	1	1	-	-	1

Course Title	INTERNSHIP				
Course Code	23ET8SRINT	Credits	06	L:T:P	0:0:6

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 16 to 20 weeks 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)**	