

Dr.Ambedkar Institute of Technology, Bengaluru-560056
Outcome Based Education(OBE) and Choice Based Credit System
B. E. Name of the programme: Electronics & Telecommunication Engineering
Tentative Scheme of Teaching and Examination Academic Year 2026-27
2022 Scheme

V SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self - Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	--	ETT501	Management & Entrepreneurship for Telecommunication Engineers	ETE	3	0	0		03	50	50	100	3
2	IPCC	ETU502	Microwave Engineering and Antenna Theory	ETE	3	0	2		03	50	50	100	4
3	PCC	ETT503	Digital Communication	ETE	3	2	0		03	50	50	100	4
4	PCCL	ETL504	Digital Communication Lab	ETE	0	0	2		03	50	50	100	1
5	PEC	ETT505x	Professional Elective Course	ETE	3	0	0		03	50	50	100	3
6	PROJ	ETM506	Mini Project	ETE	0	0	4		03	100		100	2
7	AEC	RMT507	Research Methodology and IPR	ETE	2	2	0		02	50	50	100	3
8	MC	CVT508	Environmental Studies	TD: CV PSB: CV	2	0	0		02	50	50	100	2
9	HS	CDN509	Aptitude and Verbal Ability Skills	Placement Cell	2	0	0		--	50	--	50	PP/ NP
10	MC	NSN510	National Service Scheme (NSS)	Mentors	0	0	2			100	---	100	PP/ NP
		PEN510	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		YON510	Yoga	Yoga Teacher									
Total										500	300	800	22

PCC: Professional Core Course, PCCL: Professional Core Course laboratory, UHV: Universal Human Value Course, MC: Mandatory Course (Non-credit), AEC: Ability

Enhancement Course, SEC: Skill Enhancement Course, L: Lecture, T: Tutorial, P: Practical, S= Self-Study CIE: Continuous Internal Evaluation, SEE: Semester End Evaluation. K : The letter in the course code indicates common to all the stream of Engineering. PROJ: Project /Mini Project. PEC: Professional Elective Course

Professional Elective Course 22XXT505x

ETT505A	Fundamentals of Satellite Communication	ETT505B	Multimedia Communication
ETT505C	Transmission Lines and Waveguides	ETT505D	OOPS using C++

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practicals of the same course. Credit for IPCC can be 04 and its Teaching– Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education(PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first Week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the Degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of Degree.

Mini-project work: Mini Project is a laboratory-oriented/hands on course that will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications etc. Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students.

CIE procedure for Mini-project:

(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two faculty members of the Department, one of them being the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of the project report, project presentation skill, and question and answer session in the ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

(ii) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all the guides of the project.

The CIE marks awarded for the Mini-project, shall be based on the evaluation of the project report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

No SEE component for Mini-Project.

Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of Engineering. Each group will provide an option to select one course. The minimum number of students' strengths for offering a professional elective is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.

Dr.Ambedkar Institute of Technology, Bengaluru-560056
Outcome Based Education(OBE) and Choice Based Credit System
C. B.E. Name of the programme: Electronics & Telecommunication Engineering
Tentative Scheme of Teaching and Examination effective from the Academic Year 2025-26
2022 Scheme

VI SEMESTER

Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self - Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
IPCC	ETU601	Computer Communication Networks	ETE	3	0	2		03	50	50	100	4
PCC	ETT602	ARM Processor & Embedded System Design	ETE	3	2	0		03	50	50	100	4
PEC	ETT603x	Professional Elective Course	ETE	3	0	0		03	50	50	100	3
OEC	ETT604x	Open Elective Course-I	ETE	3	0	0		03	50	50	100	3
PROJ	ETP605	Major Project Phase I	ETE	0	0	4		03	100	--	100	2
PCCL	ETL606	ARM Processor & Embedded System Design Lab	ETE	0	0	2		03	50	50	100	1
AEC/SDC	ETT607x OR ETL607x	Ability Enhancement Course/ Skill Development Course V	ETE	If the course is offered as a Theory				01	50	50	100	1
				1	0	0						
				If course is offered as a practical								
				0	0	2						
HS	CDN608	Analytical and Reasoning Skills	Placement Cell	2	0	0		--	50	--	50	PP/ NP

MC	NSN609	National Service Scheme (NSS)	Mentors	0	0	2			100	---	100	PP/ NP
	PEN609	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
	YON609	Yoga	Yoga Teacher									
Total									500	300	800	18

PCC: Professional Core Course, **PCCL:** Professional Core Course laboratory, **UHV:** Universal Human Value Course, **MC:** Mandatory Course (Non-credit), **AEC:** Ability Enhancement Course, **SEC:** Skill Enhancement Course, **L:** Lecture, **T:** Tutorial, **P:** Practical, **S=** Self-Study, **CIE:** Continuous Internal Evaluation, **SEE:** Semester End Evaluation. **K :** The letter in the course code indicates common to all the stream of Engineering. **PROJ:** Project /Mini Project. **PEC:** Professional Elective Course. **PROJ:** Project Phase -I, **OEC:** Open Elective Course.

Professional Elective Course: XXT603x			
ETT603A	Cryptography& Network Security	ETT603B	RADAR Engineering
ETT603C	Fundamentals of AI & ML	ETT603D	Principles of VLSI Design
Open Elective Course XXT604x			
ETT604A	Mobile Communication	ETT604B	Embedded System Design & ARM Processor
ETT604C	Fundamentals of VLSI Design	ETT604D	Principles of Satellite Communication

Ability Enhancement Course / Skill Enhancement Course-V XXT607x OR XXL607x			
ETT607A	Antenna Design & Testing Lab	ETT607B	IoT Lab
ETT607C	Communication Simulink Toolbox	ETT607D	Virtual Instrumentation using LabVIEW
ETT607E	VLSI Design Lab		

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practicals of the same course. Credit for IPCC can be 04 and its Teaching– Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23 National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education(PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first Week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the Degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of Degree.
Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of Engineering. Each group will provide an option to select one course. The minimum number of students’ strengths for offering professional electives is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.
Open Elective Courses: Students belonging to a particular stream of Engineering and Technology are not entitled to the open electives offered by their parent Department. However, they can opt for an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor. The minimum numbers of students’ strength for offering Open Elective Course is 10. However, this condition shall not be applicable to class where the admission to the program is less than 10.
Project Phase-I : Students have to discuss with the mentor /guide and with their help he/she has to complete the literature survey and prepare the report and finally define the problem statement for the project work.

Dr. Ambedkar Institute of Technology, Bengaluru-560056
Outcome Based Education(OBE) and Choice Based Credit System
B.E. Name of the programme: Electronics and Telecommunication Engineering
Tentative Scheme of Teaching and Examination Academic Year 2026-27 (2022 Scheme)

VII SEMESTER(Swappable VII and VIII SEMESTER)

Sl.No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours/Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self-Study	Duration hours	CIE Marks	SEE Marks	Total Marks	
1	IPCC	22ETU701	Optical Fiber Communication		3	0	2		03	50	50	100	4
2	IPCC	22ETU702	Wireless and Mobile Networks		3	0	2		03	50	50	100	4
3	PCC	22ETT703	Adaptive Signal Processing		3	2	0		03	50	50	100	4
4	PEC	22ETT704x	Professional Elective Course		3	0	0		03	50	50	100	3
5	OEC	22ETT705x	Open Elective Course – 2		3	0	0		01	50	50	100	3
6	PROJ	22ETP706	Major Project Phase-II		0	0	12		03	100	100	200	6
										400	300	700	24

PCC: Professional Core Course, **PCCL:** Professional Core Course laboratory, **PEC:** Professional Elective Course, **OEC:** Open Elective Course, **PR:** Project Work, **L:** Lecture, **T:** Tutorial, **P:** Practical, **S:** Self-Study, **CIE:** Continuous Internal Evaluation, **SEE:** Semester End Evaluation. **TD:** Teaching Department, **PSB:** Paper Setting department, **OEC:** Open Elective Course, **PEC:** Professional Elective Course. **PROJ:** Project work

Professional Elective Course 22XXT704x

22ETT704A	DSP algorithms and architecture	22ETT704C	Machine Learning using Python
22ETT704B	Digital image processing and its applications	22ETT704D	Wireless Sensor Networks and its Applications

Open Elective Course 22XXT705x

22ETT705A	Wireless Sensor Networks	22ETT705C	Fundamentals of Digital Image Processing
22ETT705B	Multimedia Communication		

Note: VII and VIII semesters of IV years of the program

(1) Institutions can swap the VII and VIII Semester Schemes of Teaching and Examination to accommodate research internships/industry internships after the VI semester.
(2) Credit earned for the courses of VII and VIII Semester Scheme of Teaching and Examination shall be counted against the corresponding semesters whether the VII or VIII semesters is completed during the beginning of the IV year or the later part of IV year of the program.

Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of Engineering. Each group will provide an option to select one course. The minimum number of students' strength for offering professional electives is 10. However, this condition shall not be applicable to cases where the admission to the program is less than 10.

Open Elective Courses:

Students belonging to a particular stream of Engineering and Technology are not entitled to the open electives offered by their parent Department. However, they can opt for an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor. The minimum numbers of students' strength for offering Open Elective Course is 10. However, this condition shall not be applicable to class where the admission to the program is less than 10.

PROJECT WORK (21XXP75): The objective of the Project work is

- (i) To encourage independent learning and the innovative attitude of the students.
- (ii) To develop interactive attitude, communication skills, organization, time management, and presentation skills.
- (iii) To impart flexibility and adaptability.
- (iv) To inspire team working.
- (v) To expand intellectual capacity, credibility, judgment and intuition.
- (vi) To adhere to punctuality, setting and meeting deadlines. To install responsibilities to oneself and others.
- (vii) To train students to present the topic of project work in a seminar without any fear, face the audience confidently, enhance communication skills, involve in group discussion to present and exchange ideas.

CIE procedure for Project Work:

(1) Single discipline: The CIE mark shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.

The CIE marks awarded for the project work, shall be based on the evaluation of the project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

(2) Interdisciplinary: Continuous Internal Evaluations shall be group-wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

SEE procedure for Project Work: SEE for project work will be conducted by the two examiners appointed by the University. The SEE marks awarded for the project work shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25.

Dr.Ambedkar Institute of Technology, Bengaluru-560056
Outcome Based Education(OBE) and Choice Based Credit System
B.E. Name of the programme: -----

Tentative Scheme of Teaching and Examination effective from the Academic Year ----- (2022 Scheme)

VIII SEMESTER(Swappable VII and VIII SEMESTER)

Sl.No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours/Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/Drawing	Self-Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	PEC	22ETT801x	Professional Elective (Online Courses)		3	0	0		-	-	-	-	3
2	OEC	22ETT802x	Open Elective (Online Courses) - 3		3	0	0		-	-	-	-	3
3	INT	22ETI803	Internship (Industry/Research) (14-20 Weeks)		0	0	12		03	100	100	200	10
										200	200	400	16

L:Lecture, **T:**Tutorial, **P:**Practical **S=** Self-Study, **CIE:**Continuous Internal Evaluation, **SEE:**Semester End Evaluation. **TD-**Teaching Department, **PSB:**Paper Setting department, **OEC:**Open Elective Course, **PEC:**Professional Elective Course. **PROJ:**Project work, **INT:**Industry Internship/Research Internship/Rural Internship.

Professional Elective Course (Online courses) 22ETT801x

22ETT801A		22ETT801C	
22ETT801B		22ETT801D	

Open Elective Courses (Online Courses) 22XXT802x

22ETT802A		22ETT802C	
22ETT802B		22ETT802D	

Note: VII and VIII semesters of IV years of the program Swapping Facility

- Institutions can swap VII and VIII Semester Scheme of Teaching and Examination to accommodate **research internships/industry internships/Rural Internship** after the V semester.
- Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether VII or VIII semester is completed during the beginning of IV year or later part of IV year of the program.

Elucidation:

At the beginning of IV year of the program i.e., after VI semester, VII semester classwork and VIII semester **Research Internship/Industrial Internship/Rural Internship** shall be permitted to be operated simultaneously by the University so that students have ample opportunity for an internship. In other words, a good percentage of the class shall attend VII semester classwork and a similar percentage of others shall attend to Research Internship or Industrial Internship or Rural Internship.

Research/Industrial /Rural Internship shall be carried out at an Industry, NGO, MSME, Innovation center, Incubation center, Start-up, center of Excellence (CoE), Study Centre established in the parent institute and/or at reputed research organizations/institutes.

The mandatory Research internship /Industry internship / Rural Internship is for 14 to 20 Weeks. The internship shall be considered as a head of passing and shall be considered for the award of a Degree. Those, who do not take up/complete the internship shall be declared to fail and shall have to complete it during the subsequent University examination after satisfying the internship requirements.

Research internship: A research internship is intended to offer the flavor of current research going on in the research field. It helps students get familiarized with the field and imparts the skill required for carrying out research.

Industry internship: Is an extended period of work experience undertaken by students to supplement their Degree for professional development. It also helps them learn to overcome unexpected obstacles and successfully navigate organizations, perspectives, and cultures. Dealing with contingencies helps students recognize, appreciate, and adapt to organizational realities by tempering their knowledge with practical constraints.

Rural Internship: Rural development internship is an initiative of Unnat Bharat Abhiyan Cell, RGIT in association with AICTE to involve students of all departments studying in different academic years for exploring various opportunities in techno-social fields, to connect and work with Rural India for their upliftment.

The faculty coordinator or mentor has to monitor the student's internship progress and interact with them to guide for the successful completion of the internship. The students are permitted to carry out the internship anywhere in India or abroad. University shall not bear any expenses incurred in respect of the internship.

- With the consent of the internal guide and Principal of the Institution, students shall be allowed to carry out the internship at their hometown (**within or outside the state or abroad**), provided favorable facilities are available for the internship and the student remains regularly in contact with the internal guide. **University/Institute shall not be at any cost involved in carrying out the internship by students.** However, students can receive any financial assistance extended by the organization.

V Semester

MANAGEMENT AND ENTREPRENEURSHIP FOR TELECOMMUNICATION ENGINEERS			
Course Code:	ETT501	CIE Marks:	50
Teaching Hours/Week (L:T:P:S):	3:0:0:0	SEE Marks:	50
Total Hours :	39	Total Marks:	100
Credits:	03	Exam Hours:	03
Course objectives: 1. Understand basic skills of Management. 2. Understand the need for Entrepreneurs and their skills. 3. Identify the Management functions and Social responsibilities.			
Module-1			08 hrs
Management: Nature and Functions of Management- Importance, Definition, Management Functions, Levels of Management, Roles of Manager, Managerial Skills, Management & Administration, Management as a Science, Art & Professions, Introduction to Project Management in Telecommunications. Planning: Planning-Nature, Importance, Types, Steps and Limitations of Planning; Decision Making-Meaning, Types and Steps in Decision Making, Project Planning and Integration in Telecommunications. (Selected topics from Chapters 4 & 5, Text 1 and Introduction chapter in Text 2).			
Module-2			07 hrs
Organizing and Staffing: Organization-Meaning, Characteristics, Process of Organizing, Principles of Organizing, Span of Management (meaning and importance only), Departmentalisation, Committees-Meaning, Types of Committees; Centralization Vs Decentralization of Authority and Responsibility; Staffing-Need and Importance, Recruitment and Selection Process (Selected topics from Chapters 7, 8 & 11, Text 1).			
Module-3			08 hrs
Directing and Controlling: Meaning and Requirements of Effective Direction, Giving Orders; Motivation-Nature of Motivation, Motivation Theories (Maslow's Need-Hierarchy Theory and Herzberg's Two Factor Theory); Communication - Meaning, Importance and Purposes of Communication; Leadership-Meaning, Characteristics, Behavioural Approach of Leadership. (Selected topics from Chapters 15 to 18 and 9, Text 1).			

Module-4												08 hrs			
Social Responsibilities of Business: Meaning of Social Responsibility, Social Responsibilities of Business towards Different Groups, Social Audit, Business Ethics and Corporate Governance (Selected topics from Chapter 3, Text 1).															
Module-5												08 hrs			
Entrepreneurship: Definition of Entrepreneur, Importance of Entrepreneurship, concepts of Entrepreneurship, Characteristics of successful Entrepreneur, Classification of Entrepreneurs, Myths of Entrepreneurship, Entrepreneurial Development models, Entrepreneurial development cycle, Problems faced by Entrepreneurs and capacity building for Entrepreneurship (Selected topics from Chapter 2, Text 3).															
Course outcomes: At the end of the course the student will be able to: CO 1. Understand the fundamental concepts of Management and Entrepreneurship and opportunities in order to setup a business CO 2. Identify the various organizations' architecture CO 3. Describe the functions of Managers, Entrepreneurs and their social responsibilities CO 4. Understand the components in developing a business plan CO 5. Recognize the various sources of funding and institutions supporting entrepreneurs.															
CO-PO-PSO Mapping:															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	2	-	1	-	-	-	2	-	3	1	2	3
CO2	2	3	3	2	2	-	-	-	2	2	2	2	3	2	1
CO3	3	3	3	2	2	-	-	-	3	3	1	1	3	3	2
CO4	2	3	3	2	2	-	-	-	2	2	2	2	3	2	1
CO5	3	1	-	2	-	1	-	-	-	2	-	3	1	2	3
NOTE : Correlation levels 1, 2 or 3 are as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)															
Suggested Learning Resources:															
Text Books:															
1. Principles of Management - P.C Tripathi, P.N Reddy, McGraw Hill Education, 11th Edition, 2017. ISBN- 13:978-93-5260-535-4.															
2. Project Management for Telecommunication Managers, Cella L. Desmond, Kluwer Academic Publishers.															
3. Entrepreneurship Development Small Business Enterprises- Poomima MCharantimath, Pearson Education 2008, ISBN 978-81-7758-260-4.															
4. Robert D. Hisrich, Mathew J. Manimala, Michael P Peters and Dean A. Shepherd, "Entrepreneurship", 11th Edition, Tata Mc-Graw Hill Publishing Co.Ltd.- New Delhi, 2012															
Reference Books:															
1. Essentials of Management: An International, Innovation and Leadership perspective by Harold Koontz, Heinz Weihrich McGraw Hill Education, 10th Edition 2016. ISBN- 978-93-392-2286-4															

Course Title	MICROWAVE ENGINEERING & ANTENNA THEORY						
Course Code	ETU502						
Category Scheme and Credits	Integrated Professional Core Course (IPCC)					Category Scheme and Credits	Professional Core Course (IPCC) No. of Hours/Week
	No. of Hours/Week	Scheme and Credits	No. of Hours/Week	Scheme and Credits	No. of Hours/Week		
	L	0	L	0	L	65	L
CIE Marks : 50	4			Total Max. Marks = 100		4	

UNIT No.	Syllabus Content	No. of Teaching Hours
1	Introduction: Microwave communication system, advantages and applications, frequency bands. Working principle of Klystrons, Travelling Wave Tube Amplifiers, Magnetron Oscillator, Working principle of GUNN diode, PIN diode, relevant problems. (Text-1)	7
2	Microwave Devices : Passive Devices- Introduction, Working principle and S-Matrix representation of Microwave Tee Junctions, Directional couplers, Isolators and Circulators. (Text-2)	7
3	Antenna Basics: Introduction, Basic Antenna Parameters, Patterns, Beam Area, Radiation Intensity, Beam efficiency, Directivity and Gain, Antenna Aperture Effective height, Bandwidth, Radio communication Link, Antenna Field Zones (Text 3).	8
4	Point sources and arrays: Introduction, Point Sources, Power patterns, Power theorem, Radiation Intensity, Arrays of 2 isotropic point sources, Pattern multiplication, Linear arrays of n Isotropic sources of equal amplitude and Spacing, relevant problems. (Text 3)	8
5.	Antenna Types: Introduction: Horn Antennas, Rectangular antennas, The Helix geometry, Helix modes, yagi-uda antenna, Helical Antenna, Parabolic Reflector, The paraboloidal Reflector, relevant problems. (Text 3)	9

PRACTICAL COMPONENT OF IPCC	
Using suitable simulation software, demonstrate the operation of the following circuits:	
Sl no.	Experiments
1	Experiment to study Gunn Diode source and its characteristics
2	Determination of the Modes Transit Time, Electronic Timing Range and Sensitivity of klystron source.
3	Calibration of Crystal Detector.
4	Calibration of Variable Waveguide Attenuator
5	Finding Isolation and Insertion loss of Circulator/Isolator.

6	Finding the parameters of Directional coupler. Extraction of S-parameter.
7	Finding the parameters of Magic tee. Extraction of S- parameter.
8	Field intensity measurement of a Horn antenna.
9	Field intensity measurement of a Parabolic dish
10	Matlab/C implementation of to obtain the radiation pattern of an antenna.
11	Experimental study of radiation pattern of two modes in Helical antenna

Course Outcomes :

CO1: Realize the applications of microwave communication system

CO2: Apply S-Matrix representation for various microwave devices

CO3: Identify the basic parameters for antenna systems

CO4: Analyze various antenna parameters and their significance.

CO5: Identify various antenna configurations for suitable applications.

TEACHING LEARNING PROCESS: Chalk and Talk, power point presentation, animations, videos

CO-PO-PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	3	-	-	-	2	1	1	1	3	2	1
CO2	3	3	2	2	3	-	-	-	2	1	1	1	3	2	2
CO3	3	3	3	2	3	-	-	-	2	1	1	1	3	3	1
CO4	3	3	3	2	3	-	-	-	2	1	1	1	3	2	1
CO5	3	3	3	2	3	-	-	-	2	1	1	1	3	2	1

NOTE : Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

TEXT BOOKS:

1. Microwave Engineering: Annapurna Das, Sisir K Das TMH Publication, 2nd, 2010

2. Microwave & RADAR Engineering – M. Kulkarni, Umesh Publications, 2001, reprint

3. Antennas and Wave Propagation - John D Krauss, Ronald J Marhefka, Ahmad S Khan, 4th Edition, McGraw Hill Education, 2013.

REFERENCE BOOKS / WEBLINKS :

1. . Microwave Devices and circuits- Liao / Pearson Education.

2. Antennas and Wave Propagation- Harish and Sachidananda, Oxford University Press, 2007.

Web links and Video Lectures (e-Resources)

- Nptel Videos and Lectures
- https://www.tutorialspoint.com/antenna_theory/antenna_theory_horn.html
- <http://www.antenna-theory.com/antennas/smallLoop.php>

Course Title	Digital Communication						
Course Code	ETU503						
Category	Professional Core Course (PCC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	3	2	0	0	5	65	4
CIE Marks : 50	SEE Marks : 50		Total Max. Marks = 100			Duration of SEE : 03 Hours	

Course Objectives :

1. Understand the concept of signal processing of digital data and signal conversion to symbols at the transmitter and receiver.
2. Compute performance metrics and parameters for symbol processing and recovery in ideal and corrupted channel conditions.
3. Understand the principles of spread spectrum communications.
4. Understand the basic principles of information theory and various source coding techniques.
5. Build a comprehensive knowledge about various Source and Channel Coding techniques.

6.

UNIT No	Syllabus Content	No. of Teaching Hours	Tutorials
1	Waveform Coding Techniques: Introduction, Quantization noise and SNR, types of quantization, Adaptive Delta modulation, applications & Problems	08	05
2	Base-Band Shaping for Data Transmission: Discrete PAM signals, power spectra of discrete PAM signals. ISI, Nyquist's criterion for distortion less base-band binary transmission, correlative coding, eye pattern, base-band M-ary PAM systems, adaptive equalization for data transmission.	08	05
3	Digital Modulation Techniques: Digital Modulation formats, Coherent binary modulation techniques, Coherent quadrature modulation techniques. Non-coherent binary modulation techniques. Spread Spectrum Modulation: Pseudo noise sequences, notion of spread spectrum, direct sequence spread spectrum, coherent binary PSK, frequency hop spread spectrum, applications.	08	05
4	Information Theory: Introduction, Measure of Information, Information Content of a Message, Average Information	08	06

	Content(Entropy) of Symbols in Long Independent Sequences, Average Information Content of Symbols in Long Dependent Sequences, Markoff Statistical Model for Information Sources, Entropy and Information rate of Markoff Sources.		
5.	Source Coding : Encoding the source output, Shannon's Encoding Algorithm, Shannon-Fano encoding algorithm, Huffman Coding, Source Coding theorem, prefix coding,	07	05

Course Outcomes :

After the completion of the Course, the student will be able to

- CO1 : Analyze different digital modulation techniques and choose the appropriate modulation technique for the given specifications.
- CO2 : Test and validate symbol processing and performance parameters at the receiver under ideal and corrupted bandlimited channels.
- CO3 : Differentiate various spread spectrum schemes and compute the performance parameters of communication system.
- CO4 : Apply the fundamentals of information theory and perform source coding for given message.
- CO5: Apply the fundamentals of information theory and perform channel coding for given message.

CO-PO-PSO Mapping :

NOTE : Correlation levels 1, 2 or 3 are as defined below:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2		2	1						1	3	2	1
CO2	3	3	2		2	1						1	3	2	1
CO3	3	3	2		2	1						1	3	2	1
CO4	3	3	2		2	1						1	3	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

TEXT BOOKS:

1. Simon Haykin, "Digital Communication Systems", John Wiley & sons, First Edition, 2014, ISBN 978- 0-471-64735-5.
2. John G Proakis and Masoud Salehi, "Fundamentals of Communication Systems", 2014 Edition, Pearson Education, ISBN 978-8-131-70573-5.
3. K Sam Shanmugam, "Digital and analog communication systems", John Wiley India Pvt. Ltd, 1996.
4. Hari Bhat, Ganesh Rao, "Information Theory and Coding", Cengage, 2017.
5. Todd K Moon, "Error Correction Coding", Wiley Std. Edition, 2006.

Reference Books:

1. Bernard Sklar, "Digital Communications – Fundamentals and Applications", Second Edition, Pearson Education, 2016, ISBN: 9780134724058.
2. K Sam Shanmugam, "Digital and analog communication systems", John Wiley India Pvt. Ltd, 1996.

Web links and Video Lectures (e-Resources)

https://nptel.ac.in/courses/108102096

Course Title	Digital Communication Lab					
Course Code	ETL504					
Category	Professional Core Course Lab (PCCL)					
Scheme and Credits	No. of Hours/Week					Total teaching hours
	L	T	P	SS	Total	
	0	0	2	0	2	26
CIE Marks : 50	SEE Marks : 50		Total Max. Marks = 100			Duration of SEE : 03 Hours

Course objectives:

This laboratory course enables students to

1. Design and demonstrate communication circuits for different digital modulation techniques.
2. To simulate Source coding Algorithms using C/C++/ MATLAB code.

Sl. No.	Experiment Content
1	To conduct the experiment of Amplitude shift keying SK generation and detection.
2	To conduct the experiment of Frequency shift keying generation and detection.
3	To conduct the experiment of Binary phase shift keying generation and detection.
4	To conduct the experiment of Quadrature phase shift keying generation and detection using kit
5	To conduct the experiment of Differential phase shift keying generation and detection using kit
6	To conduct the experiment of Pulse Code modulation using kit.
7	Write a Matlab program to find the entropy of information source generating independent message sequences.
8	Write a Matlab program to encode binary data using Shannon's theorem.
9	Write a Matlab program program to encode binary data using Huffman code.
10	Write a Matlab program to encode binary data using Shannon-Fano encoding.

Course outcomes (Course Skill Set):

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

- CO1: Design and test the digital modulation circuits and display the waveforms.
CO2: To Implement the source coding algorithm using C/C++/ MATLAB code.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2		2	1			3			1	3	2	1
CO2	3	3	2		2	1			3			1	3	2	1
CO3	3	3	2		2	1			3			1	3	2	1
CO4	3	3	2		2	1			3			1	3	2	1

CO-PO-PSO Mapping:

NOTE : Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) **2:** Moderate (Medium) **3:** Substantial (High)

Suggested Learning Resources:

1. Simon Haykin, "Digital Communication Systems", John Wiley & sons, First Edition, 2014, ISBN 978- 0-471-64735-5.

2. K Sam Shanmugam, "Digital and analog communication systems", John Wiley India Pvt. Ltd, 1996.

Sub Title : Fundamentals of Satellite Communication		
Sub Code: ETT505A	No. of Credits : 3=3:0:0 (L-T-P)	No. of lecture hours/week : 3
Course Category : Professional Elective		
Exam Duration : 3 hours	CIE + SEE = 50 + 50 =100	Total No. of Contact Hours : 39

Course Objectives: This course will enable students to:

1. Analyse the different orbits and orbital parameters.
2. Understand antenna look angles and eclipse.
3. Understand different link budget analysis.
4. Understand various subsystems and controls.
5. Become familiar with earth segments

Unit No.	Syllabus	No. of Teaching hours
1	Orbits : Introduction, Kepler's Laws, Definitions, Orbital Elements, Apogee and Perigee Heights, Orbital perturbations, Sidereal Time, The Orbital Plane, Sun-synchronous Orbit. - relevant problems	08
2	Geostationary Orbit : Antenna Look Angles, Polar Mount Antenna, Limits of Visibility, Earth Eclipse of Satellite, Sun Transit Outage, Launching Orbits	08
3	Space Link : EIRP, Transmission Losses, Link Power budget equation, System noise, CNR , Uplink, Downlink, Combined CNR. - relevant problems	08
4	Space Segments : Power supply, Attitude Control, Station Keeping, Thermal Control, TT&C Subsystem, Transponders Specialized services: Satellite Mobile service, VSATs , Radarsat, GPS (Text2)	08
5	Earth Segment : Receive only home TV system, out door unit, indoor unit, MATV, CATV,Tx-Rx earth station	07

Course Outcomes:

- CO1 : Analyze different types of orbits and orbital parameters.
 CO2 : To calculate look angle for a satellite .
 CO3 : Compute different types of losses in satellite communication.
 CO4 : Able to analyze different subsystems
 CO5 : Have knowledge of earth segment.

CO-PO-PSO Mapping :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2		2	1						1	3	2	1
CO2	3	3	2		2	1						1	3	2	1
CO3	3	3	2		2	1						1	3	2	1
CO4	3	3	2		2	1						1	3	2	1
CO5	3	3	2		2	1						1	3	2	1

NOTE : Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

TEXT BOOKS:

1. Satellite Communications –Dennis Roddy,4thEdition,McGraw Hill International edition,2008.
2. Fundamentals of Satellite Communication-SK Raman,PearsonEducation,2011

REFERENCE BOOKS/WEBLINKS:

1. Satellite Communications – Timothy Pratt, Charles Bostian and Jeremy Allnutt, 2nd Edition, John Wiley & Sons, 2006.
2. Satellite Communication Concepts and Applications – K.N.RajaRao, 2nd Edition., PHI ,Publication year 2013.
3. www.nrsc.gov.in

Sub Title : TRANSMISSION LINES AND WAVE GUIDES		
Sub Code: ETT505C	No. of Credits : 3=3:0:0 (L-T-P)	No. of lecture hours/week : 3
Course Category : Professional Elective		
Exam Duration : 3 hours	CIE + SEE = 50 + 50 =100	Total No. of Contact Hours : 39

Course Objectives :

1. To introduce the types of Transmission Lines and analyze of their circuit equivalent.
2. To understand the concept of Standing waves.

3. To learn use of Smith chart.
4. To understand different types of propagation in Guided waves.
5. To Study waves in rectangular guide, Attenuation in co-axial line, excitation, and resonant cavities

UNIT No.	Syllabus Content	No. of Teaching Hours
1	Transmission – Line Theory :The transmission Line general solution, Physical significance of the equations; the infinite line, The distortion less Line, The telephone cable, Reflection on a Line not terminated in Z_0 , Open and short circuited Lines, Reflection loss, problems . (Text 1)	08
2	Impedance matching : standing waves; nodes ; standing wave ratio. input impedance of dissipation less line, input impedance of open- and short-circuited lines, single-stub impedance matching, The quarter wave Line and its applications, relevant equations and problems. (Text 1)	08
3	Smith Chart and its applications : Smith Circle diagram, Applications of Smith chart, Single-stub impedance matching with Smith Chart. (Text 1)	08
4	Guided waves : Applications of restrictions to Maxwell's equation, types of propagation; TM, TE and TEM, Transmission of TM, TE and TEM waves in parallel planes. (Text 1 & 2)	08
5.	Wave guides : Application of Maxwell's equations to the rectangular wave guides, The $TM_{m,n}$ wave in the rectangular guide, The $TE_{m,n}$ wave in the rectangular guide, Excitation of wave guides, Guide terminations, Resonant cavities (Text 1 & 2)	07

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

- CO1 : Explain various types of transmission lines, types of losses and distortions in them.
- CO2 : Computation of parameters related to standing wave and learning design strategies for impedance matching.
- CO3 : Use Smith chart to solve problems associated with transmission lines and impedance matching.
- CO4 : Analyse types of guided wave between two parallel planes.
- CO5: Analyse presence of modes in various types of waveguides.

CO-PO-PSO Mapping :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2		2	1						1	3	2	1
CO2	3	3	2		2	1						1	3	2	1
CO3	3	3	2		2	1						1	3	2	1
CO4	3	3	2		2	1						1	3	2	1

CO5	3	3	2		2	1					1	3	2	1
-----	---	---	---	--	---	---	--	--	--	--	---	---	---	---

NOTE : Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

TEXT BOOKS:

1. “**Network Lines and Fields**”, John D Ryder, 2 edition, PHI, 2005.

REFERENCE BOOKS/WEBLINKS:

1. “**Transmission Lines and Networks**”, Umesh Sinha, 8th edition, Satya Prakashana (Tech India Publication), 2003.
2. “**Networks and systems**”, Roy Choudhury, 2nd edition, 2009, New Academic Science Ltd.

Course Title	Multimedia Communication						
Course Code	ETT505B						
Category	Professional Elective Course(PEC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	3	0	0	0	3	39	3
CIE Marks : 50	SEE Marks : 50		Total Max. Marks = 100			Duration of SEE : 03 Hours	

Course Objectives :

1. To study the different types of Media and their representation in different forms.
2. To understand the different compression techniques for Text and Image with examples.
3. To study the different compression techniques for Audio.
4. To study the different compression techniques for Video.
5. To identify Multimedia Communication across Networks.

Unit No	Syllabus Content	No. of Teaching Hours
1	MULTIMEDIA COMMUNICATIONS: Introduction, multimedia information representation, multimedia networks, multimedia applications, media types, communication modes, network types, multipoint conferencing, Network QoS, Application QoS.	07
2	TEXT AND IMAGE COMPRESSION: Introduction, compression principles, Text compression – Static Huffman coding, Arithmetic coding, Lempel-ziv and Welsh coding, Image compression- GIFF, TIFF, Digitized documents and Pictures, JPEG Encoder and Decoder.	08
3	AUDIO COMPRESSION: Introduction, Audio compression – DPCM, ADPCM, LPC, Code excited LPC, Perceptual coding, MPEG Audio coders, Dolby Audio coders.	08
4	VIDEO COMPRESSION : Video compression principles, H.261, H.263, H.264, H.265, MPEG, MPEG-1, MPEG-2, and MPEG-4, animation.	08
5	ENTERPRISE NETWORKS: Introduction, LANS, Ethernet, Token Ring, Bridges, FDDI High- Speed LANS	08
TEACHING LEARNING PROCESS: Chalk and Talk, power point presentation, animations, videos		

Course Outcomes :

After the completion of the Course, the student will be able to

CO1: Acquire the knowledge of types of Multimedia networks and applications.

CO2: Illustrate the representation of information of Text, Images, Audio and Video.

CO3: Analyze the Text and Image compression using different techniques and Standards.

CO4: Analyze the Audio and Video compression using different techniques and Standards.

CO5: Describe Multimedia Communication across Networks.

CO-PO-PSO Mapping :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		1	1						2		2	2	1	
CO2	2	2	3	1	2				2	1		2	3	2	1
CO3	2	3	2	1	3				2	1		2	3	2	1
CO2	2	2	2	1	2				2	1		2	3	2	1
CO3	3		1	1						2		2	2	1	

NOTE : Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) **2:** Moderate (Medium) **3:** Substantial (High)

TEXT BOOK:

1. **Multimedia Communications: Applications, Networks, Protocols, and Standards** – Fred Halsall, Pearson Education, Asia, Fifth Indian reprint 2011.

REFERENCE BOOKS:

1. **Multimedia: Computing, Communications and Applications-** Raif Steinmetz, Klara Nahrstedt, Pearson Education, 2002, ISBN-978817758
2. **Fundamentals of Multimedia** – Ze-Nian Li, Mark S Drew, and Jiangchuan Liu.

Sub Title : OOPs using C++		
Sub Code: ETT505D	No. of Credits : 3=3:0:0 (L-T-P)	No. of lecture hours/week : 3
Professional Elective		
Exam Duration : 3 hours	CIE + SEE = 50 + 50 =100	Total No. of Contact Hours : 39

Course Objectives:

1. To learn the concepts of object oriented programming.
2. To learn the basic concepts and functions in C++.
3. To learn programming in C++ using classes and objects.
4. To study constructors, destructors and operator overloading concepts.
5. To study inheritance and virtual functions in C++.

UNIT No	Syllabus	No. of Teaching hours
1	Beginning with C++: Object Oriented Programming Paradigm, Basic concepts of OOP, Benefits of OOP, Applications of C++, Structure of C++ program,	08

	Tokens, Keywords, Identifiers, Data types, User Defined Data types, Derived Data types, Symbolic constants, Dynamic Initialization of variables.	
2	Reference Variables, Operators in C++, Scope Resolution Operators, Memory Management Operators, Manipulators, Type-cast operators, Operator precedence, Control Structures, Functions prototyping, Call by reference, Return by reference, Inline function, Default arguments, Function Overloading.	08
3	Classes and objects : Specifying the class, Defining member functions, Nesting of member functions, Private Member functions, Arrays within a class, Memory allocation for objects, Static Data members, Static member functions, Arrays of objects, Objects as function arguments, Friendly functions.	08
4	Constructors, Destructors and operator overloading : Parameterized Constructors, Constructors with default arguments, Copy constructor, Const Objects, Destructors Operator Overloading Unary and binary operators, Overloading binary operators using friends.	08
5	Inheritance, Defining Derived classes, Single, Multilevel, Multiple hierarchical and hybrid inheritance, Virtual base classes, Abstract classes, Constructors and derived classes, Pointers, Pointers to objects, Pointers to derived classes. (Blended Learning)	07

Course Outcomes :

- CO1: Apply the basic concepts and structure of OOPs for programming in C++.
- CO2 : Describe the object-oriented programming approach in connection with C++.
- CO3 : Illustrate the usage of objects and classes.
- CO4 : Make use of constructors, destructors and operator overloading in C++ programs.
- CO5 : Apply inheritance, virtual and pure functions in C++ programming.

CO-PO-PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2		2	1						1	3	2	1
CO2	3	3	2		2	1						1	3	2	1
CO3	3	3	2		2	1						1	3	2	1
CO4	3	3	2		2	1						1	3	2	1

TEXT BOOK:

- Object Oriented Programming with C++, E. Balaguruswamy, Galgotia Publications, 2004.

REFERENCE BOOKS/WEBLINKS :

- Object Oriented Programming using C++, Robert Lafore, Galgotia publications.
- C++ Primer , Lippman and Lajoie, 3rd edition, Addison Wesley.
- www.atilim.edu.tr/~mcs215/Lecture%20Notes/book.pdf

Course Title	Computer Communication Networks						
Course Code	ETU601						
Category	Integrated Professional Core Course (IPCC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	3	0	2	0	5	65	4
CIE MARKS : 50	SEE Marks : 50		Total Max. Marks = 100			Duration of SEE : 03 Hours	

Course objectives: This course will enable students to:

1. To define and understand the Layer functions of OSI model and TCP/IP Suite.
2. To study framing, flow control and error control and different Multiple accesses techniques.
3. To study the standards and protocols of Wired and Wireless LANs.
4. To understand IPv4, IPv6 formats and to implement the different Routing algorithms.
5. To study UDP and TCP protocols in Transport Layer.

UNIT	Syllabus Content	No. of Teaching Hours
1	Layered tasks & Models: OSI Model, Layers in OSI model, TCP/IP Suite, Addressing. Switching: Circuit switched Networks, Datagram Networks, Virtual-Circuit Networks.	8
2	Data Link Control : Framing, Flow & Error Control, Cyclic Redundancy Check, Sliding Window Protocols, HDLC. Multiple Access: Random access –CSMA, CSMA/CD, CSMA/CA, Controlled access – Reservation, Polling and Token Passing, Channelization – FDMA, TDMA, CDMA.	8
3	Wired LANs: Ethernet: IEEE standards, Standard Ethernet. Changes in the standards, Fast Ethernet, Gigabit Ethernet. Wireless LANS: IEEE 802.11, Bluetooth. Connecting Devices: Passive Hubs, Repeaters, Active Hubs, Bridges, Loop problem & Spanning Tree, Routers, Gateways.	8
4	Network Layer: Internetworking, IPV4, IPV6, Transition from IPV4 to IPV6, Delivery, Forwarding techniques and Process, Unicast Routing Protocols: Distance Vector Routing, Link State Routing, Dijktras Algorithm.	8

5.	Transport layer:: User Datagram protocol: User Datagram, UDP operation, UDP Applications. Transmission Control Protocol: TCP Services, TCP Features, Segment. Congestion Control & QOS: Congestion Control, Scheduling & Traffic Shaping- Leaky Bucket & Token Bucket.	8
----	---	---

s

PRACTICAL COMPONENT OF IPCC	
Sl No.	I. Implementation of Algorithms using C/C++ Language
1	HDLC frame to perform Bit stuffing and destuffing.
2	HDLC frame to perform Byte stuffing and destuffing.
3	Encryption and decryption using Substitution method.
4	Encryption and decryption using Transposition method.
5	Sliding Window Protocol of Data Link Layer
6	CRC-CCIT polynomial to obtain CRC code and verify the same for with and without Error
7	Dijkstra's algorithm to compute the shortest routing path.
8	To find minimum spanning tree of a subset.
9	Congestion control using Leaky Bucket algorithm.
II. CCN Experiments using Hardware	
10	Establishing connection between external devices using RS 232 communication
11	Establishing connection between external devices using MODEM communication
12	Establishing connection between external devices using Fiber Optic communication.
TEACHING LEARNING PROCESS: Chalk and Talk, power point presentation, animations, videos	

Course Outcomes :

- CO1: Identify and differentiate the architecture of OSI model and TCP/IP model and different Switching Techniques.
- CO2: Implement DLL protocols in HDLC formats. and Analyze performance of channel Access using Random, Controlled and Channelization protocols.
- CO3: Discuss the different Ethernet standards of Wired and Wireless LANs.
- CO4: Implement different Routing algorithms and analyze IPV4 and IPV6 formats and transitions.
- CO5: Acquire the knowledge of UDP and TCP Protocols in Transport Layer, Congestion and QOS

CO-PO-PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	2	-	1	-	-	-	2	-	3	1	2	3
CO2	2	3	3	2	2	-	-	-	2	2	2	2	3	2	1
CO3	3	3	3	2	2	-	-	-	3	3	1	1	3	3	2
CO4	2	3	3	2	2	-	-	-	2	2	2	2	3	2	1
CO5	3	1	-	2	-	1	-	-	-	2	-	3	1	2	3

NOTE : Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

TEXT BOOKS:

1. **Data Communication and Networking**, Behrouz A Forouzan, “Data Communications and Networking”, 5th Edition, McGraw Hill, 2013, ISBN: 1-25- 906475-3.

REFERENCE BOOKS / WEBLINKS :

1. **Computer Networks**, Andrew Tanenbaum, Pearson Education 2008
2. **Computer Networks**, James F. Kurose, Keith W. Ross: Pearson education, 2nd Edition, 2003
3. **Introduction to Data communication and Networking**, Wayne Tomasi: Pearson education 2007
4. www.tutorialspoint.com/...communication_computer_network/data_communication

Course Title	ARM & Embedded System Design						
Course Code	ETT602						
Category	PCC						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	3	0	2	0	5	65	4
CIE MARKS : 50	SEE Marks : 50		Total Max. Marks = 100			Duration of SEE : 03 Hours	

Course objectives: This course will enable students to:

1. Understand the basic concepts of Embedded Systems.
2. Explain the Characteristics and quality attributes and Program of Embedded Systems.
3. Get exposure to an advanced microcontroller Cortex M3.
4. Understand the definition, structure and Working of Real Time Operating system.
5. Analyze different Embedded Systems in various Domain applications.

UNIT	Syllabus Content	No. of Teaching Hours	Tutorial
1	Typical Embedded System: Definition, Embedded systems vs. General Computing Systems, Core of the Embedded System, Memory, Sensors and Actuators, Communication Interface, Embedded Firmware and Embedded Firmware approaches.	08	05
2	Characteristics and Quality Attributes of Embedded Systems: Characteristics of an Embedded system, Quality attributes of Embedded Systems. Hardware Software Co-Design and Program Modelling: Fundamental issues in Hardware Software Co-Design, Computational Models in Embedded Design.	08	05
3	ARM-32bit Microcontroller: ARM Cortex-M3 Processor-Introduction, Overview of the Cortex-M3, Cortex-M3 Basics, Instruction Sets.	08	05
4	RTOS for Embedded System Design: Operating System basics, Types of operating systems, Task, process and threads (Only POSIX Threads with an example program), Multiprocessing and Multitasking, Task scheduling, Task Communication.	08	05

5.	Embedded Systems-Application and Domain Specific: Washing Machine-application specific Embedded System, Automotive-Domain Specific Example of Embedded Systems, Key Players of Automotive Embedded Market. Design Case Studies: Digital camera, Embedded Systems in Automobile, Smart Card Reader, Automated Meter Reading System.	07	06
----	---	----	----

Course Outcomes :

CO1. Understand different blocks of a Typical Embedded System.

CO2. Analyze different characteristics, quality attributes and modelling Techniques of embedded system design

CO3. Apply the knowledge of Instruction Set to program ARM 32bit Microcontroller.

CO4. Analyze the concepts of Real time kernel & Operating System services.

CO5. Evaluate the current trends in embedded industry and analyze different application and domain specific examples of embedded systems through case studies.

CO-PO-PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		2										2	2	2
CO2	3	2	2	2	2								2	2	2
CO3	3	2	2	2	2								2	2	2
CO4	3		2										2	2	2
CO5	3	3	2	2	2								2	2	2

NOTE : Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Text book

1. Shibu K V, “Introduction to Embedded Systems”, First Edition, Tata McGraw Hill Education Private Limited, 2009

2. Joseph Yiu, “The Definitive Guide to the ARM Cortex-M3”, Second Edition, Newnes, (Elsevier), 2008

Reference Books:

1. “Raj Kamal, “Embedded Systems – Architecture, Programming and Design”, edition, Mc Graw Hill, 2012

3. James K Peckol “Embedded Systems – A contemporary Design Tool”, edition, John Wiley, 2008

Sub Title : CRYPTOGRAPHY & NETWORK SECURITY		
Sub Code: ETT603A	No. of Credits : 3=3:0:0 (L-T-P)	No. of lecture hours/week : 3
Category	Professional Elective	
Exam Duration : 3 hours		Total No. of Contact Hours : 39

Course Objectives:

1. To provide an introduction to the fundamental principles of cryptography and its applications on the network security domain.
2. To study various approaches to Encryption techniques, Design Principles and Modes of operation.
3. To study a given system with respect to security of the system.
4. To analyze the given system with respect to digital signature and intruders.
5. To analyze the given system with respect to malicious software and firewalls.

UNIT No	Syllabus Content	No of Teaching Hours
1	Introduction: Services, mechanisms and attacks, The OSI security architecture, A model for network security. Symmetric Ciphers: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Simplified DES, Data encryption standard (DES), The strength of DES, Differential and Linear Cryptanalysis, Block Cipher Design Principles and Modes of Operation.	08
2	Principles of Public-Key Cryptosystems: Public-key cryptosystems, Applications for public-key cryptosystems, requirements for public-key cryptography, The RSA algorithm, Key Management, Diffie – Hellman KeyExchange.	07
3	Web Security Consideration: Security socket layer (SSL), SSL architecture, Transport layer security, Secure Electronic Transaction.	07
4	Digital signatures: Requirements, direct digital signature, arbitrated digital signature, Digital Signature Standard , DSS approach, Digital Signature Algorithm. Intruders: Intruders, Intrusion techniques, Intrusion Detection, distributed intrusion detection, honeypots, Intrusion detection exchange format.	09

5	Malicious software: Viruses and Related Threats, malicious programs, nature of viruses, virus structure, types, Virus Countermeasures, antivirus approaches, advanced antivirus techniques, . Firewalls: Firewalls Design Principles, firewall characteristics, types of firewalls, firewall configurations, Trusted Systems, data access control, concept of trusted systems.	08
---	--	----

Course Outcomes:

CO1: Apply the concepts of cryptographic techniques that provides information and network security.

CO2: Demonstrate the importance of SSL layer and Transport layer security.

CO3: Explain the concepts of public-key Cryptosystems.

CO4: Illustrate the importance of Digital signature and Intruders.

CO5 : Understanding of Firewalls

CO-PO-PSO Mapping:

	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012	PS01	PS02	PS03
C01	3		2										2	2	2
C02	3	2	2	2	2								2	2	2
C03	3	2	2	2	2								2	2	2
C04	3		2										2	2	2
C05	3	3	2	2	2								2	2	2

NOTE : Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

TEXT BOOK:

1. **Cryptography and Network Security– William Stalling, Pearson Education, 2003.**

REFERENCE BOOKS:

1. **Cryptography and Network Security – Behrouz A. Forouzan, TMH, 2007.**
2. **Cryptography and network security– Atul Kahate, , TMH, 2003.**
3. **williamstallings.com/Extras/Security-Notes/**

Sub Title : Fundamentals of AI & ML		
Sub Code: ETT603C	No. of Credits : 3=3:0:0 (L-T-P)	No. of lecture hours/week : 3
Course Category : Professional Elective		
Exam Duration : 3 hours	CIE + SEE = 50 + 50 =100	Total No. of Contact Hours : 39

Course Objectives:

After completing the course, the students should:

1. Analyse the various Machine Learning challenges.
2. Understand various classification techniques.
3. Understand various dimensionality reduction and SVM methods.
4. Understand decision trees.
5. Become familiar with random forest concept.

Unit No.	Syllabus	No. of Teaching hours
1	The Machine Learning Landscape: About Machine Learning(ML), Uses and applications with examples, Types of Machine learning, Main challenges of Machine learning, Testing and Validating. End to End Machine Learning: Working with Real Data, Frame the Problem, Select the performance measure, Prepare the Data for ML Algorithms, Training and evaluating the Data set. Bayesian Decision Theory: Introduction, Classification, Losses and Risks, Discriminant Functions, Association Rules.	08
2	Classification: MNIST, Training binary Classifiers, Performance measures, MultiClass classification, Error Analysis, Multilevel and Multi-output Classification. Training Models: Linear Regression, Gradient descent, Regularised Linear models- Ridge and Lasso Regression, Logistic Regression.	08
3	Dimensionality Reduction: The Curse of Dimensionality, Main Approaches of Dimensionality, PCA, Kernel PCA, LLE, Linear Discriminant Analysis(LDA). Support Vector Machines: Linear SVM classification, Non-Linear SVM, SVM Regressions, Kernelized SVMs.	08
4	Decision Trees: Univariate Trees: Classification and Regression Trees, Training and Visualising a Regression Tree, Pruning, Rule Extraction from Trees, Learning Rules from data, Making prediction, Learning Estimating Class probabilities, CART Training Algorithm, Computational Complexity, G1n1 Impurity or Entropy? Regularisation Hyperparameters, Multivariate Trees.	08

5	Ensemble Learning and Random Forests: Voting Classifiers, Bagging and Pasting, Random Patches and Random Subspaces, Random Forests, Boosting. Unsupervised Learning Techniques: Clustering – K Means, Spectral, Hierarchical.	07
---	--	----

Course Outcomes:

CO1 : Ability to analyze the Machine Learning challenges.

CO2 : Understanding of various classification techniques.

CO3 : Understanding of various dimensionality reduction and SVM methods.

CO4 : Understanding of various dimensionality reduction and SVM methods.

CO5 : Familiarity with random forest concept.

CO-PO-PSO Mapping :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2		2	1						1	3	2	1
CO2	3	3	2		2	1						1	3	2	1
CO3	3	3	2		2	1						1	3	2	1
CO4	3	3	2		2	1						1	3	2	1
CO5	3	3	2		2	1						1	3	2	1

NOTE : Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Text Books:

1. Introduction to Machine Learning, Ethem Alpaydin, PHI learning Pvt. Ltd, 3rd Edition, 2018.
2. Hands on Machine learning with Scikit-Learn and TensorFlow: concepts, tools, and Techniques to build intelligent systems, Aurelien Geron, O'Reilly Media 2019.

Reference Books :

1. Pattern Recognition and Machine Learning, Bishop, Christopher M, Springer Publication.
2. The Elements of Statistical Learning, Trevor Hastie, Robert Tibshirani, Jerome H, Friedman, Springer Publication.

Sub Title : RADAR Engineering		
Sub Code:ETT603B	No. of Credits : 3=3:0:0 (L-T-P)	No. of lecture hours/week : 3
Course Category : Professional Elective		
Exam Duration : 3 hours	CIE + SEE = 50 + 50 =100	Total No. of Contact Hours : 39

Course Objectives:

After completing the course, the students should:

1. To understand radar principles, waveforms, and operational basics.
2. To predict radar range, detection capabilities, and signal-to-noise ratio (SNR).
3. To Explore MTI, Pulse Doppler radar, and digital signal processing in radar systems.
4. To learn about radar applications, tracking systems, and radar antenna designs.
5. To develop skills in solving radar-related problems and analyzing system components.

Unit No.	Syllabus	No. of Teaching hours
1	Basics of Radar: Introduction, Maximum Unambiguous Range, Radar Waveforms, Definitions with respect to pulse wave form-PRF,PRI, Duty Cycle, Peak Transmitter Power, Average transmitter Power. Simple form of the Radar Equation, Radar Block Diagram and Operation, Radar Frequencies, Applications of Radar, The Origins of Radar, Illustrative Problems.	08
2	The Radar Equation: Prediction of Range 'Performance, Detection of signal in Noise, Minimum Detectable Signal, Receiver Noise, SNR, Modified Radar Range Equation, Envelope Detector - False Alarm Time and Probability, Probability of Detection, Radar Cross Section of Targets: simple targets - sphere, cone-sphere, Transmitter Power, PRF and Range Ambiguities, System Losses (qualitative treatment), Illustrative Problems.	08
3	MTI and Pulse Doppler Radar: Introduction, Principle, Doppler Frequency Shift, Simple CW Radar, Sweep to Sweep subtraction and Delay Line Canceler, MTI Radar with- Power Amplifier Transmitter, Delay Line Cancelers- Frequency Response of Single Delay- Line Canceler, Blind Speeds, Clutter Attenuation, MTI Improvement Factor, N- Pulse Delay-Line Canceler, Digital MTI Processing-Blind phases, I and Q Channels, Digital MTI Doppler signal processor, Moving Target Detector- Original MTD.	08
4	Tracking Radar:	08

	Tracking with Radar- Types of Tracking Radar Systems, Monopulse Tracking-Amplitude Comparison Monopulse (one-and two- coordinates), Phase Comparison Monopulse. Sequential Lobing, Conical Scan Tracking, Block Diagram of Conical Scan Tracking Radar, Tracking in Range, Comparison of Trackers.	
5	The Radar Antenna : Functions of The Radar Antenna, Antenna Parameters, Reflector Antennas and Electronically Steered Phase darrayAntennas. Radar Receiver: The Radar Receiver, Receiver Noise Figure, Super Heterodyne Receiver, Duplexers and Receivers Protectors, Radar Displays.	07

Course Outcomes:

After successful completion of the course, the students are able to

CO1 : Describe the radar fundamentals.

CO2 : Analyze the radar signals.

CO3 : Explain the working principle of pulse Doppler radars, their applications and limitations.

CO4 : Describe the working of various radar transmitters and receivers.

CO5 : Analyze the range parameters of pulse radar system, which affect the system performance.

CO-PO-PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	2	-	1	-	-	-	2	-	3	1	2	3
CO2	2	3	3	2	2	-	-	-	2	2	2	2	3	2	1
CO3	3	3	3	2	2	-	-	-	3	3	1	1	3	3	2
CO4	2	3	3	2	2	-	-	-	2	2	2	2	3	2	1
CO5	3	1	-	2	-	1	-	-	-	2	-	3	1	2	3

NOTE : Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

TEXT BOOKS:

1. Introduction to Radar Systems- Merrill Skolink, 3e, TMH, 2001

REFERENCE BOOKS/WEBLINKS:

1. Radar Principles, Technology, Applications-Byron Edde, Pearson Education, 2004.

Subject Title : Principles of VLSI Design		
Sub Code : ETT603D	No of credits : 3=3:0:0 (L-T-P)	No of hrs/week : 3
Course Category : Professional Elective		
Exam duration : 3hrs	CIE+SEE = 50 + 50 =100	Total No of Contact Hours : 39

Course objectives :

1. To teach the Basic MOS technology.
2. To design the Basic circuit and Layout diagram.
3. To teach CMOS subsystem design and basic circuit concepts.
4. To analyze scaling of MOS circuits and process illustration.
5. To teach the basics of memory, registers clocks in MOS technology.

Unit No	Syllabus	No of hours
1	BASIC MOS TECHNOLOGY: Integrated circuit's era. Enhancement and depletion mode MOS transistors. nMOS fabrication. CMOS fabrication. BiCMOS technology.	8
2	CIRCUIT DESIGN PROCESSES: The Complementary CMOS Inverter –DC Characteristics. MOS layers. Stick diagrams. Design rules and layout – lambda-based design and other rules. Examples. Layout diagrams. Symbolic diagrams.	8
3	CMOS SUBSYSTEM DESIGN: Architectural issues. Switch logic. Gate logic, Design examples – combinational logic, CMOS Complementary, Pseudo NMOS, Dynamic CMOS, Clocked CMOS, Pass Transistor logic, Clocked circuits. BASIC CIRCUIT CONCEPTS: Sheet resistance. Area capacitances. Capacitance calculations. The delay unit. Inverter delays. Driving capacitive loads. Propagation delays. Wiring capacitances.	8
4	SCALING OF MOS CIRCUITS: Scaling models and factors. CMOS SUBSYSTEM DESIGN PROCESSES: General considerations. Process illustration. ALU subsystem. Adders. Multipliers, Serial Parallel, Braun Array, Baugh-Wooley.	8
5	MEMORY, REGISTERS AND CLOCK: Timing considerations. 4 Transistor Dynamic Memory, One Transistor Dynamic Memory, 4 Transistor Dynamic & 6 Transistor Static, Memory elements. Memory cell arrays.	7

Course Outcomes:

CO1 : An ability to apply to apply knowledge about basic MOS technology.

CO2 : An ability to design and implement MOS transistor, layout and symbolic diagrams.

CO3 : An ability to design architectural issues and basic circuit concepts.

CO4 : An ability to identify scaling models and their limitations with subsystem process illustration.

CO5 : The broad education necessary to understand the impact of CMOS in storage devices and clocks

CO-PO-PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	2	-	1	-	-	-	2	-	3	1	2	3
CO2	2	3	3	2	2	-	-	-	2	2	2	2	3	2	1
CO3	3	3	3	2	2	-	-	-	3	3	1	1	3	3	2
CO4	2	3	3	2	2	-	-	-	2	2	2	2	3	2	1
CO5	3	1	-	2	-	1	-	-	-	2	-	3	1	2	3

NOTE : Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

TEXT BOOKS:

1. Basic VLSI Design - Douglas A. Pucknell & Kamran Eshraghian, PHI 3rd Edition (original Edition – 1994), 2005.
2. Principles of CMOS VLSI Design: A Systems Perspective, Neil H. E. Weste and K. Eshragian, 2nd edition, Pearson Education (Asia) Pvt. Ltd., 2000.

REFERENCE BOOKS:

1. **Fundamentals of Semiconductor Devices**, M. K. Achuthan and K. N. Bhat, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2007.
2. <http://www.scrbd.com/doc/121356137/CMOS-VLSI-VTU-full-notes>

Course Title	Mobile Communication						
Course Code	ETT604A						
Category	Open elective (OEC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	3	0	0	0	3	39	3
CIE MARKS : 50	SEE Marks : 50		Total Max. Marks = 100			Duration of SEE : 03 Hours	

Course Objectives:

After completing the course, the students should:

1. Analyse the environment in which the wireless industry operates.
2. Understand the different propagation mechanisms of wireless signals.
3. Understand different modulation schemes used in wireless communications.
4. Understand GSM concepts for wireless communication.
5. Become familiar with 3G technologies.

Unit No.	Syllabus	No. of Teaching hours
1	Introduction to wireless communication system & Networks: History & Evolution of mobile radio communication, Different generation of Wireless Cellular Networks 1G,2G, 3G ,4G & 5G. Examples of Wireless Communication System. Cellular Concept: Frequency reuse. Channel Assignment Strategies, Interference and System Capacity, Trunking and Grade of Service, Improving Capacity in Cellular Systems.	08
2	Mobile radio propagation(large scale path loss): Free space propagation model, relating power to electric field, three basic propagation mechanisms, reflection, Two-ray model, diffraction, outdoor and indoor propagation models	07
3	Mobile radio propagation(Small scale fading and multipath): Small scale multipath propagation, impulse response model, small scale multipath measurement, parameters of mobile multipath channels, types of small scale fading.	08
4	Global System for Mobile (GSM): GSM services and features, system architecture, Radio subsystem, channel types. Example of GSM call, frame structure for GSM, signal processing in GSM.	08

5	3G Digital cellular technology: 2.5G TDMA,GPRS ,EDGE Technologies, Need for 3G cellular network,IMT-2000 global standard, UMTS technology, W-CDMA air interface, TD-SCDMA technology, CDMA 2000 cellular technology. (Text 2)	08

Course Outcomes:

1. Demonstrate cellular radio concepts in the design of wireless communication systems
2. Analyse different propagation mechanisms.
3. Study small scale propagation models and modulation scheme of wireless communication systems .
4. Understand GSM concepts for wireless communication.
5. Learn about 3G wireless technology

CO-PO-PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C01	3	3			3	3							2	2	2
C02	3	3			3			3					2	2	2
C03	3			3	3	3							2	2	2
C04	3	3				2		2					2	2	2
C05	3	3				2			2				2	2	2

TEXT BOOKS:

1. **Wireless communications –Theodore. S. Rappaport**, PHI, second edition,2010.
2. **Wireless Communications – T.L. Singal**, Mcgraw Hill,2015.

REFERENCE BOOKS/WEBLINKS:

1.	Mobile Cellular Telecommunication – Lee W.C.Y, MGH, 2002.
2.	Wireless communication – D P Agrawal: 2 nd Edition Thomson learning, 2007.
3.	Fundamentals of Wireless Communication – David Tse, Pramod Viswanath, Cambridge.
4.	Fundamentals of 5G Mobile networks – Jonathan Rodriguez, WILEY, 2015.
5.	https://youtu.be/hQvHNVRv_ms (5G cellular networks: 6 new technologies)

Subject Title : Fundamentals of VLSI Design		
Sub Code : ETT604C	No of credits : 3=3:0:0 (L-T-P)	No of hrs/week : 3
Category	Open elective (OEC)	
Exam duration : 3hrs	CIE+SEE = 50 + 50 =100	Total No of Contact Hours : 39

Course objectives :

1. To teach the Basic MOS technology.
2. To design the Basic circuit and Layout diagram.
3. To teach CMOS subsystem design and basic circuit concepts.
4. To analyze scaling of MOS circuits and process illustration.
5. To teach the basics of memory, registers clocks in MOS technology.

Unit No	Syllabus	No of hours
1	BASIC MOS TECHNOLOGY: Integrated circuit's era. Enhancement and depletion mode MOS transistors. nMOS fabrication. CMOS fabrication. BiCMOS technology.	8
2	CIRCUIT DESIGN PROCESSES: The Complementary CMOS Inverter –DC Characteristics. MOS layers. Stick diagrams. Design rules and layout – lambda-based design and other rules. Examples. Layout diagrams. Symbolic diagrams.	8
3	CMOS SUBSYSTEM DESIGN: Architectural issues. Switch logic. Gate logic, Design examples – combinational logic, CMOS Complementary, Pseudo NMOS, Dynamic CMOS, Clocked CMOS, Pass Transistor logic, Clocked circuits. BASIC CIRCUIT CONCEPTS: Sheet resistance. Area capacitances. Capacitance calculations. The delay unit. Inverter delays. Driving capacitive loads. Propagation delays. Wiring capacitances.	8
4	SCALING OF MOS CIRCUITS: Scaling models and factors. CMOS SUBSYSTEM DESIGN PROCESSES: General considerations. Process illustration. ALU subsystem. Adders. Multipliers, Serial Parallel, Braun Array, Baugh -Wooley.	8
5	MEMORY, REGISTERS AND CLOCK: Timing considerations. 4 Transistor Dynamic Memory, One Transistor Dynamic Memory, 4 Transistor Dynamic & 6 Transistor Static, Memory elements. Memory cell arrays.	7

Course Outcomes:

CO1 : An ability to apply to apply knowledge about basic MOS technology.

CO2 : An ability to design and implement MOS transistor, layout and symbolic diagrams.

CO3 : An ability to design architectural issues and basic circuit concepts.

CO4 : An ability to identify scaling models and their limitations with subsystem process illustration.

CO5 : The broad education necessary to understand the impact of CMOS in storage devices and clocks

CO-PO-PSO Mapping:

	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012	PS01	PS02	PS03
C01	3	3			3	3							2	2	2
C02	3	3			3			3					2	2	2
C03	3			3	3	3							2	2	2
C04	3	3				2		2					2	2	2
C05	3	3				2			2				2	2	2

TEXT BOOKS:

1. Basic VLSI Design - Douglas A. Pucknell & Kamran Eshraghian, PHI 3rd Edition (original Edition – 1994), 2005.
2. Principles of CMOS VLSI Design: A Systems Perspective, Neil H. E. Weste and K. Eshraghian, 2nd edition, Pearson Education (Asia) Pvt. Ltd., 2000.

REFERENCE BOOKS:

1. **Fundamentals of Semiconductor Devices**, M. K. Achuthan and K. N. Bhat, TataMcGraw-Hill Publishing Company Limited, New Delhi, 2007.

<http://www.scrbd.com/doc/121356137/CMOS-VLSI-VTU-full-notes>

Course Title	Embedded System Design & ARM Processor						
Course Code	ETT604B						
Category	Open Elective						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	3	0	0	0	0	39	3
CIE MARKS : 50	SEE Marks : 50		Total Max. Marks = 100			Duration of SEE : 03 Hours	

Course objectives: This course will enable students to:

1. Understand the basic concepts of Embedded Systems.
2. Explain the Characteristics and quality attributes and Program of Embedded Systems.
3. Get exposure to an advanced microcontroller Cortex M3.
4. Understand the definition, structure and Working of Real Time Operating system.
5. Analyze different Embedded Systems in various Domain applications.

UNIT	Syllabus Content	No. of Teaching Hours
1	Typical Embedded System: Definition, Embedded systems vs. General Computing Systems, Core of the Embedded System, Memory, Sensors and Actuators	7
2	Characteristics and Quality Attributes of Embedded Systems: Characteristics of an Embedded system, Quality attributes of Embedded Systems. Hardware Software Co-Design and Program Modelling: Fundamental issues in Hardware Software Co-Design, Computational Models in Embedded Design.	8
3	ARM-32bit Microcontroller: ARM Cortex-M3 Processor- Introduction, Overview of the Cortex-M3, Instruction Sets.	8
4	RTOS for Embedded System Design: Operating System basics, Types of operating systems, Task, process and threads (Only POSIX Threads with an example program), Multiprocessing and Multitasking, Task scheduling, Task Communication.	8
5.	Embedded Systems-Application and Domain Specific: Washing Machine-application specific Embedded System, Automotive-Domain Specific Example of Embedded Systems, Key Players of Automotive Embedded Market.	8

Course Outcomes :**CO1. Understand different blocks of a Typical Embedded System.****CO2. Analyze different characteristics, quality attributes and modelling Techniques of embedded system design****CO3. Apply the knowledge of Instruction Set to program ARM 32bit Microcontroller.****CO4. Analyze the concepts of Real time kernel & Operating System services.****CO5. Evaluate the current trends in embedded industry and analyze different application and domain specific examples of embedded systems through case studies.****CO-PO-PSO Mapping:**

	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012	PS01	PS02	PS03
C01	3		2										2	2	2
C02	3	2	2	2	2								2	2	2
C03	3	2	2	2	2								2	2	2
C04	3		2										2	2	2
C05	3	3	2	2	2								2	2	2

NOTE : Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Text book 1:Shibu K V, “Introduction to Embedded Systems”, First Edition, Tata McGraw Hill Education Private Limited, 2009**Text Book 2:**Joseph Yiu,“The Definitive Guide to the ARM Cortex-M3”, Second Edition, Newnes, (Elsevier), 2008**Reference Books:**

1. “Raj Kamal, “Embedded Systems – Architecture, Programming and Design”, edition, Mc Graw Hill, 2012

2. James K Peckol “Embedded Systems – A contemporary Design Tool”, edition, John Wiley, 2008

Sub Title : Principles of Satellite Communication		
Sub Code: ETT604D	No. of Credits : 3=3:0:0 (L-T-P)	No. of lecture hours/week : 3
Professional Elective		
Exam Duration : 3 hours	CIE + SEE = 50 + 50 =100	Total No. of Contact Hours : 39

Course Objectives:

After completing the course, the students should:

1. Analyse the different orbits and orbital parameters.
2. Understand antenna look angles and eclipse.
3. Understand different link budget analysis.
4. Understand various subsystems and controls.
5. Become familiar with earth segments

Unit No.	Syllabus	No. of Teaching hours
1	Orbits : Introduction, Kepler's Laws, Definitions, Orbital Elements, Apogee and Perigee Heights, Orbital perturbations, Sidereal Time, The Orbital Plane, Sun-synchronous Orbit. - relevant problems	08
2	Geostationary Orbit : Antenna Look Angles, Polar Mount Antenna, Limits of Visibility, Earth Eclipse of Satellite, Sun Transit Outage, Launching Orbits	08
3	Space Link : EIRP, Transmission Losses, Link Power budget equation, System noise, CNR , Uplink, Downlink, Combined CNR. - relevant problems	08
4	Space Segments : Power supply, Attitude Control, Station Keeping, Thermal Control, TT&C Subsystem, Transponders Specialized services: Satellite Mobile service, VSATs , Radarsat, GPS (Text2)	08
5	Earth Segment : Receive only home TV system, out door unit, indoor unit, MATV, CATV,Tx-Rx earth station	07

Course Outcomes:

1. Analyze different types of orbits and orbital parameters.
2. To calculate look angle for a satellite .
3. Compute different types of losses in satellite communication.
4. Able to analyze different subsystems
5. Have knowledge of earth segment.

CO-PO-PSO Mapping :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2		2	1						1	3	2	1
CO2	3	3	2		2	1						1	3	2	1
CO3	3	3	2		2	1						1	3	2	1
CO4	3	3	2		2	1						1	3	2	1

NOTE : Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

TEXT BOOKS:

1. Satellite Communications –Dennis Roddy,4th Edition,McGraw Hill International edition,2008.
2. Fundamentals of Satellite Communication-SK Raman,Pearson Education,2011

REFERENCE BOOKS/WEBLINKS:

1. Satellite Communications – Timothy Pratt, Charles Bostian and Jeremy Allnutt, 2nd Edition, John Wiley & Sons, 2006.
2. Satellite Communication Concepts and Applications – K.N.RajaRao, 2nd Edition., PHI ,Publication year 2013.
3. www.nrsc.gov.in

Course Title	ARM Processor & Embedded System Design Lab							
Course Code	ETL606							
Category	PCCL							
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits	
	L	T	P	SS	Total			
	0	0	2	0	2	26		1
CIE Marks : 50	SEE Marks : 50			Total Max. Marks = 100		Duration of SEE : 03 Hours		

Course objectives:

This laboratory course enables students to

1. Develop the embedded C level programming of ARM Cortex M3 Processor using Kiel µ vision 5.
2. Understand Interfacing of different modules to LPC1768 MCU

Sl. No.	Experiment Content
1	Write a Assembly Language Program to Calculate $10+9+8+7+\dots\dots\dots+1$.
2	Write a Assembly Language Program to store data in RAM.
3	Write a Assembly Language Program to find squares of first 5 natural numbers and store data in RAM.
4	Write a Assembly Language Program to find 2's compliment of a number and store data in RAM.
5	Write a Assembly Language Program to solve the given polynomial function.
6	Write a C program to Output the message using UART of LPC1768.
7	Write a C Program to interface LED using LPC 1768.
8	Write a C Program to interface Relay using LPC 1768.
9	.Write a C programs to interface a DAC of LPC 1768.
10	Write a C program to interface Keypad using LPC 1768.

Course outcomes (Course Skill Set):

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

CO1: Create assembly ,Embedded C level programs of ARM Cortex M3

CO2: Interface different modules to LPC1768 MCU.

CO-PO-PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2		2	2			3			1	3	2	1
CO2	3	3	2		2	2			3			1	3	2	1
CO3	3	3	2		2	2			3			1	3	2	1
CO4	3	3	2		2	2			3			1	3	2	1

NOTE : Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) **2:** Moderate (Medium) **3:** Substantial (High)

Suggested Learning Resources:

1. Joseph Ylu," The Definite Guide to the ARM Cortex M3" ,Second Edition,Newnes,2008

Course Title	ANTENNA DESIGN AND TESTING Lab						
Course Code	ETT607A						
Category	Ability Enhancement Course (AEC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	0	0	2	0	2	-	2
CIE MARKS : 50	SEE Marks : 50		Total Max. Marks = 100			Duration of SEE : 03 Hours	

Course objectives: This course will enable students to:

1. To understand the various antenna parameters.
2. Conduct experiments to study the Radiation pattern of Antennas.
3. Design different types of antenna arrays and study the pattern characteristics (MATLAB)
4. Design of MMIC antennas like Patch Antenna and study the characteristics.

Sl.No	Experiments
1	Matlab/C implementation of to obtain the radiation pattern of an antenna.
2	To obtain the radiation pattern of a Dipole Antenna and calculate its directivity.
3	To calculate the aperture of a Dipole Antenna.
4	Determine the directivity and Gain of Horn antenna.
5	To obtain the Radiation pattern of a microstrip antenna.
6	Experimental study of radiation pattern of Parabolic antenna..
7	Analysis of E & H plane horns.
8	Plot 2-D and 3-D radiation pattern of omnidirectional antenna using MATLAB.
9	Design and implementation of any broadside array antenna using MATLAB.
10	Design and implementation of any endfire array antenna using MATLAB.
Demonstration Experiments	
11	Design of dipole antenna using FEKO/ HFSS Software
12	Design of a Patch Antenna using FEKO /HFSS Software.
Course outcomes : At the end of the course the student will be able to: 1. Analyze the radiation pattern and characteristics of antenna 2. Ability to design various antenna 3. Ability to use different software tools to study antenna characteristics 4. Analyze radiation pattern of linear array antennas	

CO-PO-PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	3	-	-	-	2	1	2	1	3	2	2
CO2	3	3	2	2	3	-	-	-	2	1	2	1	3	2	2
CO3	3	3	3	2	3	-	-	-	2	1	2	1	3	3	3
CO4	3	3	3	2	3	-	-	-	2	1	2	1	3	2	1
CO5	3	3	3	2	3	-	-	-	2	1	2	1	3	3	2

NOTE : Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Course Title	Communication Simulink Toolbox						
Course Code	ETT607C						
Category	Ability Enhancement Course(AEC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	0	0	2	0	2	26	1
CIE Marks : 50	SEE Marks : 50			Total Max. Marks = 100		Duration of SEE : 03 Hours	

Course objectives:

- To impart knowledge of simulation software in communication systems.
- To develop skills required to build and analyze the performance of various communication systems under different conditions.

Sl. No.	Experiment Content
1	Amplitude Modulation & demodulation using Simulink.
2	Frequency Modulation & demodulation using Simulink.
3	Phase Modulation & demodulation using Simulink.
4	DSB-SC & SSB Modulation & demodulation using Simulink.
5	ASK Modulation & demodulation using Simulink.
6	FSK Modulation & demodulation using Simulink.
7	PSK Modulation & demodulation using Simulink.
8	QPSK Transmitter and Receiver in Simulink.
9	DPSK Modulation & demodulation using Simulink.
10	Obtain the scatter plots & eye diagrams of a QPSK signal to visualize the signal behavior in presence of AWGN.
Study Experiment:	
11	Modulation & demodulation of a random binary data stream using 16 – QAM.
12	Multiplexing – TDM, FDM using Simulink.
13	PCM using Simulink.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

1. Perform modulation and demodulation of various through simulation.
2. Analyze different keying techniques.
3. Plot eye diagram and scatter plot of digital modulation techniques.
4. Demonstrate different modulation and multiplexing schemes using matlab/simulink.

CO-PO-PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	2	1	1	2	1	1	1	3	3	1
CO2	3	3	3	3	3	2	1	1	2	1	1	1	3	3	1
CO3	3	3	3	3	3	2	1	1	2	1	1	1	3	3	1
CO4	3	3	3	3	3	2	1	1	2	1	1	1	3	3	1

NOTE : Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) **2:** Moderate (Medium) **3:** Substantial (High)

Suggested Learning Resources:

1. Communication Toolbox – Examples (<https://in.mathworks.com/>)
2. "Digital Communication Laboratory" Courseware by Professor Lee C Potter, Dr. Yang Yang, Electrical and Computer Engineering, The Ohio State University.

Course Title	IoT LAB						
Course Code	ETT607B						
Category	Ability Enhancement Course (AEC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	0	0	2	0	2	26	
CIE Marks : 50	SEE Marks : 50		Total Max. Marks = 100			Duration of SEE : 03 Hours	

Course objectives:

1. Assess the vision and introduction of IoT and understand how M2M is connected to IOT.
2. Identify the appropriate hardware and software components of IoT for communication.
3. Gain knowledge on Cloud Storage models, web servers and how to integrate device, data and cloud management framework for IoT.
4. Learn the concepts of various data analytics and operational technology security with IoT.

Sl. No.	Experiment Content
1	Getting Started with IoT Arduino/Raspberry Pi
2	To interface LED/Buzzer with Arduino/Raspberry Pi and write a program to turn ON LED for 1 sec after every 2 seconds.
3	To interface Push button/Digital sensor (IR/LDR) with Arduino/Raspberry Pi and write a program to turn ON LED when push button is pressed or at sensor detection.
4	To interface DHT11 sensor with Arduino/Raspberry Pi and write a program to print temperature and humidity readings.
5	To interface motor using relay with Arduino/Raspberry Pi and write a program to turn ON motor when push button is pressed.
6	To interface Bluetooth with Arduino/Raspberry Pi and write a program to send sensor data to smartphone using Bluetooth
7	To interface Bluetooth with Arduino/Raspberry Pi and write a program to turn LED ON/OFF when '1'/'0' is received from smartphone using Bluetooth.
8	Write a program on Arduino/Raspberry Pi to upload temperature and humidity data to thingspeak cloud.

9	Write a program on Arduino/Raspberry Pi to retrieve temperature and humidity data from thingspeak cloud.
10	To interface OLED with Arduino/Raspberry Pi and write a program to print temperature and humidity readings on it.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

CO1: Interpret the vision of IoT from a global context, compare and contrast M2M and IoT Technology

CO2: Relate the appropriate Hardware and software components of IoT for providing the communication among the devices

CO3: Implement device, data and cloud management services for IoT applications.

CO4: Explore various data analytical techniques and operational security for IoT applications.

CO-PO-PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3							2	2		2	3	2	2
CO2	3	3							2	2		2	3	2	2
CO3	3	3							2	2		2	3	2	2
CO4	3	3							2	2		2	3	2	2

NOTE : Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) **2:** Moderate (Medium) **3:** Substantial (High)

Course Title	Virtual instrumentation using LabVIEW						
Course Code	ETT607D						
Category	Ability Enhancement course (AEC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	0	0	2	0	2	26	1
CIE MARKS : 50	SEE Marks : 50			Total Max. Marks = 100		Duration of SEE : 03 Hours	

Course Objectives:

1. .Aware of various front panel controls and indicators. □
2. Connect and manipulate nodes and wires in the block diagram. □
3. Locate various tool bars and pull-down menus for the purpose of implementing specific functions. □
4. Locate and utilize the context help window. □
5. Familiar with LabVIEW and different applications using it. □

Sl. No.	Experiment Content
	Programs(using LabVIEW software)to realize the following:
1	1. Basic arithmetic operations: addition, subtraction, multiplication and division
2	2. Boolean operations: AND, OR, XOR, NOT and NAND
3	3. Sum of 'n' numbers using 'for' loop
4	4. Factorial of a given number using 'for' loop
5	5. Determine square of a given number
6	6. Factorial of a given number using 'while' loop
7	7. Sorting even numbers using 'while' loop in an array
8	8. Finding the array maximum and array minimum
9. Demonstration Experiments (For CIE)	
9	10. Build a Virtual Instrument that simulates a heating and cooling system. The system must be able to be controlled manually or automatically.
10	11. Build a Virtual Instrument that simulates a Basic Calculator (using formula node).

Course Outcomes:

At the end of the course the student will be able to:

- CO1 : Use LabVIEW to create data acquisition, analysis and display operations
- CO2 : Create user interfaces with charts, graph and buttons
- CO3 : Use the programming structures and data types that exist in LabVIEW
- CO4 : Use various editing and debugging techniques.
- CO5 : Analyse various electronic circuits

CO-PO-PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	1	2	-	-	-	-	3	1	1	3	1	1
CO2	3	3	2	1	2	-	-	-	-	3	1	1	3	1	2
CO3	3	3	3	1	2	-	-	-	-	3	1	1	3	1	1
CO4	3	3	3	1	2	-	-	-	-	3	1	1	3	1	1
CO5	3	2	1	1	2	-	-	-	-	3	1	1	3	1	2

NOTE : Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

TEXT BOOKS:

1. Virtual Instrumentation using LABVIEW, Jovitha Jerome, PHI, 2011
2. Virtual Instrumentation using LABVIEW, Sanjay Gupta, Joseph John, TMH, McGraw Hill, Second Edition, 2011.

Course Title	VLSI Design Lab						
Course Code	ETT607E						
Category	Ability Enhancement course (AEC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	0	0	2	0	2	26	1
CIE MARKS : 50	SEE Marks : 50			Total Max. Marks = 100		Duration of SEE : 03 Hours	

Course Objectives:

6. .Aware of various front panel controls and indicators. □
7. Connect and manipulate nodes and wires in the block diagram. □
8. Locate various tool bars and pull-down menus for the purpose of implementing specific functions. □
9. Locate and utilize the context help window. □
10. Familiar with LabVIEW and different applications using it. □

Sl. No.	Experiment Content
	Programs(using LabVIEW software)to realize the following:
1	12. Basic arithmetic operations: addition, subtraction, multiplication and division
2	13. Boolean operations: AND, OR, XOR, NOT and NAND
3	14. Sum of 'n' numbers using 'for' loop
4	15. Factorial of a given number using 'for' loop
5	16. Determine square of a given number
6	17. Factorial of a given number using 'while' loop
7	18. Sorting even numbers using 'while' loop in an array
8	19. Finding the array maximum and array minimum
20. Demonstration Experiments (For CIE)	
9	21. Build a Virtual Instrument that simulates a heating and cooling system. The system must be able to be controlled manually or automatically.
10	22. Build a Virtual Instrument that simulates a Basic Calculator (using formula node).

Course Outcomes:

At the end of the course the student will be able to:

- CO1 : Use LabVIEW to create data acquisition, analysis and display operations
- CO2 : Create user interfaces with charts, graph and buttons
- CO3 : Use the programming structures and data types that exist in LabVIEW
- CO4 : Use various editing and debugging techniques.
- CO5 : Analyse various electronic circuits

CO-PO-PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	1	2	-	-	-	-	3	1	1	3	1	1
CO2	3	3	2	1	2	-	-	-	-	3	1	1	3	1	2
CO3	3	3	3	1	2	-	-	-	-	3	1	1	3	1	1
CO4	3	3	3	1	2	-	-	-	-	3	1	1	3	1	1
CO5	3	2	1	1	2	-	-	-	-	3	1	1	3	1	2

NOTE : Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

TEXT BOOKS:

1. Virtual Instrumentation using LABVIEW, Jovitha Jerome, PHI, 2011
2. Virtual Instrumentation using LABVIEW, Sanjay Gupta, Joseph John, TMH, McGraw Hill, Second Edition, 2011.

Course Title	Optical Fiber Communication						
Course Code	22ETU701						
Category	Integrated Professional Core Course (IPCC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	3	0	2	0	5	65	4
CIE MARKS: 50	SEE Marks: 50			Total Max. Marks = 100		Duration of SEE: 03 Hours	

Course objectives: This course will enable students to:

1. Understand the working and classification of optical fibers in terms of propagation modes
2. Solve problems of transmission characteristics and losses in optical fiber
3. Explain the constructional features and the characteristics of optical sources and detectors
4. Describe the operations of optical amplifiers
5. Understand the concept of Multiplexing, WDM and optical networks

UNIT	Syllabus Content	No. of Teaching Hours
1	Optical fiber Communications: The general Optical Fiber communication system, Advantages of optical fiber communication, Optical fiber waveguides: Ray theory transmission, Modes in Planar Guide, Total Internal Reflection, Acceptance angle, Numerical Aperture, Skew rays. Fibers: Types and refractive index profiles, Step index fibers, Graded index fibers, Single mode fibers, Cutoff wavelength, Mode field diameter, effective refractive index.	8
2	Transmission characteristics of optical fiber: Attenuation, Material absorption losses, Linear scattering losses, Nonlinear scattering losses, Fiber bend loss, Dispersion, Chromatic dispersion, Intermodal dispersion: Multimode step index fiber. Optical Fiber Connectors: Fiber alignment and joint loss, Fiber splices, Fiber connectors, Fiber couplers.	8

3	Optical sources: LEDs and LDs, structures, characteristics, modulators using LEDs and LDs. coupling with fibers, noise in Laser diodes, Amplified Spontaneous Emission noise, effects of Laser diode noise in fiber communications. Optical detectors: Types and characteristics, structure and working of PIN and AP, noise in detectors, comparison of performance. Optical receivers, Ideal photo receiver and quantum limit of detection.	8
4	Optical Amplifiers: basic concept, applications, types, doped fiber amplifiers, EDFA, basic theory, structure and working, Semiconductor laser amplifier, Raman amplifiers, TDFA, amplifier configurations, performance comparison.	8
5.	Optical System Design: Considerations, Component choice, Multiplexing, Point-to- point links, System considerations, Link power budget with examples. Rise the time budget with examples. WDM –Passive DWDM Components- Elements of optical networks-SONET/SDH.	8

PRACTICAL COMPONENT OF IPCC	
Sl No.	I. Experiments using Optical devices
1	Study of characteristics of LED's, Photo diodes.
2	Study of characteristics Photo Transistors
3	Design of Opto- Couplers circuits
4	Realization of scheme for Optical isolation and applications
5	Study of WDM
II. Experiments using Optical Fiber Communications Trainer (OFT)	
6	Setting up a Fiber Optic Analog Link
7	Setting up a Fiber Optic digital Link
8	Losses in Optical Fiber
9	Measurement of Numerical Aperture
10	Study experiment: Realtime voice signal transmission and receiver using optical fiber

	communication
TEACHING LEARNING PROCESS: Chalk and Talk, power point presentation, animations, videos	
<u>Course Outcomes :</u> CO1: Know the classification and working of optical fiber with different modes of signal Propagation. CO2: Understand the transmission characteristics and losses in optical fiber. CO3: Describe the constructional features and the characteristics of optical sources and Detectors. CO4: Describe the performance of optical amplifiers. CO5: Acquire knowledge of optical components and networks	

CO-PO-PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1		-		-	-	-	2	-	1	1	2	3
CO2	3	3	2			-	-	-	2	2	2	1	3	2	1
CO3	3	3	2			-	-	-	3	3	1	1	3	3	2
CO4	3	3	1			-	-	-	2	2	2	1	3	2	1
CO5	3	3	2		-		-	-	-	2	-	1	1	2	3

NOTE : Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

TEXT BOOKS:

1. **Optical Fiber Communications**, McGraw Hill, Gerd Keiser, 2nd Edition, 2013
2. **Optical Fiber Communications**, John M Senior, Pearson Education, 3rd Edition, 2010.

REFERENCE BOOKS / WEBLINKS:

1. **Optical Fibre Communication**, Chakrabarti, McGraw Hill, 2015
2. **Optical fibre communication**, Hebbar, Elsevier, 2014
3. **Fibre Optic Communications**, Joseph C. Palais, 5th Edition Pearson, 2013
4. **Optical Communication Essentials (SIE)**, Keiser, 1st Edition, McGraw Hill Education New Delhi, 2008.
3. **Fibre optic Communication**, Mishra and Ugale, Wiley, 2013
5. <https://archive.nptel.ac.in/courses/108/106/108106167/>

--

Sub Title: WIRELESS AND MOBILE NETWORKS		
 Sub Code: 22ETU702	No. of Credits: 4=4:0:0(L:T:P)	No of lecture hours per week: 4
Exam Duration : 3 hours	CIE + SEE = 50 + 50 =100	Total No. of Contact Hours : 52

Course Objectives :

1. To study fundamentals of Wireless communication networks, their issues and standards.
2. To study WBAN technology, its architecture, design issues, protocols and applications
3. To study WPAN technology, its architecture, design issues, protocols, components and applications.
4. To study WLAN components, design requirements, WMAN architecture, protocols and applications.

1	Review of fundamentals of wireless communication and Networks: Wireless communication channel specifications, Wireless communication systems, Wireless networks, Switching technology, Communication problems, Wireless network issues and standards.	10
2	Wireless body area networks: Properties, Network architectures, Components, Design issues, Network Protocols, WBAN technologies and WBAN applications.	10
3	Wireless personal area networks: Network Architectures, WPAN Components, Requirements of WPAN devices, WPAN Technologies and protocols, WPAN applications, Bluetooth and Zigbee.	8
4	Wireless LANs: Network components, design requirements, Architectures, IEEE-802.11x, WLAN protocols, 802.11p and applications. WMANs, IEEE-802.16: Architectures, Components, WiMax mobility support, Protocols, Broadband networks and applications.	12
5	WWANs, cellular networks, Satellite Network, Applications. Wireless ad-hoc networks: Mobile ad-hoc networks, Sensor network, Mesh networks, VANETs, Research issues in Wireless networks.	12

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	2	2	3	2	3	3	2	2	3	1
CO2	3	3	2	2	2	1	3	3	1	2	3	2	2	3	1
CO3	2	3	3	2	2	1	3	2	2	2	3	2	2	3	1
CO4	1	2	1	3	3	3	2	1	3	1	2	2	1	3	2

TEXT BOOK:

1. S S Manvi, and M. S. Kakkasageri, "Wireless and Mobile network concepts and Protocols", Wiley India Pvt Ltd, 2010.

REFERENCE BOOKS:

1. P Kaveh, Krishnamurthy, "Principles of Wireless network: A unified approach", PHI, 2006.
2. Iti Saha Mitra, "Wireless communication and network: 3G and Beyond", McGraw Hill, 2009.
3. Ivan Stojmenovic, "Handbook of Wireless networks and Mobile Computing", Wiley, 2009.
4. P Nicopolitidis, M. S. Obaidat, et al, "Wireless Networks", Wiley, 2009.
5. Yi-Bing Lin, Imrich Chlamtac, "Wireless and Mobile Network Architectures", Wiley, 2009.
6. Mullet, "Introduction to Wireless Telecommunication Systems and Networks", Cengage, 2009.

Wireless & Mobile Communication Networks Lab

1. Write a MATLAB program to calculate the path loss for Okumura outdoor propagation model in an urban area for 925.7 MHz, 926.4 MHz, 927.8 MHz, 927.1MHz Parameters given
 - $d = 1$ to 20Km (in range of 2Km)
 - $h_{te} = 100$ m to 300m (in range of 50m)
 - $h_{re} = 2$ m to 10m (in range of 2m)
 - EIRP = 1kW
 - Assume unity gain receiving antenna

2. Using Okumura outdoor propagation model, obtain graphical plot for variation of path loss with distance varying assuming that h_{te} , h_{re} , EIRP and gain are constant for 925.7 MHz, 926.4 MHz, 927.1 MHz, 927.8 MHz in MATLAB.
3. Write a MATLAB program to calculate the path loss for Hata outdoor propagation model in an urban area for 925.7 MHz, 926.4 MHz, 927.8 MHz, 927.1 MHz Parameters given-
 - $d = 1$ to 20 Km (in range of 2 Km)
 - $h_{te} = 100$ m to 300 m (in range of 50 m)
 - $h_{re} = 2$ m to 10 m (in range of 2 m)
 - EIRP = 1 kW
 - Assume unity gain receiving antenna
4. Using Hata outdoor propagation model, obtain graphical plot for variation of path loss with distance varying assuming that h_{te} , h_{re} , EIRP and gain are constant for 925.7 MHz, 926.4 MHz, 927.1 MHz, 927.8 MHz in MATLAB.
5. Using Hata outdoor propagation model, obtain graphical plot for variation of path loss with heights of receiving/transmitting antenna varying assuming that d , EIRP and gain are constant for 925.7 MHz, 926.4 MHz, 927.1 MHz, 927.8 MHz in MATLAB.
6. Find and plot the variation in power received for Okumura outdoor propagation model in a suburban area assuming all the necessary variables for 925.7 MHz, 926.4 MHz, 927.1 MHz, 927.8 MHz in MATLAB.
7. Considering a band of frequencies between 920 MHz to 950 MHz, plot the variation in path loss for Hata outdoor propagation model in a suburban area using MATLAB
8. Obtain the plot for the median path loss using Indoor propagation model, for the frequencies 925 MHz, 925.7 MHz, 926.4 MHz, 927.8 MHz and 927.1 MHz in an urban area Parameters given-
 - $d = 1$ to 20 Km (in range of 2 Km)
 - $h_{te} = 100$ m to 300 m (in range of 50 m)
 - $h_{re} = 2$ m to 10 m (in range of 2 m)

- EIRP= 1kW
 - Assume unity gain receiving antenna.
9. Assuming all the necessary variables, plot the median path loss for Indoor propagation model for a band of frequencies ranging from 930 MHz to 950 MHz in MATLAB.
 10. Write a MATLAB code for CDMA realization.
 11. Configure a GSM uplink system using MATLAB.
 12. Configure a GSM downlink system using MATLAB.
 13. Write a MATLAB code to configure a VOIP network.
 14. Write a MATLAB code to configure a Wi-MAX network for three propagation paths.

Course Outcomes :

CO1: Have complete knowledge fundamentals of wireless communication and Networks and their applications.

CO2: Identify the different wireless networks like WBAN, WMAN, WLAN, WMAN, WMAN and understand their architecture and their components.

CO3: Understand and interpret the protocols and standards in different Wireless Communication and Networks.

CO4: Analyze the various design issues in WMAN, WLAN, WMAN, WMAN.

Course Title	Adaptive Signal Processing						
Course Code	22ETT703						
Category	Professional Core Course						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	3	2	0	0	5	65	4
CIE MARKS: 50	SEE Marks: 50		Total Max. Marks = 100			Duration of SEE: 03 Hours	

Course Objectives: The objectives are to

1. Know the analysis of discrete time signals.
2. Study modern digital signal processing algorithms and applications.
3. Have an in-depth knowledge of the use of digital systems in real time applications.
4. Apply the algorithms for a wide area of recent applications.
5. Acquire knowledge of adaptive signal processing, prediction, model estimation (learning), and array processing.

UNIT No	Syllabus Content	No. of Teaching Hours	Tutorials
1	INTRODUCTION: The filtering problem, Adaptive filters, linear filter structures, approaches the development of linear adaptive filter algorithms. ADAPTIVE SYSTEMS: Definitions and characteristics - applications – properties examples - adaptive linear combiner input signal and weight vectors - performance function-gradient and minimum mean square error.	8	5
2	SEARCHING PERFORMANCE SURFACE-STABILITY AND RATE OF CONVERGENCE: Learning curve gradient search - Newton's method - method of steepest descent - comparison - Gradient estimation - performance penalty - variance - excess MSE and time constants – mis-adjustments.	8	5

3	LINEAR FILTER: Linear optimum filtering problem statement, principle of orthogonality, minimum mean squared error, wiener-hopf equations, error performance surface. Channel equalization. Linearly constrained minimum variance filter, generalized side lobe cancellers.	8	5
4	METHOD OF STEEPEST DESCENT: Steepest descent algorithm, stability of the Steepest descent algorithm. LMS ALGORITHM CONVERGENCE OF WEIGHT VECTOR: Least Mean square adaptation Algorithm, stability and performance analysis of the LMS algorithm. Concept of least squares.	8	5
5.	RECURSIVE LEAST SQUARES (RLS) ALGORITHM: The matrix inversion lemma, the exponentially weighted RLS algorithm, Convergence analysis of the RLS algorithm. KALMAN FILTERS: Recursive minimum mean square estimation for scalar random variables, statement of the Kalman filtering problem.	8	5

Course Outcomes: After the completion of the course, the student will be able to

1. Learn how to use iterative techniques.
2. Solve parameter estimation problems.
3. Theoretical guarantees of iterative and recursive methods.
4. Enable them to choose the appropriate method for signal processing systems.
5. Techniques like Kalman Filtering and Recursive Least Squares techniques.

CO-PO-PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2		2	1						1	3	2	1
CO2	3	3	2		2	1						1	3	2	1
CO3	3	3	2		2	1						1	3	2	1
CO4	3	3	2		2	1						1	3	2	1
CO5	3	3	2		2	1						1	3	2	1

NOTE: Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

TEXTBOOKS

1. B. Widrow, S. Stearns, “Adaptive Signal Processing”, Prentice-Hall, 1985.
2. S. Haykin, “Adaptive Filter Theory”, Prentice-Hall, 2013.

REFERENCE BOOKS / WEBLINKS:

1. Ali H. Sayed, “Fundamentals of Adaptive Filtering”, John Wiley, 2003.
2. B. Farhang-Boroujen, “Adaptive Filters: Theory and Applications”, John Wiley and Sons, 2013.
3. John G. Proakis, Dimitris G. Manolakis, “Digital Signal Processing, Principles, Algorithms and Applications”, Pearson Education / PHI, 2007
4. Bruce P. Gibbs, “Advanced Kalman Filtering, Least-Squares and Modeling”, John Wiley & Sons, Inc., Hoboken, New Jersey, 2011.

https://onlinecourses.nptel.ac.in/noc25_ee120/preview

<https://web.mit.edu/kirtley/kirtley/binlustuff/literature/control/Kalman%20filter.pdf>

Course Title	DSP Algorithms & Architecture						
Course Code	22ETT704A						
Category	Professional Elective						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	3	0	0	0	3	40	3
CIE Marks : 50	SEE Marks : 50		Total Max. Marks = 100			Duration of SEE : 03 Hours	

Course Objectives :

1. Understand the concepts of digital signal processing techniques.
2. Understand the computational building blocks of DSP processors and its speed issues.
3. Understand the various addressing modes, peripherals, interrupts and pipelining structure of the TMS320C54xx processor.
4. Learn how to interface the external devices to the TMS320C54xx processor in various modes.
5. Understand DSP algorithms and applications with their implementation using TMS320C54xx processor.

UNIT No	Syllabus Content	No. of Lecture Hours
1	Introduction to Digital Signal Processing: Introduction, A Digital Signal – Processing system, Major features of programmable Digital signal processors, The Sampling Process, Discrete Time Sequences, Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear Time-Invariant Systems, Digital Filters, Decimation and Interpolation.	9
2	Architectures for Programmable Digital Signal Processing Devices: Introduction, Basic Architectural Features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Speed Issues, Features for External Interfacing.	8
3	Programmable Digital Signal Processors: Introduction, Commercial Digital Signal-processing Devices, Data Addressing Modes of TMS320C54XX, Memory Space of TMS320C54xx Processors, Program Control. Detail Study of TMS320C54X & 54xx Instructions and Programming, On – Chip Peripherals, Interrupts of TMS320C54XX Processors, Pipeline Operation of TMS320C54xx Processor.	8

4	Implementation of Basic DSP Algorithms: Introduction, The Q – notation, FIR Filters, IIR Filters, Interpolation and Decimation Filters (one example in each case). Implementation of FFT Algorithms: Introduction, An FFT Algorithm for DFT Computation, Overflow and Scaling, Bit – Reversed Index. Generation & Implementation on the TMS320C54xx	7
5.	Interfacing Memory and Parallel I/O Peripherals to Programmable DSP Devices: Introduction, Memory Space Organization, External Bus Interfacing Signals. Memory Interface, Parallel I/O Interface, Programmed I/O, Interrupts and I/O Direct Memory Access (DMA). Interfacing and Applications of DSP Processors: Introduction, Synchronous Serial Interface, A CODEC Interface Circuit, DSP Based Bio-telemetry Receiver, A Speech Processing System, An Image Processing System.	7
TEACHING LEARNING PROCESS: Chalk and Talk, power point presentation, animations, videos		

Course Outcomes :**At the end of the course the student will be able to:****CO1:** Explain the fundamentals of digital signal processing systems and the mathematical tools such as DFT, FFT, and digital filters.**CO2:** Analyze various architectures and memory organizations of programmable DSP devices for efficient data processing.**CO3:** Demonstrate programming skills using TMS320C54xx DSP processors, including addressing modes, instruction sets, and pipeline operations.**CO4:** Implement basic DSP algorithms such as FIR, IIR, interpolation, decimation, and FFT using fixed-point representation and evaluate their performance on real-time DSP hardware.**CO5:** Design and interface memory and I/O peripherals with DSP processors for applications in speech, biomedical, and image processing systems.**CO-PO-PSO Mapping :****NOTE :** Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2					1			1	1			1	2
CO2	3	3				1		2				2			
CO3	3	2			3		1				1				3
CO4	3	3	2	2	3				1				3		
CO5	3	3	3		3										

TEXT BOOKS:

1. “Digital Signal Processing”, Avatar Singh and S Srinivasan, Thomson Learning, 2004

REFERENCE BOOKS/WEBLINKS :

1. “Digital Signal Processing: A practical approach”, Ifeachor E C, Jervis B. W Pearson-Education, PHI, 2002.
2. “Digital Signal Processors”, B Venkataramani and M Bhaskar, TMH, 2nd Ed., 2010
3. “Architectures for Digital Signal Processing”, Peter Pirsch, John Wiley.

Course Title	Digital Image Processing and its applications						
Course Code	22ETT704B						
Category	Professional elective (PE) course						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	3	0	0	0	3	39	3
CIE MARKS : 50	SEE Marks : 50		Total Max. Marks = 100			Duration of SEE : 03 Hours	

Course Objectives : The objectives are to

6. Understand the basic principles and methods of digital image processing.
7. Be able to formulate solutions to general image processing problems.
8. To learn various image enhancement techniques.
9. To study segmentation techniques used in different applications.
10. To acquire knowledge of concepts of color image processing.

UNIT No	Syllabus Content	No. of Teaching Hours
1	DIGITAL IMAGE FUNDAMENTALS Background, fundamental steps in Digital Image Processing, Components of an Image processing system, elements of Visual Perception, Image sensing and acquisition, Image Sampling and Quantization, Some basic relationships between pixels.	9

2	IMAGE ENHANCEMENT IN SPATIAL DOMAIN Background, Some Basic Gray Level Transformations, Histogram Processing, Enhancement using Arithmetic/ Logic Operations, Use of Python for implementation of image processing algorithms, medical applications.	8
3	IMAGE ENHANCEMENT IN FREQUENCY DOMAIN Introduction to Fourier Transform and the Frequency domain for an image, Smoothing Frequency Domain Filters, Sharpening Frequency domain filters, homomorphic filtering.	7
4	IMAGE SEGMENTATION: Detection of discontinuities, edge linking and boundary detection, Thresholding, region oriented segmentation, segmentation of morphological watersheds, the use of motion in segmentation, face detection applications.	8
5.	COLOR IMAGE PROCESSING : Color Fundamentals, Color Models, Pseudo color Image Processing, processing basics of full color image processing	7

Course Outcomes : After the completion of the course, the student will be able to

6. Explain the representation of a digital image.
7. Understand the effect of applying various enhancement techniques in spatial domain.
8. Analyze the impact of frequency domain techniques on images.
9. Analyze computer-vision applications with various segmentation techniques.
10. Know the applicability of various color-models.

CO-PO-PSO Mapping :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2		2	1						1	3	2	1
CO2	3	3	2		2	1						1	3	2	1
CO3	3	3	2		2	1						1	3	2	1
CO4	3	3	2		2	1						1	3	2	1

NOTE : Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

TEXT BOOKS

1. Rafael C Gonzalez and Richard E. Woods, "Digital Image Processing", PHI 4th Edition, 2017.
2. S.Jayaraman, S.Esakkirajan, T.Veerakumar," Digital Image Processing, TMH

3. Publication, 2nd edition, 2017

REFERENCE BOOKS / WEBLINKS:

1. Anil K.Jain, “Fundamentals of Digital Image Processing”, PHI Learning , 3rd Edition,
2. Madhuri A Joshi “Digital Image Processing –an algorithm approach”, PHI Learning, 2006
3. <http://eeweb.poly.edu/~onur/lectures/lecture8.pdf>

Course Title	Machine Learning with Python							
Course Code	22ETT704C							
Category	Professional Elective Course							
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits	
	L	T	P	SS	Total			
	3	0	0	0	3	39	3	
CIE Marks : 50	SEE Marks : 50		Total Max. Marks = 100			Duration of SEE : 03 Hours		

Course Objectives :

1. Define machine learning and problems relevant to machine learning.
2. Differentiate supervised, unsupervised and reinforcement learning
3. Apply neural networks, Bayes classifier and k nearest neighbor, for problems appear in machine learning.
4. Perform statistical analysis of machine learning techniques.

7.

UNIT No	Syllabus Content	No. of Teaching Hours
1	Introduction: Well posed learning problems, Designing a Learning system, Perspective and Issues in Machine Learning. Concept Learning: Concept learning task, Concept learning as search, Find-S algorithm, Version space, Candidate Elimination algorithm, Inductive Bias. Python libraries suitable for Machine Learning: Numerical Analysis and Data Exploration with NumPy Arrays, and Data Visualization with Matplotlib Text Bookl, Sections: 1.1 — 1.3, 2.1-2.5, 2.7 L1 - L5	08
2	Decision Tree Learning: Decision tree representation, Appropriate problems for	08

	decision tree learning, Basic decision tree learning algorithm, hypothesis space search in decision tree learning, Inductive bias in decision tree learning, Issues in decision tree learning. Example program in Python Text Book1, Sections: 3.1-3.7 L1 - L3	
3	Artificial Neural Networks : Introduction, Neural Network representation, Appropriate problems, Perceptrons, Back propagation algorithm. Example program in Python Text book 1, Sections: 4.1 —4.6 L1 - L3	07
4	Bayesian Learning : Introduction, Bayes theorem, Bayes theorem and concept learning, ML and LS error hypothesis, ML for predicting probabilities, MDL principle, Naive Bayes classifier, Bayesian belief networks, EM algorithm, Example program in Python. Text book 1, Sections: 6.1 — 6.6, 6.9, 6.11, 6.12 L1 - L4	08
5.	Evaluating Hypothesis : Motivation, Estimating hypothesis accuracy, Basics of the sampling theorem, General approach for deriving confidence intervals, Difference in error of two hypotheses, Comparing learning algorithms. Instance-Based Learning: Introduction, k—nearest neighbor learning, locally weighted regression, radial basis function, cased-based reasoning, Reinforcement Learning: Introduction, Learning Task, Q Learning Example program in Python. Textbook 1, Sections: 5.1-5.6, 8.1-8.5, 13.1-13.3 L1 - L3	08
TEACHING LEARNING PROCESS: Chalk and Talk, power point presentation, animations, videos		

Course Outcomes :

After the completion of the Course, the student will be able to

1. Identify the problems in machine learning.
2. Select supervised, unsupervised or reinforcement learning for problem-solving.
3. Apply theory of probability and statistics in machine learning
4. Apply concept learning, ANN, Bayes classifier, k nearest neighbor.
5. Perform statistical analysis of machine learning techniques.

CO-PO-PSO Mapping :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2		2	1						1	3	2	1
CO2	3	3	2		2	1						1	3	2	1
CO3	3	3	2		2	1						1	3	2	1
CO4	3	3	2		2	1						1	3	2	1

NOTE : Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

TEXTBOOKS:

1. Tom M. Mitchell, Machine Learning, India Edition 2013, McGraw Hill Education.

Reference Books:

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, 2nd edition, Springer series in statistics.
2. Ethem Alpaydm, Introduction to machine learning, second edition, MIT press.
3. <https://www.analyticsvidhya.com/blog/2015/04/comprehensive-guide-data-exploration-sas-using-python-numpy-scipy-matplotlib-pandas/>
4. <https://www.oreilly.com/library/view/python-for-data/9781491957653/ch01.html>

Course Title	Wireless Sensor Networks and its Applications						
Course Code	22ETT704D						
Category	Professional elective (PE) course						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	3	0	0	0	3	39	3
CIE MARKS : 50	SEE Marks : 50		Total Max. Marks = 100			Duration of SEE : 03 Hours	

Course Objectives:

1. To learn the technologies and challenges of Wireless Sensor Networks.
 2. To study the architecture of node and networks.
 3. To understand various protocols of Wireless Sensor Networks.
 4. To learn the topology control and positioning of nodes.
- To get familiarized with different platforms and tools needed for Wireless Sensor Networks.

Unit No.	Syllabus	No. of Teaching hours
1	OVERVIEW OF WIRELESS SENSOR NETWORKS Challenges for Wireless Sensor Networks, Enabling Technologies For Wireless Sensor Networks, Mobile Ad-Hoc Networks, 4G LTE and	08

	applications.	
2	ARCHITECTURES Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes, Operating Systems and Execution Environments, Network Architecture - Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts.	08
3	NETWORKING SENSORS Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - S-MAC, B- MAC, IEEE 802.15.4 standard and Zigbee, Dissemination protocol for large sensor network. The Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols- Energy-Efficient Routing, Geographic Routing.	09
4	INFRASTRUCTURE ESTABLISHMENT Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control. SENSOR NETWORK PLATFORMS AND TOOLS Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node-level Simulators, State-centric programming.	08
5	APPLICATION Design Issues, Protocol Paradigms -End-to-end, Real-time streaming and sessions, Publish/subscribe, Web service paradigms, Common Protocols -Web service protocols, MQ Telemetry transport for sensor networks (MQTT-S), ZigBee compact application protocol (CAP), Service discovery, Simple network management protocol (SNMP), Real-time transport and sessions, Industry- Specific protocols	06

Course Outcomes :

- CO1. Learnt the technologies and challenges of Wireless Sensor Networks.
CO2. Understood the architecture of sensor node and networks.
CO3. Understood various protocols of Wireless Sensor Networks.
CO4. Learnt the topology control and positioning of nodes, different platforms and tools.
CO5. To Study the Application for Wireless Sensor Networks.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2			2	2	2					1	3	2	2
CO2	3	2			3							2	3	3	1
CO3	3	2			3							2	3	3	1
CO4	3	2	2	2	3				2	2		1	3	3	2
CO5	3	3	2	2	3	2	2	1	2	2	2	1	3	3	3

NOTE : Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

TEXT BOOKS:

1. Holger Karl and Andreas Willig, “Protocols and Architectures for Wireless Sensor Networks” John Wiley, 2005.
2. Feng Zhao and Leonidas J. Guibas, “Wireless Sensor Networks- An Information Processing Approach”, Elsevier, 2007.
3. Raghavendra, Cauligi S, Sivalingam, Krishna M, Zanti Taiev. “Wireless Sensor Networks”, Springer 1st Edition 2004.
4. Anna Forster, “Introduction to Wireless Sensor Networks”, Wiley, 2017.

REFERENCE BOOKS:

1. Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003.
2. Kazem Sohraby, Daniel Minoli, and Taieb Znati, “Wireless Sensor Networks Technology, Protocols and applications”, Wiley Publications, 2013.
3. K Akkaya and M. Younis, “A survey of routing protocols in wireless sensor networks”, Elsevier Ad Hoc Network Journal, Vol. 3, no. 3, pp. 325—349.
4. N P Mahalik, “Sensor Networks and Configuration- Fundamentals , standards , platforms and

Course Title	Wireless Sensor Networks						
Course Code	22ETT705A						
Category	Open elective (OE) course						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	3	0	0	0	3	39	3
CIE MARKS : 50	SEE Marks : 50		Total Max. Marks = 100			Duration of SEE : 03 Hours	

applications”, Springer verlag, 2007.

Course Objectives:

5. To learn the technologies and challenges of Wireless Sensor Networks.
6. To study the architecture of node and networks.
7. To understand various protocols of Wireless Sensor Networks.
8. To learn the topology control and positioning of nodes.
To get familiarized with different platforms and tools needed for Wireless Sensor Networks.

Unit No.	Syllabus	No. of Teaching
----------	----------	-----------------

		hours
1	OVERVIEW OF WIRELESS SENSOR NETWORKS Challenges for Wireless Sensor Networks, Enabling Technologies For Wireless Sensor Networks, Mobile Ad-Hoc Networks, 4G LTE and applications.	09
2	ARCHITECTURES Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes, Operating Systems and Execution Environments, Network Architecture - Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts.	09
3	NETWORKING SENSORS Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - S-MAC, B- MAC, IEEE 802.15.4 standard and Zigbee, Dissemination protocol for large sensor network. The Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols- Energy-Efficient Routing, Geographic Routing.	09
4	INFRASTRUCTURE ESTABLISHMENT Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control.	06
5	SENSOR NETWORK PLATFORMS AND TOOLS Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node-level Simulators, State-centric programming.	06

Course Outcomes :

- CO1. Learnt the technologies and challenges of Wireless Sensor Networks.
CO2. Understood the architecture of sensor node and networks.
CO3. Understood various protocols of Wireless Sensor Networks.
CO4. Learnt the topology control and positioning of nodes.
CO5. Studied the different platforms and tools for Wireless Sensor Networks.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2			2	2	2					1	3	2	2
CO2	3	2			3							2	3	3	1
CO3	3	2			3							2	3	3	1
CO4	3	2	2	2	3				2	2		1	3	3	2

CO5	3	3	2	2	3	2	2	1	2	2	2	1	3	3	3
-----	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

NOTE : Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

TEXT BOOKS:

5. Holger Karl and Andreas Willig, “Protocols and Architectures for Wireless Sensor Networks” John Wiley, 2005.
6. Feng Zhao and Leonidas J. Guibas, “Wireless Sensor Networks- An Information Processing Approach”, Elsevier, 2007.
7. Raghavendra, Cauligi S, Sivalingam, Krishna M, Zanti Taiev. “Wireless Sensor Networks”, Springer 1st Edition 2004.

REFERENCE BOOKS:

5. Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003.
6. Kazem Sohraby, Daniel Minoli, and Taieb Znati, “Wireless Sensor Networks Technology, Protocols and applications”, Wiley Publications, 2013.
7. K Akkaya and M. Younis, “A survey of routing protocols in wireless sensor networks”, Elsevier Ad Hoc Network Journal, Vol. 3, no. 3, pp. 325—349.
8. N P Mahalik, “Sensor Networks and Configuration- Fundamentals , standards , platforms and applications”, Springer verlag, 2007.

Course Title	Multimedia Communication						
Course Code	22ETT705B						
Category	Open Elective Course(OEC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	3	0	0	0	3	39	3
CIE Marks : 50	SEE Marks : 50		Total Max. Marks = 100			Duration of SEE : 03 Hours	

Course Objectives :

1. To study the different types of Media and their representation in different forms.
2. To understand the different compression techniques for Text and Image with examples.
3. To study the different compression techniques for Audio.
4. To study the different compression techniques for Video.
5. To identify Multimedia Communication across Networks.

Unit No	Syllabus Content	No. of Teaching Hours
1	MULTIMEDIA COMMUNICATIONS: Introduction, multimedia information representation, multimedia networks, multimedia applications, media types, communication modes, network types, multipoint conferencing, Network QoS, Application QoS.	07
2	TEXT AND IMAGE COMPRESSION: Introduction, compression principles, Text compression – Static Huffman coding, Arithmetic coding, Lempel-ziv and Welsh coding, Image compression- GIFF, TIFF, Digitized documents and Pictures, JPEG Encoder and Decoder.	08

3	AUDIO COMPRESSION: Introduction, Audio compression – DPCM, ADPCM, LPC, Code excited LPC, Perceptual coding, MPEG Audio coders, Dolby Audio coders.	08
4	VIDEO COMPRESSION : Video compression principles, H.261, H.263, H.264, H.265, MPEG, MPEG-1, MPEG-2, and MPEG-4, animation.	08
5	MULTIMEDIA INFORMATION NETWORKS: Introduction, LANS, Ethernet, Token Ring, Bridges, FDDI High- Speed LANS	08
TEACHING LEARNING PROCESS: Chalk and Talk, power point presentation, animations, videos		

Course Outcomes :

After the completion of the Course, the student will be able to

CO1: Acquire the knowledge of types of Multimedia networks and applications.

CO2: Illustrate the representation of information of Text, Images, Audio and Video.

CO3: Analyze the Text and Image compression using different techniques and Standards.

CO4: Analyze the Audio and Video compression using different techniques and Standards.

CO5:.. Describe Multimedia Communication across Networks.

CO-PO-PSO Mapping :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		1	1						2		2	2	1	
CO2	2	2	3	1	2				2	1		2	3	2	1
CO3	2	3	2	1	3				2	1		2	3	2	1
CO2	2	2	2	1	2				2	1		2	3	2	1
CO3	3		1	1						2		2	2	1	

NOTE : Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

TEXT BOOK:

1. **Multimedia Communications: Applications, Networks, Protocols, and Standards** – Fred Halsall, Pearson Education, Asia, Fifth Indian reprint 2011.

REFERENCE BOOKS:

1. **Multimedia: Computing, Communications and Applications-** Raif Steinmetz, Klara Nahrstedt, Pearson Education, 2002, ISBN-978817758
2. **Fundamentals of Multimedia** – Ze-Nian Li, Mark S Drew, and Jiangchuan Liu.

Course Title	Fundamentals of Digital Image Processing						
Course Code	22ETT705C						
Category	Open elective (OE) course						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	3	0	0	0	3	39	3
CIE MARKS : 50	SEE Marks : 50		Total Max. Marks = 100			Duration of SEE : 03 Hours	

Course Objectives : The objectives are to

11. Understand the basic principles and methods of digital image processing.
12. Be able to formulate solutions to general image processing problems.
13. To learn various image enhancement techniques.
14. To study segmentation techniques used in different applications.
15. To acquire knowledge of concepts of color image processing.

UNIT No	Syllabus Content	No. of Teaching Hours
1	DIGITAL IMAGE FUNDAMENTALS Background, fundamental steps in Digital Image Processing, Components of an Image processing system, elements of Visual Perception, Image sensing and acquisition, Image Sampling and Quantization, Some basic relationships between pixels.	9
2	IMAGE ENHANCEMENT IN SPATIAL DOMAIN Background, Some Basic Gray Level Transformations, Histogram Processing, Enhancement using Arithmetic/ Logic Operations, Use of Python for implementation of image processing algorithms.	8

3	IMAGE ENHANCEMENT IN FREQUENCY DOMAIN Introduction to Fourier Transform and the Frequency domain for an image, Smoothing Frequency Domain Filters, Sharpening Frequency domain filters, homomorphic filtering.	7
4	IMAGE SEGMENTATION: Detection of discontinuities, edge linking and boundary detection, Thresholding, region oriented segmentation, segmentation of morphological watersheds, the use of motion in segmentation.	8
5.	COLOR IMAGE PROCESSING : Color Fundamentals, Color Models, Pseudo color Image Processing, processing basics of full color image processing	7

Course Outcomes : After the completion of the course, the student will be able to

11. Explain the representation of a digital image.
12. Understand the effect of applying various enhancement techniques in spatial domain.
13. Analyze the impact of frequency domain techniques on images.
14. Analyze computer-vision applications with various segmentation techniques.
15. Know the applicability of various color-models.

CO-PO-PSO Mapping :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2		2	1						1	3	2	1
CO2	3	3	2		2	1						1	3	2	1
CO3	3	3	2		2	1						1	3	2	1
CO4	3	3	2		2	1						1	3	2	1

NOTE : Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

TEXT BOOKS

1. Rafael C Gonzalez and Richard E. Woods, "Digital Image Processing", PHI 4th Edition, 2017.
2. S.Jayaraman, S.Esakkirajan, T.Veerakumar," Digital Image Processing, TMH Publication, 2nd edition, 2017

REFERENCE BOOKS / WEBLINKS:

1. Anil K.Jain, "Fundamentals of Digital Image Processing", PHI Learning , 3rd Edition,

2. Madhuri A Joshi “Digital Image Processing –an alogorithm approach”, PHI Learning, 2006
3. <http://eeweb.poly.edu/~onur/lectures/lecture8.pdf>