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 effective from the Academic Year 2023-24

III SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (QSP)	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	PCC	22ETT301	Transform Calculus, Fourier Series and Numerical Techniques		3	0	0		03	50	50	100	3
2	IPCC	22ETT302	Digital System Design using Verilog		3	0	2		03	50	50	100	4
3	IPCC	22 ETT303	Signals and Systems		3	0	2		03	50	50	100	4
4	PCC	22ETT304	Analog Electronic Circuits		3	0	0		03	50	50	100	3
5	PCCL	22ETL305	Analog and Digital Electronics Lab		0	0	2		03	50	50	100	1
6	ESC	22XXT306x	ESC/ETC/PLC		3	0	0		03	50	50	100	3
7	UHV	22HST307	Social Connect and Responsibility	Any Department	0	0	2		01	100	---	100	1
8	AEC/ SEC	22ETL308A	Ability Enhancement Course/Skill Enhancement Course – III		If the course is a Theory: 1	0	0		01	50	50	100	1
					If a course is a laboratory: 0	0	2		02				
9	HS	22CDN309	Aptitude and Verbal Ability Skill-I	Placement Cell	2	0	0		--	50	--	50	PP/NP
10	MC	22NSN310	National Service Scheme (NSS)	NSS coordinator	0	0	2		--	100	---	100	PP/NP
		22PEN310	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		22YON310	Yoga	Yoga Teacher									
									Total	550	350	900	20

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: This letter in the course code indicates common to all the streams of Engineering. ESC: Engineering Science Course, ETC: Emerging Technology Course, PLC: Programming Language Course

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Engineering Science Course (ESC/ETC/PLC) 22XXT306x			
22ETT3061	Fundamentals of Telecommunications	**22ETT3063**	Principles of Sensors and Signal Conditioning
22ETT3062	8051 Microcontroller	**22ETT3064**	Control Systems
Ability Enhancement Course – III 22XXT308x **OR** 2XXL308x			
22EEL3081	Logic Design Lab using Pspice / MultiSIM	**22EEL3083**	Linear Integrated Circuits Lab using Pspice / MultiSIM
22EEL3082	Analog Electronic Circuits Lab using PSpice/MultiSIM	**22EEL3084**	LabVIEW Programming Basics

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practical 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.

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.

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 effective from the Academic Year 2023-24

IV SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lect	Tutorial	Practical/ Drawing	Self - Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	PCC	22ETT401	Communication Theory		3	0	0		03	50	50	100	3
2	IPCC	22ETT402	Digital Signal Processing		3	0	2		03	50	50	100	4
3	IPCC	22ETT403	Network & Field Theory		3	0	2		03	50	50	100	4
4	PCCL	22ETL404	Communication Laboratory		0	0	2		03	50	50	100	1
5	ESC	22XXT405x	ESC/ETC/PLC		3	0	0		03	50	50	100	3
6	AEC/ SEC	22ETL406x	Ability Enhancement Course/Skill Enhancement Course- IV	TD and PSB: Concerned department	If the course is Theory: 1	0	0		01	50	50	100	1
					If the course is a lab: 0	0	2		02				
7	BSC	22BIT407	Biology For Engineers	TD / PSB: BT, CHE,	3	0	0		03	50	50	100	3
8	UHV	22HST408	Universal human values	Any Department	1	0	0		01	50	50	100	1
9	HS	22CDN409	Aptitude and Verbal Ability Skill-II	Placement Cell	2	0	0		--	50	--	50	PP/ NP
10	MC	22NSN410	National Service Scheme (NSS)	NSS coordinator	0	0	2			100	---	100	PP/ NP
		22PEN410	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		22YON410	Yoga	Yoga Teacher									
									Total	500	400	900	20

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 : This letter in the course code indicates common to all the stream of engineering.

Engineering Science Course (ESC/ETC/PLC) 22XXT405x OR 22XXL405x			
22ETT4051	Principles of Transmission Lines & Waveguides	**22ETT4052**	Telecommunication Switching Systems
22ETT4053	Television Engineering		
Ability Enhancement Course / Skill Enhancement Course – IV 22XXT405x OR 22XXL406x			
22EEL4061	Embedded C Basics	**22EEL4062**	Octave / Scilab for Signals
22EEL4063	C++ Basics	**22EEL4064**	Electronic Devices & Circuits using LABVIEW

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practical 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.

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 courses is mandatory for the award of Degree.

Dr. Ambedkar Institute of Technology, Bengaluru-560 056

SCHEME OF TEACHING AND EXAMINATION from the AY 2021

B. E in Electronics and Telecommunication Engineering

Outcome Based Education (OBE) and Choice Based Credit System (CBCS**) (Applicable to Batch 2021-2024(NEP))**

V SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department	Teaching Hours / Week					Examination				Credits
					L	T	P	S	Total	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
1	PCC	21ETT501	Communication System-II	ET	2	2	0	0	4	03	50	50	100	3
2	IPCC	21ETT502	Computer Communication Network	ET	3	0	2	0	5	03	50	50	100	4
3	PCC	21ETT503	Satellite Communication	ET	2	2	2	0	4	03	50	50	100	3
4	PCC	21ETT504	Microwave Engineering and Antenna Theory	ET	2	2	0	0	4	03	50	50	100	3
5	PCL	21ETL505	Communication Systems Lab-II	ET	0		0	2	2	03	50	50	100	1
6	AEC	21RMI506	Research Methodology & Intellectual Property Rights	TD: Any Department PSB: As identified by University	1	2	0	0	3	02	50	50	100	2
7	HSMC	21CIV507	Environmental Studies	TD: Civil/ Environmental/Chemistry/ Biotech. PSB: Civil Engg	0	2	0	0	2	01	50	50	100	1
8	AEC	21EE508X	Ability Enhancement Course V	ET	If offered as theory course					01	50	50	100	1
					0	2	0	0	2					
					If offered as lab course					02				
					0	0	0	2	2					
										Total	**400**	**400**	**800**	**18**

Ability Enhancement Course – V			
21ETL5081	IoT Lab	21ETL5082	Antenna & Desing Testing Lab
21ETL5083	Communication Simulink Toolbox Lab	21ETL5084	Microwave Lab

Note: BSC: Basic Science Course, **PCC:** Professional Core Course, **IPCC:** Integrated Professional Core Course, **AEC** –Ability Enhancement Course **INT** –Internship, **HSMC**: Humanity and Social Science & Management Courses. **L** –Lecture, **T** – Tutorial**, P-** Practical/ Drawing, **S** – Self Study Component, **CIE**: Continuous Internal Evaluation, **SEE:** Semester End Examination.

Integrated Professional Core Course (IPCC): refers to Professional Theory Core Course Integrated with Practical 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). Theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by CIE only and there shall be no SEE. For more details the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech.) 2021-22 may be referred.

Dr. Ambedkar Institute of Technology, Bengaluru-560 056

SCHEME OF TEACHING AND EXAMINATION from the AY 2021

B. E in Electronics and Telecommunication Engineering

Outcome Based Education (OBE) and Choice Based Credit System (CBCS**) (Applicable to Batch 2021-2024(NEP))**

VI SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department	Teaching Hours / Week					Examination				Credits
					L	T	P	S	Total	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
1	HSMC	21ETT601	Management and Entrepreneurship	HSME/ET	3	0	0	0	3	03	50	50	100	3
2	IPCC	21ETT602	Embedded System Design & ARM Processor	EE	3	0	2	0	5	03	50	50	100	4
3	PCC	21ETT603	Wireless and Cellular Communication	EE	2	2	0	0	4	03	50	50	100	3
4	PEC	21ETT604X	Professional Elective Course-I	EE	3	0	0	0	3	03	50	50	100	3
5	OEC	21ETL605X	Open Elective Course-I	Concerned Department	3	0	0	0	3	03	50	50	100	3
6	PCC	21ETL606	Wireless and Cellular Communication Lab	EE	0	0	2	0	2	03	50	50	100	1
7	MP	21ETMP607	Mini Project	EE	Two contact hours /week for interaction between the faculty and students.					-	100	-	100	2
8	INT	21INT608	Innovation/Entrepreneurship /Societal Internship	Completed during the intervening period of IV and V semesters.						-	100	-	100	3
										Total	**500**	**300**	**800**	**22**

Professional Elective - I			
21ETT6041	Artificial Intelligence	21ETT6043	Multimedia Communication
21ETT6042	Cryptography	21ETT6044	RADAR Engineering

Open Electives – I offered by the Department of Electrical and Electronics Engineering to other Department students	
21ETT6051	Mobile Communication
21ETT6052	Wireless Sensor Networks
21ETT6053	Basics of VLSI Design
21ETT6054	Embedded Systemd Design & ARM Processor

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with Practical 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 CIE only and there shall be no SEE. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech) 2021-22 may be referred.

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 students' strength for offering professional electives is 10. However, this conditional shall not be applicable to cases where the admission to the programme is less than 10.

Open Elective Courses: Students belonging to a particular stream of Engineering and Technology are not entitled for the open electives offered by their parent Department. However, they can opt 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. Selection of an open elective shall not be allowed if, **(i)** The candidate has studied the same course during the previous semesters of the program. **(ii)** The syllabus content of open electives is similar to that of the Departmental core courses or professional electives. **(iii)** A similar course, under any category, is prescribed in the higher semesters of the program. In case, any college is desirous of offering a course (not included in the Open Elective List of the University) from streams such as Law, Business (MBA), Medicine, Arts, Commerce, etc., can seek permission, at least one month before the commencement of the semester, from the University by submitting a copy of the syllabus along with the details of expertise available to teach the same in the college. The minimum students' strength for offering open electives is 10.
However, this conditional shall not be applicable to cases where the admission to the programme is less than 10.

Mini-project work: Mini Project is a laboratory-oriented course which will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications. 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 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 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.

VII semester Classwork and Research Internship /Industry Internship (21INT82): Swapping Facility
Institutions can swap VII and VIII Semester Scheme of Teaching and Examinations to accommodate research internship/ industry internship after the VI semester**.**
(2) 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 programme i.e., after VI semester, VII semester classwork and VIII semester Research Internship /Industrial Internship shall be permitted to be operated simultaneously by the University so that students have ample opportunity for internship. In other words, a good percentage of the class shall attend VII semester classwork and similar percentage of others shall attend to Research Internship or Industrial Internship.
Research/Industrial Internship shall be carried out at an Industry, NGO, MSME, Innovation centre, Incubation centre, Start-up, Centers of Excellence (CoE), Study Centre established in the parent institute and /or at reputed research organizations / institutes. The intership can also be rural internship.
The mandatory Research internship /Industry internship is for 24 weeks. The internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take up/complete the internship shall be declared fail and shall have to complete during the subsequent University examination after satisfying the internship requirements.

INT21INT82 Research Internship/ Industry Internship/Rural Internship

Research internship: A research internship is intended to offer the flavour 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: A long-term goal, as proposed under the AICTE rural internship programme, shall be counted as rural internship activity.

The student can take up Interdisciplinary Research Internship or Industry Internship.

The faculty coordinator or mentor has to monitor the students' 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 internship.

TECHNICAL SEMINAR (21EES81): The objective of the seminar is to inculcate self-learning, present the seminar topic confidently, enhance communication skill, involve in group discussion for exchange of ideas. Each student, under the guidance of a Faculty, shall choose, preferably, a recent topic of his/her interest relevant to the programme of Specialization.

(i) Carry out literature survey, systematically organize the content. **(ii)** Prepare the report with own sentences, avoiding a cut and paste act.

(iii) Type the matter to acquaint with the use of Micro-soft equation and drawing tools or any such facilities. **(iv)** Present the seminar topic orally and/or through PowerPoint slides.

(v) Answer the queries and involve in debate/discussion. (**vi)** Submit a typed report with a list of references.

The participants shall take part in the discussion to foster a friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

Evaluation Procedure: The CIE marks for the seminar shall be awarded (based on the relevance of the topic, presentation skill, participation in the question and answer session, and quality of report) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three teachers from the department with the senior-most acting as the Chairman.

Marks distribution for CIE of the course: Seminar Report:50 marks; Presentation skill:25 marks; Question and Answer: 25 marks.■ No SEE component for Technical Seminar

Non – credit mandatory courses (NCMC): National Service Scheme/Physical Education (Sport and Athletics)/ Yoga:

(1) Securing 40 % or more in CIE,35 % or more marks in SEE and 40 % or more in the sum total of CIE + SEE leads to successful completion of the registered course.

(2) In case, students fail to secure 35 % marks in SEE, they has to appear for SEE during the subsequent examinations conducted by the University.

(3) In case, any student fails to register for NSS, PE or Yoga/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have not completed the requirements of the course. In such a case, the student has to fulfill the course requirements during subsequently to earn the qualifying CIE marks subject to the maximum programme period.

(4) Successful completion of the course shall be indicated as satisfactory in the grade card. Non-completion of the course shall be indicated as Unsatisfactory.

(5) These course shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award degree.

Dr. Ambedkar Institute of Technology, Bengaluru-560 056

SCHEME OF TEACHING AND EXAMINATION : **2018 Scheme**

B.E ELECTRONICS & TELECOMMUNICATION ENGINEERING

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

VII SEMESTER

Sl. No	Course and Course code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory **Lecture**	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	MC	18HS71/72	CMEP / OSHA	IM/CV	2	--	--	03	50	50	100	2
2	PC	18ET71	Microwave Engineering		3	2	--	03	50	50	100	4
3	PC	18ET72	Wireless and Mobile networks		3	2	--	03	50	50	100	4
4	PE	18ET73X	Professional Elective -3		3	--	--	03	50	50	100	3
5	PE	18ET74X	Professional Elective -4		3	--	--	03	50	50	100	3
6	OE	18ETE75X	Open Elective –C		3	--	--	03	50	50	100	3
7	PC	18ETL76	Microwave Lab		--	--	2	03	50	50	100	1
8	PC	18ETL77	WMN Lab		--	--	2	03	50	50	100	1
9	Project	18ETP78	Project Work Phase - 1		--	--	2	03	50	50	100	2
10	INT	18ETI79	Internship	(If not completed after VI semester examinations, it has to be carried out during the intervening vacations of VII and VIII semesters)				--	--	--	--	--
				TOTAL	**17**	**4**	**6**	**27**	**450**	**450**	**900**	**23**

Note: PC: Professional Core, PE: Professional Elective, OE: Open Elective, INT: Internship, MC: Mandatory Course

Internship: All the students admitted to III year of BE have to undergo mandatory internship of 4 weeks during the vacations of VI and VII semesters and /or VII and VIII semesters. A SEE examination will be conducted during VIII semester and prescribed credits shall be added to VIII semester. Internship is considered as a head of passing and is considered for the award of degree. Those, who do not take-up/complete the internship will be declared as failed and have to complete during subsequent SEE examination after satisfy the internship requirements.

Electives

Course code	Professional Electives – 3
18ET731	Optical Communication & Networking
18ET732	Mobile Communication
18ET733	Artificial Intelligence and Machine Learning

Course code	Professional Electives – 4
18ET741	Spread Spectrum Communication
18ET742	Digital Image Processing
18ET743	Internet of Things

Open Elective -B

Students can select any one of the open electives (Please refer to consolidated list of Dr. AIT for open electives) offered by any Department. Selection of an open elective is not allowed provided,

- The candidate has studied the same course during the previous semesters of the programme.
- The syllabus content of open elective is similar to that of Departmental core courses or professional electives.
- A similar course, under any category, is prescribed in the higher semesters of the programme.

Registration to electives shall be documented under the guidance of Programme Coordinator/ Mentor.

CMEP: Cost Management of Engg Projects, OSHA: Occupational Safety and Health Administration

Course code	Open Elective – C
18ET751	Wireless Sensor Networks
18ET752	Multi Media Communication

Dr. Ambedkar Institute of Technology, Bengaluru-560 056

SCHEME OF TEACHING AND EXAMINATION : **2018 Scheme**

B.E ELECTRONICS & TELECOMMUNICATION ENGINEERING

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

VIII SEMESTER

Sl. No	Course and Course code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	MC	18XX81	CMEP / OSHA	IM /CV	4	--	--	03	50	50	100	2
2	Project	18ETP82	Project Work Phase - 2		--	--	2	03	50	50	100	10
3	Seminar	18ETS83	Technical Seminar		--	--	2	03	50	--	50	1
4	INT	18ETI84	Internship	(Completed during the intervening vacations of VI and VII semesters and /or VII and VIII semesters.)				03	50	50	100	2
			TOTAL		**4**	--	**4**	**12**	**200**	**150**	**350**	**15**

Note: PC: Professional Core, PE: Professional Elective, ,INT: Internship, MC: Mandatory Course

Internship: Those, who have not pursued /completed the internship will be declared as failed and have to complete during subsequent SEE examination after they satisfy the internship requirements.

CMEP: Cost Management of Engg Projects, OSHA: Occupational Safety and Health Administration

Course Title	**Digital System Design Using Verilog**						
Course Code	**22ETT302**						
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 impart the concepts of simplifying Boolean expression using K-map techniques and Quine-McCluskey minimization techniques.
2. To impart the concepts of designing and analyzing combinational logic circuits.
3. To impart design methods and analysis of sequential logic circuits.
4. To impart the concepts of VERILOG-data flow and behavioral models for the design of Digital systems.

UNIT No.	Syllabus Content	No. of Teaching Hours
1	**Principles of combinational logic:** Definition of combinational logic, Canonical forms, Generation of switching equations from truth tables, Karnaugh maps-3 and 4 variables, incompletely specified functions (Don't Care terms), Quine-McCluskey using don't care terms. **Introduction to Verilog:** Structure of Verilog module, Operators, Data Types, Styles of Description.	8
2	**Logic Design with MSI Components:** Adders and subtractors – Half, Full and Parallel, Binary comparators Decoders-BCD decoders, Encoders. **Verilog Data flow description:** Highlights of Data flow description, Structure of Data flow description, Signal Declaration and Assignment Statement, Data Type: Vector.	9
3	**Logic Design with Programmable Logic Devices:** Digital multiplexers - Using multiplexers as Boolean function generators, Programmable Logic Devices (PLDs).	6
4	**Flip-Flops:** The Master-Slave Flip-flops (Pulse-Triggered flip-flops): SR flip-flops, JK flip flops, D flip flop, T Flip-flop Characteristic equations, Registers. **Verilog Behavioral description:** Structure, Variable Assignment Statement, Sequential Statements, Loop Statements, Verilog Behavioral Description of combinational and sequential circuits.	9

5	**Applications of Flip-Flops:** Binary Ripple Counters, Synchronous Binary Counters, Counters based on Shift Registers –Ring and Johnson counters, Design of Synchronous mod-n Counter using clocked T, JK, D and SR flip-flops. **Verilog Structural description:** Highlights of Structural description, Organization of structural description, Binding, Structural description of combinational and sequential circuits.	8

PRACTICAL COMPONENT OF IPCC Using suitable simulation software, demonstrate the operation of the following circuits:	
Sl no.	**Experiments**
1	To simplify the given Boolean expressions and realize using Verilog program.
2	To realize Adder/Subtractor (Full/half) circuits using Verilog data flow description.
3	To realize 4-bit ALU using Verilog program.
4	To realize the following Code converters using Verilog Behavioral description a) Gray to binary and vice versa b) Binary to excess3 and vice versa
5	To realize using Verilog Behavioral description: 8:1 mux, 8:3 encoder, Priority encoder
6	To realize using Verilog Behavioral description: 1:8 Demux, 3:8 decoder, 2-bit Comparator
7	To realize using Verilog Behavioral description: Flip-flops: a) JK type b) SR type c) T type and d) D type
8	To realize Counters - up/down (BCD and binary) using Verilog Behavioral description.
Demonstration Experiments (For CIE only – not to be included for SEE) Use FPGA kit for downloading VERILOG codes and check the output for interfacing experiments.	
9	Verilog code to display messages on the given seven segment display.
10	Verilog code to control speed, direction of Stepper motor.
11	Verilog code to generate different waveforms (Square, Triangle, Ramp, Sine) using DAC change the frequency and amplitude.
12	Verilog code to control external lights using relays.
13	Verilog code to simulate Elevator operation.
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: Simplify Boolean functions using K-map and Quine-McCluskey minimization technique.

CO2: Analyze and design for combinational logic circuits.

CO3: Analyze the concepts of Flip Flops (SR, D, T and JK) and to design the synchronous sequential Circuits using Flip Flops.

CO4: Model Combinational circuits (adders, subtractors, multiplexers) and sequential circuits using VERILOG descriptions.

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

Suggested Learning Resources:

Text Books

1. Digital Logic Applications and Design by John M Yarbrough, Thomson Learning, 2001.
2. Digital Principles and Design by Donald D Givone, McGraw Hill, 2002.
3. HDL Programming VERILOG and Verilog by Nazeih M Botros, 2009 reprint, Dreamtech press.

Reference Books:

1. Fundamentals of logic design, by Charles H Roth Jr., Cengage Learning
2. Logic Design, by Sudhakar Samuel, Pearson/ Sanguine, 2007
3. Fundamentals of HDL, by Cyril P R, Pearson/Sanguine 2010

Course Title	**SIGNALS AND SYSTEMS**						
Course Code	**22ETT303**						
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. learn the basics of signals, systems and their properties.
2. apply impulse response representation of Linear Time Invariant systems to compute system output.
3. represent systems in time, frequency and complex domain.
4. understand properties of impulse response representation, difference and differential equation and block diagram representation.
5. compute Z – transform, its inverse and RoC. To learn unilateral Z-Transforms for solving difference equation.
6. To study Fourier series and transform of signals. To compute frequency domain representation of signals.

UNIT	Syllabus Content	No. of Teaching Hours
1	**Basics of Signals and Systems:** Definitions of signal and system, Classification of signals, Sampling of Signals, Basic operations on signals, elementary signals: basic continuous-time signals and discrete-time signals, Properties of systems. Problems. (L1, L2, L3)	8
2	**Linear Time Invariant system – 1 :** Introduction, Convolution: Impulse response representation for LTI Systems, Convolution sum and Convolution Integral. Problems. Auto correlation and cross correlation. (L1, L2, L3)	8
3	**Linear Time Invariant system – 2 :** Properties of impulse response representation for LTI systems, Differential and Difference equation representations. (L1, L2, L3)	8
4	**Z-Transforms:** Introduction, Z – transform, Properties of ROC, Properties of Z – transforms, Problems Inversion of Z – transforms, Transform analysis of LTI Systems, Unilateral Z- Transform and its application to solve difference equations, Problems. (L1, L2, L3)	8

5.	**Fourier Analysis of Continuous Time Signals and systems** : Introduction, Fourier Series representation of periodic signals, Fourier Transform, Properties of Fourier Transforms, Problems. **Fourier Analysis of Discrete Time signals and systems :** Introduction, Discrete Fourier series, Fourier Transform, Properties of Fourier Transforms, Problems. (L1, L2, L3)	8

PRACTICAL COMPONENT OF IPCC		
Sl No.	**Experiments**	
1	a.	Program to create and modify a vector (array).
	b.	Program to create and modify a matrix.
2	Programs on basic operations on matrix.	
3	Program to solve system of linear equations.	
4	Program to generate discrete waveforms.	
5	Program to perform basic operation on signals.	
6	Program to perform convolution of two given sequences.	
7	a.	Program to perform verification of commutative property of convolution.
	b.	Program to perform verification of distributive property of convolution.
	c.	Program to perform verification of associative property of convolution.
8	Program to compute Impulse response from the given system.	
9	Program to compute step response from the given system.	
10	Program to solve difference equation.	
11	Programs to find Z-transform and inverse Z-transform of a sequence.	
12	Program to verify sampling theorem in time domain.	
TEACHING LEARNING PROCESS: Chalk and Talk, power point presentation, animations, videos		

Course Outcomes :

CO1: Explain signals, systems and their representation in time and frequency domains.
CO2: Evaluate the response of the system in time and frequency domains.
CO3: Analyze frequency domain representation of continuous time and discrete time systems.
CO4: Apply transformation to analyze signal characteristics in time and frequency domain and . properties of transforms to solve problems on LTI systems.

CO-PO-PSO Mapping:

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

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

TEXT BOOKS:

1. Simon Haykin and Barry Van Veen "Signals and Systems", Wiley India Pvt Ltd, 2nd Edition, 2007.

REFERENCE BOOKS / WEBLINKS :

1. M J Roberts, "Signals and Systems", Mc Graw Hill, 2nd Edition, 2011.
2. I J Nagrath, S N Sharan, R Ranjan and S Kumar. "Signals and Systems" TMH, 2002.
3. H P Hsu "Signals and Systems", Scham's outlines, TMH, 2008.
4. Alan V Oppenheim, Alan S, Willsky and A Hamid Nawab, "Signals and Systems", Pearson Education Asia / PHI, 2nd Edition, 2015.
5. https://engineering.purdue.edu/ChanGroup/ECE302Notes/Book_v1.pdf

Course Title	**Analog Electronic Circuits**						
Course Code	**22ETT304**						
Category	Professional Core Course (PCC)						
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 design various Diode and BJT biasing configurations.
2. To explain and design various types of MOSFET configurations.
3. To analyze different Power amplifier circuit
4. To analyze and construct different Op-amp feedback circuits.
5. To understand and design different filter circuits using Op-amp.

UNIT No	Syllabus Content	No. of Teaching Hours
1	Diode Circuits and Transistor biasing: Clippers and clampers, Voltage Multipliers. Operating point of transistor, Fixed bias circuits, Emitter bias , Voltage divider bias, DC bias with voltage feedback configuration, Design operations, Transistor switching networks, PNP transistors, Bias stabilization - relevant problems. (Text 1: 2.9,2.10,2.12,4.2,4.3,4.4,4.5,4.6,4.8,4.9,4.11,4.12)	09
2	Field Effect Transistor : VMOS,CMOS, Introduction to MOSFET, Enhancement & Depletion MOSFETs, EMOSFET Drain feed back configuration, Voltage divider configuration, Design of FET amplifier networks. (Text 1: 5.10, 5.11, 9.8, 9.9, 9.10, 9.11, 9.12)	07
3	Power Amplifiers: Introduction, series fed and transformer coupled Class A amplifiers, Class B amplifier operations and circuits, amplifier distortions, heat sinking, Class C and ClassD amplifiers-relevant problems. (Text 1: 16.1,16.2,16.3,16.4,16.5,16.6,16.7,16.8)	07
4	Operational Amplifiers: Introduction, Ideal Op-amp ,Equivalent circuit, Ideal voltage transfer curve, Open loop configurations, Op-amp with negative feedback, Block diagram representation of feedback configurations, Voltage series and shunt feedback amplifiers, Difference Amplifier. [Text 2: 2.3,2.4,2.5,2.6,3.1,3.2,3.3,3.4,3.5]	07

5.	Op-Amp Circuits and Applications: Active Filters, First and second order low-pass and high-pass Butterworth filters, Band-pass filters, Band reject filters. ADC and DAC converters. Sample and Hold circuit 555 Timer and its Applications: Monostable and Astable Multivibrators. [Text 2: 7.2, 7.3, 7.4, 7.5, 7.6, 7.8, 7.9,8.11,8.15,9.4.1, 9.4.2, 9.4.3]	09
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 : Understand the characteristics of BJTs and FETs for switching and amplifier circuits.
CO2 : Design and analyse different MOSFET circuit configurations.
CO3 : Understand the topologies in the design of power amplifiers.
CO4: Analyze different feed back amplifier configurations using op-amp, applications such as ADC, DAC, filters and timers.

CO-PO-PSO Mapping :

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

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

TEXT BOOKS:

1. Electronic Devices and Circuit, Boylestad & Nashelsky, Eleventh Edition, Pearson, January 2015.

2. Op-Amps and Linear Integrated Circuits, Ramakant A Gayakwad, 4th Edition, Pearson Education, 2018. ISBN: 978-93-325-4991-3

REFERENCE BOOKS/WEBLINKS :

1. Electronic Principles, Albert Malvino, David J Bates, 7th Edition, McGraw Hill Education (India) Private Limited, 2017, ISBN:978-0-07-063424-4 1.

2. Microelectronic Circuits, Theory and Applications, Adel S Sedra, Kenneth C Smith, 6th Edition, Oxford, 2015. ISBN:978-0-19-808913-1

Web links and Video Lectures (e-Resources)

1. Integrated Electronics: Analog and Digital Circuits and Systems, Jacob Millman, Christos C. Halkias, McGraw-Hill, 2015.
2. https://nptel.ac.in/courses/117101106

Course Title	**Analog and Digital Electronic Lab**						
Course Code	**22ETL305**						
Category	Professional Core Course (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:

1. To provide practical exposure to design, setting up, execute and analyze various analog and digital circuits.
2. To give the knowledge and practical exposure on simple applications of analog and digital circuits.

Sl. No.	Experiment Content
	Introduction to Analog and Digital lab experiments
1	Design and set up a full wave rectifier with and without filters and to determine ripple factor and rectifier efficiency.
2	Conduct experiment to test diode clipping (single/double ended) and clamping circuits (positive/negative).
3	Design and set up an RC coupled amplifier using voltage divider bias and determine the gain bandwidth product from its frequency response.
4	Design and set-up the crystal oscillator and determine the frequency of oscillation.
5	Plot the drain and transfer characteristics of an n-channel FET and calculate its parameters, namely; drain resistance, mutual conductance and amplification factor.
6	Design and set up the circuits using Op Amp: i)Adder, ii) Integrator, iii) Differentiator.
7	Design and implement (a) Half Adder & Full Adder using basic gates and NAND gates, (b) Half subtractor & Full subtractor using NAND gates.

8	Realize (i) Binary to Gray code conversion & vice-versa (IC74139), (ii) BCD to Excess-3 code conversion and vice versa
9	Realization of two-bit comparator using IC7485.
10	Truth Table Verification of: i) Master-Slave JK Flip-Flop, ii) D Flip-Flop and iii) T Flip-Flop
11	Realize the shift registers using IC7474/7495: (i) SISO (ii) SIPO (iii) PISO (iv) PIPO (v) Ring counter and (vi) Johnson counter.
12	Realize a) Design Mod – N Synchronous Up Counter & Down Counter using 7476 JK Flip-flop. b) Mod-N Counter using IC7490.

Course outcomes (Course Skill Set):

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

CO1 : Design and test simple Analog and Digital electronic circuits as per the specifications using discrete electronic components.

CO2: Design and applications of Diodes, Transistors and Op amps in electronic circuits.

CO3: Understand the Operational amplifier and FET circuits.

CO4: Design and test the combinational logic circuits for real time applications, sequential logic circuits for real time applications.

CO-PO-PSO Mapping:

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

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

Suggested Learning Resources:

1. David A Bell, "Fundamentals of Electronic Devices and Circuits Lab Manual, 5th Edition, 2009, Oxford University Press.
2. Fundamentals of Logic Design, Charles H. Roth Jr., Larry L. Kinney, Cengage Learning, 7th Edition.

Dr Ambedkar Institute of Technology, Bengaluru-56
Department of Humanities & Social Sciences
Scheme and Syllabus – OBE - CBCS – 2023 -2024

Course Title	**SOCIAL CONNECT & RESPONSIBILITIES**						
Course Code	**22HST307**						
Category	**Humanities & Social Sciences (HS)**						
Scheme and Credits	No. of Hours/Week					Total Hrs./semester	Credits
	L	T	P	SS	Total		
	0	0	1	-	01	13	01
CIE Marks: 50	SEE Marks: 50		Total Max. Marks: 100		Duration of SEE: 02 Hours		

COURSE OBJECTIVE: The course will:

1. Provide a formal platform for students to communicate and connect to the surrounding.
2. Enable to create a responsible connection with the society.

UNIT I **hours**

Plantation and adoption of a tree*:* plantation of a tree that will be adopted for four years by a group of B.tech students. They will also make an excerpt either as a documentary or a photo blog describing the plant's origin, its usage in daily life, its appearance in folkloreand literature.

UNIT II **hours**

Heritage walk and crafts corner: Heritage tour, knowing the history and culture of the city, connecting to people around through their history, knowing the city and its craftsman, photo blog and documentary on evolution and practice of various craft forms.

UNIT III **hours**

Organic farming and waste management: usefulness of organic farming, waste management, wet waste management in neighbouring villages, and implementation in the campus.

UNIT IV **hours**

Water conservation: Knowing the present practices in the surrounding villages and implementation in the campus, documentary or photo blog presenting the current practices

UNIT V **hours**

Food walk: City's culinary practices, food lore, and indigenous materials of the region used in cooking.

Activities:

Conducting a rural camp(about awareness) for one or two days or Community camp
(Social responnsility)Jamming session, open mic, and poetry: Platform to connect to others. Share life stories with others. Exhibit the talent like playing instruments, singing, one act play , art-painting, fine art
A total of 14 hrs engagement per semester is required for the 3rd semester of the B.E./ B.Tech. program.
The students will be divided into 10 groups of 35 each. Each group will be handled by two faculty mentors.
Faculty mentors will design the activities (particularly-Jamming session, open mic and poetry)
Faculty mentors has to design the evaluation system
(eg: For activities that mentioned in 05 modules –students shall submit the brief report with photographs of activities.)

COURSE OUTCOMES: The students are expected to have the ability to:

1. Understand social responsibility
2. Practice sustainability and creativity
3. Showcase planning and organizational skills

Course Title	**Logic Design Lab using Pspice/MultiSIM**						
Course Code	**22EEL3081**						
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 : 01 Hours**	

Course Objectives :

1. Impart the concepts of De Morgan's Theorem, SOP and POS forms.
2. Impart the concepts of designing and analyzing combinational logic circuits.
3. Impart the concepts of analysis of sequential logic circuits.
4. Analyze and design any given synchronous sequential circuits.

Sl. No.	Experiments
1	Implementation of De Morgan's theorem and SOP/POS expressions using Pspice/Multisim.
2	Implementation of Half Adder, Full Adder, Half Subtractor and Full Subtractor using Pspice/Multisim.
3	Design and implementation of 4-bit Parallel Adder/ Subtractor using IC 7483 and BCD to Excess-3 code conversion and vice-versa using Pspice/Multisim.
4	Design and implement of IC 7485 4-bit magnitude comparator using Pspice/Multisim.
5	To Realize Adder & Subtractor using IC 74153 (4:1 MUX) and 4-variable function using IC74151 (8:1MUX) using Pspice/Multisim.
6	To realize Adder and Subtractor using IC 74139 (Demux/Decoder) and Binary to Gray code conversion & vice versa using 74139 using Pspice/Multisim.
7	SR, Master-Slave JK, D & T flip-flops using NAND Gates using Pspice/Multisim.
8	Design and realize the Synchronous counters using JK Flipflops (up/down decade/binary) using Pspice/Multisim.

9	Realize the shift registers and their modes (SISO, PISO, PIPO, SIPO) using 7474/7495 using Pspice/Multisim.
10	Design Pseudo Random Sequence generator using 7495 using Pspice/Multisim.
11	Design Serial Adder with Accumulator and simulate using Pspice/Multisim.
12	Design using Pspice/Multisim Mod-N Ripple Counters using JK Flipflops.

Course Outcomes : (Course Skill Set):

At the end of the course the student will be able to:
CO1: Realize a given expression using minimum number of appropriate logic gates.
CO2: Design and analyze various combinational circuits such as adders, subtractors, comparators, multiplexers and code converters.
CO3: Construct flips-flops, ripple counters and shift registers.
CO4: Design and implement and analyze synchronous counters.

CO-PO-PSO Mapping:

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

NOTE: Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

Learning Resources:

1. Digital Logic Applications and Design by John M Yarbrough, Thomson Learning, 2001
2. Digital Principles and Design by Donald D Givone, McGraw Hill, 2002.

Course Title	**Analog Electronic Circuits using Lab using PSpice**						
Course Code	**22EEL3082**						
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 : 01 Hours**	

Course objectives:

- 1. To provide practical exposure to the students on designing, setting up, executing and debugging various electronic circuits using simulation software.
- 2. To give the knowledge and practical exposure on simple applications of analog electronic circuits.

Expt. No.	Experiment Content	No. of Hours
	Introduction above PSpice/MultiSIM	2
1	Experiments to realize diode clipping (single, double ended) circuits.	2
2	Experiments to realize diode clamping (positive, negative) circuits.	2
3	Experiments to realize Full wave rectifier without filter (and set-up to measure the ripple factor, Vp-p, Vrms, etc.).	2
4	Design and conduct an experiment on Series Voltage Regulator using Zener diode to determine line/load regulation characteristics.	2
5	Realize BJT Darlington Emitter follower without bootstrapping and determine the gain, input and output impedances (other configurations of emitter follower can also be considered).	2
6	Set-up and study the working of complementary symmetry class B push pull power amplifier (other power amplifiers can also be suitably considered) and calculate the efficiency.	2
7	Design and set-up the oscillator circuits (Hartley, Colpitts etc. using BJT/FET) and determine the frequency of oscillation.	2

8	Design and set-up the crystal oscillator and determine the frequency of oscillation.	2
9	Experiment to realize Input and Output characteristics of BJT Common emitter configuration and evaluation of parameters.	2
10	Experiments to realize Transfer and drain characteristics of a FET.	2
11	Experiments to realize UJT triggering circuit for Controlled Full wave Rectifier.	2
12	Experiments to realize Transfer and drain characteristics of a MOSFET.	2

Course outcomes (Course Skill Set):

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

CO1 : Understand the circuit schematic and its working.
CO2: Study the characteristics of different electronic devices.
CO3: Design and test simple electronic circuits as per the specifications using discrete electronic components.
CO4 : Compute the parameters from the characteristics of active devices.

CO-PO-PSO Mapping :

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

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

Suggested Learning Resources:

1. David A Bell, “Fundamentals of Electronic Devices and Circuits Lab Manual, 5th Edition, 2009, Oxford University Press.

2. Muhammed H Rashid, “Introduction to PSpice using OrCAD for circuits and electronics”, 3rd Edition, Prentice Hall, 2003.

Course Title	**Linear Integrated Circuits Lab using Pspice / MultiSIM**						
Course Code	**22EEL3083**						
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 : 01 Hours**	

Course objectives:

- To apply operational amplifiers in linear and nonlinear applications.
- To acquire the basic knowledge of special function ICs.
- To use MultiSim/PSpice software for circuit design and simulation.

Expt. No.	**Experiments using PSpice**	No. of Hours
1	To construct and study Inverting amplifier using OPAMP.	2
2	To construct and study Non-inverting amplifier using OPAMP	2
3	To construct and study the Differentiator & Integrator using OPAMP.	2
4	Construct & test timer circuit using IC 555 timer	2
5	Design and Verification of Differential amplifier.	2
6	To obtain the output of voltage comparator and zero crossing detector.	2
	Experiments using MultiSim	
7	To realize a Full Wave Rectifier using Op-Amps	2
8	To realize a Half Wave Rectifier using Op-Amps.	2
9	To realize an Inverting Schmitt Trigger using Op-Amps.	2
10	To realize an Astable Multivibrator using Op-Amps	2
11	To design and implement an R C Phase Shift Oscillator using Op-Amps.	2

12	To design and implement R-2R Digital to Analog Converter using Op-Amps.	2

Course outcomes (Course Skill Set):

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

1.Sketch/draw circuit schematics, construct circuits, analyze and troubleshoot circuits containing op-amps, resistors, diodes, capacitors and independent sources.

2. Relate to the manufacturer's data sheets of IC 555 timer and IC μa741 op-amp.

3. Realize and verify the operation of Analog integrated circuits like Amplifiers, Rectifiers, Comparators and Waveform generators.

4. Design and implement Analog integrated circuits like Oscillators, Timer circuits, Data converters and compare the experimental results with theoretical values.

CO-PO-PSO Mapping :

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	-	-	-	2	1	3	3	3	3	1
CO2	3	3	3	3	1	-	-	2	2	1	-	2	3	1	-
CO3	3	3	2	3	3	-	-	-	2	1	3	3	3	2	1
CO4	3	3	2	3	3	-	-	-	2	1	3	3	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. Op-Amps and Linear Integrated Circuits, Ramakant A Gayakwad, 4th Edition, Pearson Education, 2018.

Course Title	**LabVIEW Programming Basics**						
Course Code	**22EEL3084**						
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 : 01 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 toolbars 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.
- 6. Run a Virtual Instrument (VI).

Expt. No.	Experiment Content	No. of Hours
	Introduction to LabVIEW	2
1	Basic arithmetic operations: addition, subtraction, multiplication and division.	2
2	Boolean operations: AND, OR, XOR, NOT and NAND.	2
3	Sum of ‘n’ numbers using ‘for’ loop.	2
4	Factorial of a given number using ‘for’ loop	2
5	Determine square of a given number.	2
6	Factorial of a given number using ‘while ‘loop.	2
7	Sorting even numbers using ‘while’ loop in an array.	2
8	Finding the array maximum and array minimum.	2

9	Build a Virtual Instrument that simulates a heating and cooling system. The system must be able to be controlled manually or automatically.	2
10	Build a Virtual Instrument that simulates a Basic Calculator (using formula node).	2
11	Build a Virtual Instrument that simulates a Water Level Detector.	2
12	Demonstrate how to create a basic VI which calculates the area and perimeter of a circle.	2

Course outcomes (Course Skill Set):

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

CO1 : Use Lab VIEW 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 Lab VIEW

CO4 : Use various editing and debugging technique

CO-PO-PSO Mapping :

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

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

Suggested Learning Resources:

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	**FUNDAMENTALS OF TELECOMMUNICATIONS**						
Course Code	**22ETT3061**						
Category	Engineering Science Course (ESC)						
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. Understanding basic terms and principles of signal processing in telecommunication transmission.
2. Describing basic principles of the modern digital telecommunications.
3. Implementing acquired knowledge in professional specialist courses (theoretical and practical).
4. Understanding basic operation settings for telecommunication systems and equipment.

UNIT	Syllabus Content	No. of Teaching Hours
1	**Introductory Concepts:** Introduction to Telecommunication, End-Users, Nodes, and Connectivity, Telephone Numbering and Routing, The Use of Tandem Switches in a Local Area, Introduction to the Busy Hour and Grade of Service, Simplex, Half-Duplex, and Full Duplex, One-Way and Two-Way Circuits, Network Topologies, Variations in Traffic Flow, Quality of Service, Standardization in Telecommunications.	**8**
2	**Signals Convey Intelligence :** Basic Concepts of Electricity for Communications, Early Sources of Electrical Current, The Electrical Telegraph: An Early Form of Long-Distance Communications Electrical Signals, Introduction to Transmission, Modulation, Binary Digital Signals, Introduction to Transporting Electrical Signals, Wire Pair, Coaxial Cable Transmission, Fiber-Optic Cable, Radio Transmission	**7**
3	**Quality of Service and Telecommunication Impairments** Quality of Service: Voice, Data, and Image, Signal-to-Noise Ratio, Voice Transmission, Data Circuits, Video (Television), The Three Basic Impairments and How They Affect the End-User, Amplitude Distortion, Phase Distortion, Noise, Typical Levels, Echo and Singing.	**8**

4	**Transmission and Switching: Cornerstones of a Network:** Traffic Intensity Defines the Size of Switches and the Capacity of Transmission Links, Traffic Studies, Discussion of the Erlang and Poisson Traffic, Formulas, Waiting Systems (Queueing), Dimensioning and Efficiency, Quantifying Data Traffic, Introduction to Switching, Basic Switching, Concentration and Expansion, Local Switch, Early Automatic Switching Systems, Common Control (Hard-Wired), Stored Program Control, Concentrators and Remote Switching,	**8**
5.	**Voice Telephony & Television Transmission :** Definition of the Voice Channel, The Human Voice, Operation of the Telephone Subset, The Subset Mouthpiece or Transmitter, The Subset Earpiece or Receiver, Video Transmission, Composite Signal, Critical Video Parameters, Transmission Standard—Level, Video Transmission Standards (Criteria for Broadcasters), Color Transmission.	**8**

Course Outcomes:_

1. Explain basic physical and technical principles of modern digital telecommunications,
2. Describe basic principles of operation in modern digital telecommunication equipment and systems,
3. Demonstrate measurements and experiments in laboratory on actual components, devices, equipment and systems in telecommunications,
4. Describe development and implementation methods of telecommunication systems,
5. Examine communication equipment for the technical functionality.

CO-PO-PSO Mapping:

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

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

Text book

"Fundamentals of Telecommunications" by Roger L. Freeman, Second Edition A JOHN WILEY & SONS, INC., PUBLICATION.

2. H. Taub, D.L. Schilling«Principles of Telecommunication Systems", 3rd edition 2006.

3. Tziolas , M. Salehi, "Communications Systems», 1st edition 2003, University of Athens Eds.

Course Title	**8051 Microcontroller**						
Course Code	**22ETT3062**						
Category	Engineering Science Course (ESC)						
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: This course will enable students to:

1. Understand the difference between a microprocessor and a microcontroller
2. Familiarize the basic architecture of 8051 micro controller.
3. Program 8051microprocessor using Assembly Level Language and C.
4. Understand the interrupt system of 8051 and the use of interrupts.
5. Understand the operation and use of inbuilt Timers/Counters and the Serial port of 8051.
6. Interface 8051 to external memory and I/O devices using its I/O ports.

UNIT	Syllabus Content	No. of Teaching Hours
1	**Introduction to Microcontroller:** Microprocessor Vs Microcontroller, RISC & CISC CPU architecture, Harvard & Von-Neumann CPU architecture. 8051 Microcontroller: 8051 Architecture- Registers, Pin diagram, I/O ports functions, Internal Memory organization. External Memory (ROM & RAM) interfacing.(L1,L2)	7
2	**8051 Instructions and Programming**: Addressing Modes, 8051 instructions, Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instruction. 8051 programming: Assembler directives, Assembly language programs. Stack operations. (L1,L2,L3)	8

3	**8051 Programming in C:** Data Types and Time delay in 8051C, I/O programming in 8051 C, Logical Operations in C. **Timers/counters:** 8051 timers/counters, programming 8051 timers/counters in assembly and C. (L1,L2,L3)	8
4	**8051 Serial Communication**- Basics of Serial Data Communication, RS- 232 standard, 9 pin RS232 signals, 8051 Serial Communication, Programming in assembly and C. 8051 interrupts :Interrupts and Basics of Interrupts. (L1,L2,L3)	8
5.	**8051 Interfacing and Applications** Interfacing 8051 to ADC-0804, DAC, LCD, Keyboard and Stepper motor and their 8051 Assembly and C language interfacing programming. (L1,L2,L3)	8

Course Outcomes :

CO1. Explain the difference between Microprocessors & Microcontrollers, Architecture of 8051 Microcontroller, Interfacing of 8051 to external memory .
CO2. Develop 8051 Assembly level programs using the 8051 instruction set.
CO3. Develop 8051 Assembly / C language program to generate timings and waveform using 8051 timers.
CO4. Develop 8051 Assembly / C language programs to send & receive serial data using 8051 serial port.
CO5. Interface various peripheral devices to 8051 using I/O ports.

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
CO2	3	3											2	2	2
CO3	3	3											2	2	2
CO4	3	3											2	2	2
CO5	3	3											2	2	2

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

Text book 1:Kenneth J. Ayala, "The 8051 Microcontroller", Kenneth J Ayala, 3rd Edition, Thomson/Cengage Learning.
Text Book 2:Muhammad Ali Mazidi, Janice Gillespie Mazidi and Rollin D. McKinlay, "The 8051 Microcontroller and Embedded Systems – using assembly and C", PHI, 2006 / Pearson, 2006.
Reference Books:
1. "The 8051 Micro controller Based Embedded Systems", Manish K Patel, McGraw Hill, 2014,

ISBN:978-93-329-0125-4.
2. "Microcontrollers: Architecture, Programming, Interfacing and System Design", Raj Kamal, Pearson Education, 2005.

Course Title	**Principles of Sensors and Signal Conditioning**						
Course Code	**22ETT3063**						
Category	Engineering Science Course (ESC)						
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 Hr**	

Course objectives: This course will enable students:

7. To provide in depth knowledge in physical principles applied in sensing, measurement and a comprehensive understanding on how measurement systems are designed, calibrated, characterized and analyzed.

8. To introduce the students to sources and detectors of various Optical sensing mechanisms and provide in-depth understanding of the principle of measurement, and theory of instruments and sensors for measuring velocity and acceleration.

9. To give a fundamental knowledge on the basic laws and phenomena on which operation of sensor transformation of energy is based.

10.To impart a reasonable level of competence in the design, construction, and execution of mechanical measurements strain, force, torque and pressure.

UNIT	**Syllabus Content**	**No. of Teaching Hours**
1	**Sensor fundamentals and characteristics** Sensor Classification, Performance and Types, Error Analysis characteristics	8
2	**Optical Sources and Detectors** Electronic and Optical properties of semiconductor as sensors, LED, Semiconductor lasers, Fiber optic sensors, Thermal detectors, Photo multipliers,	7

	photoconductive detectors, Photo diodes, Avalanche photodiodes, CCDs.	
3	**Intensity Polarization and Interferometric Sensors** Intensity sensor, Microbending concept, Interferometers, Mach Zehnder, Michelson, Fabry- Perot and Sagnac, Phase sensor: Phase detection, Polarization maintaining fibers. **Strain, Force, Torque and Pressure sensors** Strain gages, strain gage beam force sensor, piezoelectric force sensor, load cell, torque sensor, Piezo-resistive and capacitive pressure sensor, optoelectronic pressure sensors, vacuum sensors. Design of signal conditioning circuits for strain gauges, piezo, capacitance and optoelectronics sensors.	8
4	**Position, Direction, Displacement and Level Sensors** Potentiometric and capacitive sensors, Inductive and magnetic sensor, LVDT, RVDT, eddy current, transverse inductive, Hall effect, magneto resistive, magnetostrictive sensors. Fiber optic liquid level sensing, Fabry Perot sensor, ultrasonic sensor, capacitive liquid level sensor. Signal condition circuits for reactive and self-generating sensors. **Velocity and Acceleration sensors** Electromagnetic velocity sensor, Doppler with sound, light, Accelerometer characteristics, capacitive, piezo-resistive, piezoelectric accelerometer, thermal accelerometer, rotor, monolithic and optical gyroscopes.	8
5 .	**Flow, Temperature and Acoustic sensors** **Flow sensors:** pressure gradient technique, thermal transport, ultrasonic, electromagnetic and Laser anemometer. Micro flow sensor, Coriolis mass flow and drag flow sensor. **Temperature sensors:** Thermoresistive, thermoelectric, semiconductor and optical, Piezoelectric temperature sensor. **Acoustic sensors:** microphones-resistive, capacitive, piezoelectric, fiber optic, solid state - electrect microphone.	8

Course Outcomes :

CO1-Use concepts in common methods for converting a physical parameter into an electrical quantity.

CO2-Choose an appropriate sensor comparing different standards and guidelines to make sensitive measurements of physical parameters like pressure, flow, acceleration, etc.

CO3-Design and develop sensors using optical methods with desired properties, evaluate performance characteristics of different types of sensors, Create analytical design and development

solutions for sensors.

CO4-Locate different types of sensors used in real life applications and paraphrase their importance.

CO5-Compete in the design, construction, and execution of systems for measuring physical quantities.

CO-PO-PSO Mapping:

	O1	*O2*	*O3*	*O4*	*O5*	*O6*	*O7*	*O8*	*O9*	*O10*	*O11*	*O12*	*SO1*	*SO2*	*SO3*
CO1			2					-		-	2	-	3	2	-
CO2			2					-		-	2	-	3	2	2
CO3		3				-			-	-	1	-	3	3	1
CO4		3				-	-			1	1	-	3	2	-
CO5			2					-		1	1	1	2	2	2

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

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

TEXT BOOKS:

1. Jacob Fraden, "Hand Book of Modern Sensors: physics, Designs and Applications", 2015, 3rd edition, Springer, New York.

2. Jon. S. Wilson, "Sensor Technology Hand Book", 2011, 1st edition, Elsevier, Netherland.

REFERENCE BOOKS / WEBLINKS:

1. Gerd Keiser, "Optical Fiber Communications", 2017, 5th edition, McGraw-Hill Science, Delhi.

2. John G Webster, "Measurement, Instrumentation and sensor Handbook", 2017, 2nd edition, CRC Press, Florida.

3. Eric Udd and W.B. Spillman, "Fiber optic sensors: An introduction for engineers and scientists", 2013, 2nd edition, Wiley, New Jersey.

4. Bahaa E. A. Saleh and Malvin Carl Teich, "Fundamentals of photonics", 2012, 1st edition, John Wiley, New York.

Course Title	**Control Systems**						
Course Code	**22ETT3064**						
Category	ESC/ETC/PLC						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	3	0		0	3	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.Formulate the mathematical modeling of systems and understand the concepts of transfer function, obtain transfer function using block diagram reduction and signal flow graph techniques.

2. Analyze the response of second order systems using standard test signals and analyze steady state error.

3. Analyze stability of systems using RH criteria, Root Locus, Nyquist and Bode plot and obtain state variable model for electrical systems.

UNIT	Syllabus Content	No. of Teaching Hours
1	**Mathematical Modeling and Transfer Function of Electrical system:** Introduction to control system, open loop and closed loop systems, advantages and disadvantages, types of feedback, transfer function, Transfer function of Electrical networks, Block diagram Reduction, Signal Flow Graph and Mason's gain formula.	9
2	**Time Response of feedback control systems:** Standard test signals, Unit step response of second order system, time domain specifications, Steady state error analysis.	8
3	**Stability analysis using RH Criteria:** Concepts of stability, Necessary conditions for stability using Routh's array, Routh - Hurwitz stability criterion, Relative stability analysis.	8
4	**Stability analysis using Root Locus:** The root locus concepts, Construction	8

	of root loci, Effect of addition of poles and zeros.	
5.	**Stability analysis using Bode plots**: Bode magnitude and phase plots, Gain and phase margin.	6

Course Outcomes :

CO1 Write the mathematical model for electrical systems and find the transfer function using block diagram reduction technique and signal flow graph.

CO2 Analyze transient and steady state response of second order systems using standard test signals and analyze steady state error.

CO3 Analyze the stability of the systems by applying RH criteria and root locus techniques.

CO4 Analyze the stability of the system using frequency domain technique of Bode plots.

CO5 Analyze the electrical system using state variables.

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					2	2	2
CO2	3	3		2		2		2					2	2	2
CO3	3	3		2		2		2					2	2	2
CO4	3	3		2		2		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 BOOKS:

2. Richard C.Dorf and Robert H. Bishop ,Modern Control Systems, Pearson Education, Edition XIII, 2017

REFERENCE BOOKS / WEBLINKS :

1. I.J.Nagrath and Gopal M ,Control Systems Engineering, New Age International (P) Limited, Edition V, 2008.

2. Ogata K. Modern Control Engineering, Pearson EducationAsia/PHI. Edition V, 2010.

3. Kuo C. Benjamin Automatic Control Systems, John Wiley & Sons,Edition IX, 2014.

4. Gopal M. Control Systems – Principles and Design. TMH, Edition IV, 2012.

Course Title	**Communication Theory**						
Course Code	**22ETT401**						
Category	Professional Core Course (PCC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	2	2	0	0	4	52	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 and analyse concepts of Analog Modulation schemes viz: AM, FM., Low pass sampling and Quantization.
2. Understand and analyse concepts digitization of signals viz; sampling, quantizing and encoding.
3. Evolve the concept of SNR in the presence of channel induced noise and study Demodulation of analog modulated signals.
4. Evolve the concept of quantization noise for sampled and encoded signals and study the c concepts of reconstruction from these samples at a receiver.

UNIT No	Syllabus Content	No. of Hours	
		Teaching	Tutorial
1	**AMPLITUDE MODULATION:** Introduction, Amplitude Modulation: Time & Frequency Domain description, Switching modulator, Envelop detector. **DOUBLE SIDE BAND-SUPPRESSED CARRIER MODULATION:** Time and Frequency Domain description, Ring modulator, Coherent detection, Costas Receiver, Quadrature Carrier Multiplexing.	05	05
2	**SINGLE SIDE–BAND AND VESTIGIAL SIDEBAND METHODS OF MODULATION:** SSB Modulation and	05	05

	Demodulation ,VSB Modulation, Frequency Translation, Frequency Division Multiplexing, Application of VSB.		
3	**ANGLE MODULATION:** Basic definitions, Frequency Modulation: Narrow Band FM, Wide Band FM, Transmission bandwidth of FM Signals, Generation of FM Signals, Demodulation of FM Signals, FM Stereo Multiplexing, Phase–Locked Loop: Nonlinear model of PLL, Linear model of PLL, Nonlinear Effects in FM Systems. The Superheterodyne Receiver.	06	06
4	**NOISE**: Shot Noise, Thermal noise, White Noise, Noise Equivalent Bandwidth. **NOISE IN ANALOG MODULATION**: Introduction, Receiver Model, Noise in DSB-SC receivers. Noise in AM receivers, Threshold effect, Noise in FM receivers, Capture effect, FM threshold effect, FM threshold reduction, Preemphasis and De-emphasis in FM	05	05
5.	**SAMPLING AND QUANTIZATION:** Introduction, Significance of analog to digital conversion, The Low pass Sampling process, Pulse Amplitude Modulation. Time Division Multiplexing, Pulse–Code Modulation: Sampling, Quantization, Encoding, Regeneration, Decoding, Filtering, Multiplexing; Delta Modulation	05	05
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 : Understand the amplitude and frequency modulation techniques and perform time and frequency domain transformations.

CO2 : Identify the schemes for amplitude and frequency modulation and demodulation of analog signals and compare the performance.

CO3 : Characterize the influence of channel noise on analog modulated signals.

CO4 : Understand the concepts of sampling and quantization and the characteristics of pulse amplitude modulation and pulse code modulation systems.

CO-PO-PSO Mapping :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	1	1	1	1	1	1	2	3	2	1
CO2	3	3	3	3	2	1	1	1	1	1	1	2	3	2	1
CO3	3	3	3	3	2	1	1	1	1	1	1	2	3	2	1
CO4	3	3	3	3	2	1	1	1	1	1	1	2	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. Simon Haykins & Moher, Communication Systems, 5th Edition, John Wiley, India Pvt. Ltd, 2010, ISBN 978 – 81 – 265 – 2151 – 7.

REFERENCE BOOKS/WEBLINKS :

1. B P Lathi and Zhi Ding, Modern Digital and Analog Communication Systems, Oxford University Press., 4th edition, 2010, ISBN: 97801980738002.
2. Simon Haykins, An Introduction to Analog and Digital Communication, John Wiley India Pvt. Ltd., 2008, ISBN 978–81–265–3653–5.
3. H Taub & D L Schilling, Principles of Communication Systems, TMH, 2011.

Course Title	**DIGITAL SIGNAL PROCESSING**						
Course Code	**22ETT402**						
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:

1. To introduce signals, systems, time and frequency domain concepts, frequency domain sampling, DFT and its properties and linear filtering.
2. To compute DFT using FFT algorithms.
3. To study and design analog and digital IIR filters and analog to digital filter transformation.
4. To study windows and frequency sampling method for FIR filter design.
5. To learn implementation of IIR and FIR filters by direct form – I and II, cascade, lattice and parallel realization.

UNIT	Syllabus Content	No. of Teaching Hours
1	**Discrete Fourier Transforms (DFT) & its Properties:** Frequency domain sampling and reconstruction of discrete time signals. DFT as a linear transformation, its relationship with other transforms. Properties of DFT, multiplication of two DFTs- the circular convolution, additional DFT	8

	properties, use of DFT in linear filtering, overlap-save and overlap-add method. Introduction to Decimation and Interpolation. (L1, L2, L3)	
2	**Fast-Fourier-Transform (FFT) algorithms:** Direct computation of DFT, need for efficient computation of the DFT (FFT algorithms).Radix-2 FFT algorithm for the computation of DFT and IDFT–decimation- in-time and decimation-in-frequency algorithms. Goertzel algorithm and chirp-z transform. (L1, L2, L3)	8
3	**IIR filter:** Characteristics of commonly used analog filters – Butterworth and Chebyshev filters, analog to analog frequency transformations. Design of IIR filters from analog filters (Butterworth and Chebyshev) - Impulse Invariance method and Bilinear Transformation method. (L1, L2, L3)	8
4	**FIR filter:** Introduction to FIR filters, design of FIR filters using - Rectangular, Hamming, Bartlet and Kaiser windows, FIR filter design using frequency sampling technique. (L1, L2, L3)	8
5.	**Implementation of discrete-time systems:** Structures for IIR and FIR systems- direct form I and direct form II systems, cascade, lattice and parallel realization. (L1, L2, L3)	8

PRACTICAL COMPONENT OF IPCC

List of Programs to be implemented & executed using any programming languages like C++/Python/Java/Scilab / MATLAB/CC Studio (but not limited to)

Sl no.	Experiments
1	Computation of N point DFT of a given sequence and to plot magnitude and phase spectrum.
2	Computation of circular convolution of two given sequences and verification of commutative, distributive and associative property of convolution.
3	Computation of linear convolution of two sequences using DFT and IDFT.
4	Computation of circular convolution of two given sequences using DFT and IDFT
5	Verification of Linearity property, circular time shift property & circular frequency shift property of DFT.
6	Verification of Parseval's theorem
7	Design and implementation of IIR (Butterworth) low pass filter to meet given specifications.
8	Design and implementation of IIR (Butterworth) high pass filter to meet given specifications.
9	Design and implementation of low pass FIR filter to meet given specifications.
10	Design and implementation of high pass FIR filter to meet given specifications.
11	To compute N- Point DFT of a given sequence using DSK 6713 simulator.
12	To compute linear convolution of two given sequences using DSK 6713 simulator.
13	To compute circular convolution of two given sequences using DSK 6713 simulator.

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 frequency domain representation of finite length sequences and systems.
CO2: Apply the knowledge of Fourier and Z-transform to solve the signal processing problems and realize systems.
CO3: Design filters for the given specifications by applying appropriate transformation.
CO4: Analyse the signal processing concepts for efficient system design.

CO-PO-PSO Mapping:

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

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. Proakis & Manolakis, "Digital Signal Processing - Principles Algorithms & Applications", 4th Edition, Pearson education, New Delhi, 2007. ISBN: 81-317-1000-9.
2. Li Tan, Jean Jiang, "Digital Signal processing - Fundamentals and Applications", Academic Press, 2013, ISBN: 978-0-12-415893.

Reference Books:

1. Sanjit K Mitra, "Digital Signal Processing, A Computer Based Approach", 4th Edition, McGraw Hill Education, 2013.
2. Oppenheim & Schaffer, "Discrete Time Signal Processing", PHI, 2003.
3. D Ganesh Rao and Vineeth P Gejji, "Digital Signal Processing" Cengage India Private Limited, 2017, ISBN: 9386858231

Course Title	**Network & Field Theory**						
Course Code	**21ETT403**						
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. Apply mesh and nodal techniques to solve an electrical network.
2. Solve different problems related to Electrical circuits using Network Theorems and Two port network.
3. To facilitate the students in understanding the Concepts of Electric and Magnetic Fields through Mathematical representations.
4. To enable the students in using the concepts of Field theory to arrive at important Mathematical relations associated with Electromagnetic waves.

Potential Gradient.

UNIT No	Syllabus Content	No. of Hours Teaching
1	**Basic concepts of Network Analysis :** Types of Sources, Source Transformation, Conversion from Start to Delta and Delta to Star Network, Loop analysis, Nodal analysis with independent DC and	08

	AC Excitations.	
2	**Network Theorems :** Super position theorem, Thevenin's theorem, Norton's Theorem, Maximum Power transfer Theorem, relevant problems.	08
3	**Coulomb's Law and Electric Field Intensity:** The Experimental law of Coulomb, Electric Field Intensity, Field of a line charge. **Electric Flux Density and Gauss-Divergence Theorem:** Electric Flux Density, Gauss' Law, Application of Gauss' Law for a Differential Volume Element, Divergence, Maxwell's First Equation, Divergence Theorem.	08
4	**Electric Potential:** Energy Expended in moving a point charge in an Electric field, The Line Integral, Definition of Potential Difference and Potential, Potential field of a point charge, **Boundary conditions :** Boundary conditions on fields at Conductor-dielectric and Dielectric-dielectric interface.	08
5.	**Steady Magnetic field:** Biot-Savart's Law, Ampere's Circuital Law , Current density, Curl, Stokes' Theorem, Magnetic Flux and Flux density. **Time Varying Fields and Maxwell's Equations:** Faraday's Law, Displacement Current, Maxwell's Equations in Point Form, Maxwell's Equations in Integral Form.	08

Expt. No.	**Experiments using Simulation Software : PSpice/MultiSIM/MATLAB**	**No. of Hours**
1	Verification of Mesh analysis for a given circuit.	2
2	Verification of Nodal analysis for a given circuit.	2
3	Verification of Superposition theorem	2
4	Verification of Norton's theorem	2
5	Verification of Thevenin's theorem	2
6	Verification of Maximum power transfer theorem.	2
7	Calculating Force using Coulomb's law.	2
8	Finding Electric field intensity by computing gradient of potential.	2
9	Finding Divergence of Flux density.	2
10	Finding Curl of Magnetic field intensity	2
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 : Analyse and solve Electric circuit, by applying, loop analysis, Nodal analysis and by applying network Theorems.

CO2 : Evaluate two port parameters of a network and solve electric circuit.

CO3 : Analyze the divergence theorem, Stokes' theorem from the perspective of Electric and Magnetic fields.

CO4 : Apply Electric and Magnetic field concepts to arrive at Maxwell's equations,

CO-PO-PSO Mapping :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3					2			1	2			1	2
CO2	3	3		2				2				2			
CO3			3	2			3				3				3
CO4			3	2					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. Engineering circuit analysis, William H Hayt, Jr, Jack E Kemmerly, Steven M Durbin, McGraw Hill Education, Indian Edition 8e.
2. Network Analysis, M E Van Valkenburg, Pearson, 3e.
3. W H Hayt and J A Buck, "Engineering Electromagnetics", Mc Graw Education, 8th Edition, 2014.

Reference Books :

1. Networks and Systems, D Roy Choudhury, New age international Publishers, second edition.
2. Mathew N O Sadiku, "Elements of Electromagnetics", Oxford University Press, 4th edition, 2007.
3. Karl Erik Lonngren,"**Fundamentals of Electromagnetics with MATLAB",** Sava Vasilev Savov, Randy J. Jost, SciTech Publication, 2nd edition,2007.

WEBLINKS :

https://archive.nptel.ac.in/courses/117/105/117105085

1. https://nptel.ac.in/courses/108106073

Course Title	**Communication Laboratory**						
Course Code	**21ETL404**						
Category	Professional Core Course laboratory (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. Model an analog communication system signal transmission and reception.
2. Realize the electronic circuits to perform analog and pulse modulations and demodulations.
3. Verify the sampling theorem and relate the signal and its spectrum before and after sampling.
4. Understand the process of PCM and delta modulations.
5. Understand the PLL operation.

Sl No.	Syllabus Content
1	Design of active second order Butterworth low pass and high pass filters.
2	Amplitude Modulation and Demodulation of (a) Standard AM and (b) DSBSC
3	Frequency modulation and demodulation
4	Design and test Time Division Multiplexing and Demultiplexing of two bandlimited signals.
5	Design and test Pulse sampling, flat top sampling and reconstruction.
6	Design and test Mixer for frequency translation.
7.	Design and test Pulse amplitude modulation and demodulation

8.	Illustration of (a) AM modulation and demodulation and display the signal and its spectrum. (b) DSB-SC modulation and demodulation and display the signal and its spectrum.(Use MATLAB/SCILAB)
9.	Illustration of FM modulation and demodulation and display the signal and its spectrum. (Use MATLAB/SCILAB)
10	Illustrate the process of sampling and reconstruction of low pass signals. Display the signals and its spectrums of both analog and sampled signals. (Use MATLAB/SCILAB).
11	Illustration of Delta Modulation and the effects of step size selection in the design of DM encoder. (Use MATLAB/SCILAB)
12	Demonstration of Amplitude modulation and demodulation using Labview.
13	Demonstration of Frequency modulation and demodulation using Labview.

Course Outcomes :

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

1. Demonstrate the AM and FM modulation and demodulation by representing the signals in time and frequency domain.
2. Design and test the sampling, Multiplexing and PAM with relevant circuits.
3. Demonstrate the basic circuitry and operations used in AM and FM receivers.
4. Illustrate the operation of PCM and delta modulations for different input conditions.

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	3	1
CO2					3	3	3	3					3	3	1
CO3					3	3	3	3					3	3	1
CO4					3	3	3	3					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. Louis E Frenzel, Principles of Electronic Communication Systems, McGraw Hill Education (India)Private Limited, 2016.
2. B P Lathi, Zhi Ding, Modern Digital and Analog Communication Systems, Oxford University Press,2015.

Course Title	**PRINCIPLES OF TRANSMISSION LINES AND WAVE GUIDES**						
Course Code	**21ETT4051**						
Category							
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: This course will enable students to:

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	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, Insertion loss **(Text 1)**	8
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,. **(Text 1)**	8
3	**Smith Chart and its applications :** Smith Circle diagram, Applications of Smith chart, Single-stub impedance matching with Smith Chart. **(Text 1)**	8

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)**	7
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, The TEM wave in the coaxial Line, Attenuation in the coaxial Line (Text 1 & 2)	8

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	2	3	2					1	2		2	3	1	2
CO2	2	3	3	3					1	2		2	3	2	2
CO3	2	3	3	3					1	2		2	3	2	2
CO4	3	2	3	2					1	2		2	3	1	2
CO5	3	2	3	2					1	2		2	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."**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	**TELECOMMUNICATION SWITCHING SYSTEMS**						
Course Code	**22ETT405B**						
Category	Engineering Science Course (ESC)						
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 understand Basics and features of digital switching systems and traffic model.
2. To understand evolution of switching systems.
3. Ability to design a Grading considering the inlets and outlets of switches and understand Telecommunication Traffic.
4. To understand switching systems and Time division switching.
   Ability to understand Switching system software and system maintenance.

UNIT No	Syllabus Content	No. of Hours Teaching
1	**Introduction of Telecommunication Switching:** Developments of telecommunications, Network structure, Network services, terminology, Regulation, Standards. Introduction to telecommunications transmission, Power levels, Four wire circuits, Digital transmission, FDM,TDM, PDH and SDH, Transmission performance.	8
2	**Evolution of switching Systems:** Introduction, classifications and functions of switching system, Circuit switching and message switching, Distribution systems, Basics of crossbar systems, Electronic switching, Digital Switching Systems	8
3	**Telecommunication Traffic:** Introduction, Unit of traffic, Congestion, Traffic measurement, Mathematical model, lost call systems, Queuing systems.	7
4	**I. Switching Systems:** Introduction, Single stage networks, Gradings, Link Systems, GOS of Linked systems.	7

	II. Time Division Switching: Introduction, space and time switching, Time switching networks, Synchronization, Frame alignment.	
5.	**I. Switching system software:** Introduction, Scope, Basic software architecture, Operating systems, Database Management, Concept of generic program, Software architecture for level 1, level 2 and level 3 control, Digital switching system software classification, Call models, Connect sequence, Software linkages during call, Call features, Feature flow diagram, Feature interaction. **II. Maintenance of Digital Switching System:** Introduction, Scope, Software maintenance, Interface of a typical digital switching system, central office, System outage and its impact on digital switching system reliability, Impact of software patches on digital switching system maintainability, Embedded patcher concept, Growth of digital switching system central office, Generic program upgrade, A methodology for proper maintenance of digital switching system.	9

Course Outcomes :

1. Learners will understand Introduction to Telecommunication switching systems.
2. Learners will be able to understand Evolution, functions, switching technologies of switching systems.
3. To design Traffic model grading.
4. Learners will understand switching systems and Time division switching.
5. Learners will understand Working principles of digital switching systems software and its maintenance.

CO-PO-PSO Mapping :

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

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

TEXT BOOKS:

1. Telecommunication and Switching, Traffic and Networks - J E Flood: Pearson Education, 2002.
2. Digital Switching Systems, Syed R. Ali, TMH Ed 2002.

REFERENCE BOOKS/WEBLINKS:

1. Telecommunications switching systems and networks – Thyagarajan Vishvanathan, PHI - 2003
2. http://www.btechbunks.com/2011/03/telecommunication-switching-systems.html?m=1

Course Title	**Television Engineering**						
Course Code	**22ETT405C**						
Category	Engineering Science Course (ESC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	3	0	0	0	2	39	3
CIE MARKS : 50	**SEE Marks : 50**		**Total Max. Marks = 100**			**Duration of SEE : 03 Hours**	

COURSE OBJECTIVES:

1. To study the analysis and synthesis of TVPictures, Composite Video Signal, Receiver Picture Tubes
and-Television Camera Tubes
2. To study the principles of Monochrome Television Transmitter and Receiver systems.
3. To study the advanced topics in Television systems.
4. To study the various Color Television systems with a greater emphasis on PAL.

UNIT	Syllabus Content	No. of Teaching Hours
1	**FUNDAMENTALS OF TELEVISION :** TV transmitter and receivers, synchronization, Basic factors of TV system: aspect ratio, image continuity, interlaced scanning, flicker, picture resolution, Composite video signal, Horizontal and vertical sync details, no of scanning lines, scanning sequence details. Monochromatic Picture tube, Electrostatic focusing, Beam deflection, picture tube characteristics and specifications, monochrome TV camera.	8
2	**MONOCHROME TV TRANSMITTER :** TV transmitter - picture signal transmission, sound signal transmission, vestigial side band transmission, TV signal propagation â€“ Interference - TV transmission Antennas. **MONOCHROME TV RECEIVER :** RF tuner, IF subsystem, video amplifier, sound section, sync separation and processing, deflection circuits, scanning circuits	8

3	**CAMERA TUBES : Basic Principles,** Types: Image Orthicon, Vidicon, Plumbicon, Block diagram of broad cast TV transmitter, Block diagram of broadcast TV receiver. **Essentials of Colour Television :** Compatibility colour perception- Three colour theory- luminance, hue and saturation-colour television cameras- values of luminance and colour difference signals-formation of chrominance signal.	7
4	**Colour TV display tubes :** delta gun, precision in-line and Trinitron colour picture tubes, purity and convergence, purity and static and dynamic convergence adjustments, automatic degaussing circuit, grey scale tracking. **Colour television systems :** NTSC colour TV system, limitations of NTSC system, PAL colour TV system, merits and demerits of the PAL system - SECAM colour TV system, merits and demerits of SECAM system.	8
5.	**Advanced Colour TV Systems - Cable TV :** cable signal sources, cable signal processing, cable signal distribution - digital television - DTH, threedimensional (3D) TV. **Extended Definition television (EDTV), HDTV, LCD Television :** LCD technology, LCD matrix types & operation, Plasma Television : conduction of charge, signal processingin plasma TV receivers.	8

COURSE OUTCOMES:

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

1. Acquire knowledge in Fundamentals of Television, Monochrome TV transmitter and receiver, Camera tubes and colour TV display tubes, Colour TV systems and advanced colour TV systems.
2. Identify the elements of Television, Monochrome TV transmitter and receiver, Camera tubes and colour TV display tubes, Colour TV systems and advanced colour TV systems.
3. Interpret the essentials of colour TV and various colour TV systems.
4. Acquire knowledge in fundamentals of television, Monochrome TV transmitter and receiver, Camera tubes and colour TV display tubes, Colour TV systems and advanced colour TV systems.
5. Compare different display tubes and various colour TV systems.

CO-PO-PSO Mapping:

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

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

TEXT BOOKS:

1. 1. R.R. Gulati-Modern Television Practice - Principles, Technology and Service - New Age International Publication, 2009.
2. R.R. Gulati-Monochrome and Colour TV - New Age International Publication, 2002.

REFERENCE BOOKS / WEBLINKS :

6. S. P.Bali - Colour Television Theory and Practice - TMH, 1994
7. A.M. Dhake - Television and Video Engineering - 2nd Edition - 16th Reprint-2006.
8. http://nptel.iitm.ac.in/
9. http://jwfiles.net/files/6/f0bsb8og8vy3yq/Tv-Lectures_JWFILES.pdf
10. http://jwfiles.net/fiu1pa6wkw84/Tv-L...FILES.pdf.html.

Course Title	**BIOLOGY FOR ENGINEERS**						
Course Code	**22BITT407**						
Category	Basic Science Course (BSC)						
Scheme and Credits	No of Hours/Week					Total Teaching Hours	Credits
	L	T	P	SS	Total		
	02	00	00	00	02	26	2
CIE Marks:50	**SEE Marks:50**		**Total Max.marks=100**		**Duration of SEE:02 Hours**		

COURSE OBJECTIVES:

1. To convey that Biology is as important a scientific discipline as Physics, Chemistry and Mathematics.
2. To know about the classification underlying criteria of biology, such as morphology, biochemical, or ecological.
3. To study Genetics, Bio-molecules, Enzymes and Metabolism.
4. To understanding the macro molecular analysis.
5. To learn microbiology and its industrial applications.

UNIT No	**Syllabus Content**	**No of Hours**

1	**Introduction:** Science and Engineering, Biology and its application. Cell: The Basic Unit of Life , Cell theory, Cell shapes, structure of a Cell, prokaryotic and eukaryotic Cells. **Classification:** Brief introduction to five kingdoms of classification.	**5**
2	**Bio-molecules:** Carbohydrates, Amino acids and Proteins, Lipids- classification , functions. **Enzymes:** Enzymes, properties and classification. Mechanism of enzyme action. Enzymes and their application in Industry.	**5**
3	**Genetics:** Mendelian Law, Laws of inheritance. gene interaction, genetic disorders. **Information transfer**: Nucleic acid, replication of DNA, types of RNA,transcription, genetic code.	**6**
4	**Metabolism** - Concepts, metabolic basis for living, non-equilibrium and steaty state. Photosynthesis ,glycolysis ,fermentation and Krebs cycle.	**5**
5	**Microbiology** – Microorganism, growth kinetics, culture media, microscopy, applications of microbiology, immunology and immunity.	**5**

COURSE OUTCOMES: On successful completion of this course, the students will be able to:

CO1: **Define** the cells, its structure and functions. And different types of cells , basis for classification
CO2: **Explain** about genetics, bio-molecules, its structure and function. And their role in a living organism
CO3: **Determine** the concept of enzymes and macro molecules for applications.
CO4: **Interpret** about the genes and genetic materials (DNA & RNA) present in living organisms and how they replicate, transfer & preserve vital information in living organisms.
CO5: **Illustrate** about the metabolism and microbiology applications.

Mapping of COs with POs

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

CO2	1		1			1								1
CO3	1		1			1							1	1	1
CO4	1		1			1							2	3	2
CO5	1		1			1							1	2	1
Strength of Correlation: Low-1, Medium-2, High-3															

TEXT BOOK:

1. **Biology for Engineers,** Wiley Precise Textbook series, 1st Edition.
2. **Biology for Engineers**, T Johnson, CRC press, 2011 Molecular Biology and Biotechnology 2nd Edition. J.M. Walker and E.B. Gingold. Panima Publications.
3. Biology: A global approach, N. A. Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman**,** Pearson Education Ltd, 2018.

REFERENCE BOOKS:

1. **Molecular Biology,** G. Padmanabhan, K. SivaramSastry, C. Subramanyam, 1995, Mac Millan Publications.
2. **Biochemistry of Nucleic acids.**1992. 11th edition R.L.P. Adams, J. T. Knowlers, D. P. Leader, Chapman and Hall Publications.
3. **Genetic Engineering** –SandhyaMitra.
4. **Cell and Molecular biology**. De Robertis EDP & EMF De Robertis. 2001. Lippincott Williams &Wilkins.Bombay.

Course Title	**Embedded C Basics**						
Course Code	**22EEL4061**						
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 : 01 Hours**	

<u>Course Objectives</u> :

Course objectives:

1. Understand the basic programming of Microprocessor and microcontroller.
2. To develop the microcontroller-based programs for various applications.

Sl.No	Experiments
	Conduct the following experiments by writing C Program using Keil microvision simulator (any 8051 microcontroller can be chosen as the target).
1.	Write a 8051 C program to multiply two 16 bit binary numbers.
2.	Write a 8051 C program to find the sum of first 10 integer numbers.
3.	Write a 8051 C program to find factorial of a given number.
4.	Write a 8051 C program to add an array of 16 bit numbers and store the 32 bit result in internal RAM
5.	Write a 8051 C program to find the square of a number (1 to 10) using look-up table.
6.	Write a 8051 C program to find the largest/smallest number in an array of 32 numbers
7.	Write a 8051 C program to arrange a series of 32 bit numbers in

	ascending/descending order.
8.	Write a 8051 C program to count the number of ones and zeros in two consecutive memory locations.
Demo Programs	
9.	Write a 8051 C program to scan a series of 32 bit numbers to find how many are negative.
10.	Write a 8051 C program to display "Hello World" message (either in simulation mode or interface an LCD display).
11.	Write a 8051 C program to convert the hexadecimal data 0xCFh to decimal and display the digits on ports P0, P1 and P2 (port window in simulator).

Course Outcomes :

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

1. Write C programs in 8051 for solving simple problems that manipulate input data using different instructions of 8051 C.
2. Develop testing and experimental procedures on 8051 Microcontroller, analyze their operationunder different cases.
3. Develop programs for 8051 Microcontroller to implement real world problems.
4. Design and Develop Mini projects

CO-PO-PSO Mapping :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3					2			1	2			1	2
CO2	3	3		2				2				2			
CO3			3	2			3				3				3
CO4			3	2					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. "The 8051 Microcontroller: Hardware, Software and Applications", V Udayashankara and M S Mallikarjuna Swamy, McGraw Hill Education, 1st edition, 2017.

Course Title	**Octave / Scilab for Signals**						
Course Code	**22ETL4062**						
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 : 01 Hours**	

Course Objectives:

1. Preparation: To prepare students with fundamental knowledge/ overview in the field of signal processing.
2. Core Competence: To equip students with a basic foundation in electronic engineering and mathematics fundamentals required for comprehending the operation and application of signal processing.
3. Professionalism & Learning Environment: To inculcate in students an ethical and professional attitude by providing an academic environment inclusive of effective communication, teamwork, ability to relate engineering issues to a broader social context, and life-long learning needed for a successful professional career.

Sl No	Experiments
1	Verify the Sampling theorem.
2	Determine linear convolution, Circular convolution and Correlation of two given sequences. Verify the result using theoretical computations.
3	Determine the linear convolution of two given point sequences using FFT algorithm. Verify the result using theoretical computations
4	Determine the correlation using FFT algorithm. Verify the result using theoretical computations
5	Determine the spectrum of the given sequence using FFT. Verify the result using

	theoretical computations
6	Design and test FIR filter using Windowing method (Hamming, Hanning and Rectangular window) for the given order and cut-off frequency
7	Design and test IIR Butterworth 1st and 2nd order low & high pass filter.
8	Design and test IIR Chebyshev 1st and 2nd order low & high pass filter.
9	Generation of an AM – Suppressed Carrier Wave & visualization of the time domain and frequency domain plots.
10	Generation and visualization of standard test signals (both continuous and discrete time)
11	Generation and visualization of audio signal (pre-recorded) and generation of echo.
12	Generation and visualization of the STFT of a chirp (and other related) signal.

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

CO1 : Demonstrate the DSP concepts using Scilab/Octave
CO2 : Design and verify the characteristics of digital filters using Scilab/Octave.
CO3 : Apply FFT algorithm to compute the response of the system using Scilab/Octave.
CO4 : Generate and study different signals using Scilab/Octave.
CO5 : Demonstrate and visualize different real world signals using Scilab/Octave programs.

CO-PO-PSO Mapping:

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

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High)

Suggested Learning Resources:

1. Digital Signal Processing Using MATLAB, John G Proakis and Vinay K Ingle, Cengage Learning, 2011.

Course Title	**C++ Basics**						
Course Code	**22EEL4063**						
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 : 01 Hours**	

Course objectives:

1. Understand object-oriented programming concepts, and apply them in solving problems.
2. To create, debug and run simple C++ programs.
3. Introduce the concepts of functions, friend functions, inheritance and polymorphism.
4. Introduce the concepts of exception handling.

Sl. No.	**Programs**
1	Write a C++ program to find largest & smallest of three numbers using inline functions Max & Min.
2	Write a C++ program to calculate the volume of different geometric shapes like cube,

	cylinder and sphere using function overloading concept.
3	Define a STUDENT class with USN, Name & Marks in 3 tests of a subject. Declare an array of 10 STUDENT objects. Using appropriate functions, find the average of the two better marks for each student. Print the USN, Name & the average marks of all the students.
4	Write a C++ program to create class called MATRIX using two-dimensional array of integers, by overloading the operator == which checks the compatibility of two matrices to be added and subtracted. Perform the addition and subtraction by overloading + and – operators respectively. Display the results by overloading the operator <<. If (m1 == m2) then m3 = m1+ m2 and m4 = m1 – m2 else display error.
5	Demonstrate simple inheritance concept by creating a base class FATHER with data members: *First Name, Surname, DOB & bank Balance* and creating a derived class SON, which inherits: Surname & Bank Balance feature from base class but provides its own feature: First Name & DOB. Create & initialize F1 & S1 objects with appropriate constructors & display the FATHER & SON details.
6	Write a C++ program to exercise static members & static class.
7	Write a C++ program to accept the student detail such as name & 3 different marks by get_data() method & display the name & average of marks using display() method. Define a friend function for calculating the average marks using the method mark_avg().
8	Write a C++ program to explain virtual function (Polymorphism) by creating a base class polygon which has virtual function areas two classes rectangle & triangle derived from polygon & they have area to calculate & return the area of rectangle & triangle respectively.
9	Design, develop and execute a program in C++ based on the following requirements: An EMPLOYEE class containing data members & members functions: i) Data members: employee number (an integer), Employee_ Name (a string of characters), Basic_ Salary (in integer), All_Allowances (an integer), Net_Salary (an integer). (ii) Member functions: To read the data ofan employee, to calculate Net_Salary & to print the values of all the data members. (All_Allowances= 123% of Basic, Income Tax (IT) =30% of gross salary (=basic_ Salary_All_Allowances_IT).
10	Write a C++ program with different class related through multiple inheritance & demonstrate the use of different access specifier by means of members variables & members functions.
11	Write a C++ program to create three objects for a class named count object with data members such as roll_no & Name. Create a members function set_data ( ) for setting the data values & display ( ) member function to display which object has invoked it using "this" pointer.
12	Write a C++ program to implement exception handling with minimum 5 exceptions classes including two built in exceptions.

Course Outcomes (**Course Skill Set):**

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

1. Develop C++ program to solve simple and complex problems
2. Apply and implement object-oriented concepts like message passing, function overloading,

operator overloading and inheritance to solve real-world problems.
3. Implement features such as friend function/class & exception handling to develop C++ Programs.
4. Analyze, design and develop solutions to real-world problems applying OOP concepts of C++.

CO-PO-PSO Mapping:

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

Learning Resources:

1. Object oriented programming in TURBO C++, Robert Lafore, Galgotia Publications, 2002.
2. The Complete Reference C++, Herbert Schildt, 4th Edition, Tata McGraw Hill, 2003.
3. Object Oriented Programming with C++, E Balaguruswamy, 4th Edition, Tata McGraw Hill.

Course Title	**ELECTRONIC DEVICES & CIRCUITS LABORATORY using LABview**						
Course Code	**22EEL4064**						
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 : 01 Hours**	

Course objectives:

1. Design and demonstrate the diode circuits and transistor amplifiers.
2. Explain various BJT parameters, connections and configurations.
3. Explain various types of FET biasing and demonstrate the use of FET amplifiers.
4. Analyze Power amplifier circuits in different modes of operation.
5. Construct Feedback and Oscillator circuits using FET.

Every experiment has to be designed, circuit to be drawn / constructed and executed in the specified software. Results are also to be noted and inferred.

Experiments using LabVIEW

Study of LabVIEW

1. P-N Junction Diode Characteristics (Forward & Reverse bias)
2. Zener Diode Characteristics (V-I Characteristics)
3. BJT Input & Output characteristics (CE configuration)
4. FET Drain (output) & Transfer Characteristics (CS configuration)
5. Clipper operation: positive, negative biased clippers.
6. Clamper operation: positive, negative biased clampers.
7. SCR Characteristics using Multisim/LabVIEW
8. UJT Characteristics using Multisim/LabVIEW
9. BJT- CE Amplifier using Multisim/LabVIEW
10. BJT-CC Amplifier using Multisim/LabVIEW
11. Half Wave Rectifier using Multisim/LabVIEW

12. Full Wave Rectifier using Multisim/LabVIEW

CO-PO-PSO Mapping:

	PO1	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*	*PO12*	*PSO1*	*PSO2*	*PSO3*
CO1	3	3	2	2	3	1	-	-	2	1	1	1	3	2	2
CO2	3	3	2	2	3	1	-	-	2	1	1	1	3	2	2
CO3	3	3	3	2	3	1	-	-	2	1	1	1	3	2	2
CO4	3	3	3	2	3	1	-	-	2	1	1	1	3	2	2
CO5	3	3	2	2	3	1	-	-	2	1	1	1	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	**Communication Systems II**						
Course Code	**21ETT501**						
Category	Professional Core Course (PCC)						
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. 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
1	**Waveform Coding Techniques:** Introduction, Quantization noise and SNR, types of quantization, Adaptive Delta modulation, applications & Problems	07
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.	09
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.	09
4	**Information Theory:** Introduction, Measure of Information, Information Content of a Message, Average Information Content(Entropy) of Symbols in Long Independent Sequences, Average Information Content of Symbols in Long Dependent Sequences,	07

	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
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 : 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 :

	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. 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	**Computer Communication Networks**						
Course Code	21ETT502						
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 &	8

	Traffic Shaping- Leaky Bucket & Token Bucket.	

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**

Sub Title : SATELLITE COMMUNICATION		
Sub Code:21ETT503	**No. of Credits : 3=3:0:0 (L-T-P)**	**No. of lecture hours/week : 3**
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

<u>Note :</u> Three assignments are evaluated for 5 marks: Assignment – 1 from units 1 and 2. Assignment - 2 from units 3 and 4 , Assignment – 3 from unit 5.

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.

Cos	Mapping with Pos
CO1	PO1,PO2,PO5,PO6
CO2	PO1,PO2,PO5,PO8
CO3	PO1,PO4,PO5,PO6
CO4	PO1,PO2,PO6,PO8
CO5	PO2,PO5,PO6,PO9

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

Course Title	**MICROWAVE ENGINEERING & ANTENNA THEORY**						
Course Code	**21ETT504**						
Category	Professional Core Course (IPCC)						
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: This course will enable students to:

1. understand basics of microwave communication, concepts and frequencies
2. Analysis of microwave devices-S-Matrix representation and working principle of passive and active devices.
3. Understand the basic concepts of antenna theory.
4. Analyze the Array of point sources and evaluation of fields
5. Identify antenna types for specific applications.

UNIT	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, relevant problems. (Text-1) (L1, L2, L3)	6
2	**Microwave Devices : Passive Devices**-Introduction, Working principle and S-Matrix representation of Microwave Tee Junctions, Directional couplers, Isolators and Circulators. **Solid State Devices :** Working principle of GUNN diode, IMPATT diode, BARITT Diode, PIN diode, Parametric amplifier. (Text-2) (L1, L2, L3)	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: 2.1-2.7, 2.9-2.11, 2.13).	
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. (Text 3: 5.1-5.6, 5.9, 5.13) **Electric Dipole:** Introduction, Short Electric dipole, Fields of a short dipole. Radiation resistance of a short dipole. Thin linear antenna (field analysis). (Text 3: 6.1-6.5)	

5.	**Loop and Horn antenna:** Introduction: Small loop, Comparison of far fields of small loops and Short dipole. Radiation resistance of small loop, Horn Antennas, Rectangular antennas. (Text 3: 7.1,7.2, 7.3,7.7,7.19, 7.20) **Antenna Types:** The Helix geometry, Helix modes, Practical design consideration for mono-filar axial mode Helical Antenna, Parabolic Reflector, The paraboloidal Reflector (Text 3: 8.3, 8.4, 8.5, 8.8, 9.5, 9.7)	

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 in building the RF system.
CO5: Identify various antenna configurations for suitable applications.

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 Devices and circuits- Liao / Pearson Education.
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&RADAREngineering – M.Kulkarni, Umesh Publications,2001,reprint
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	**Communication Systems Lab II**						
Course Code	**21ETL505**						
Category	Professional Core Course Lab (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. 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.

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			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

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.

Course Title	**IoT LAB**						
Course Code	**21ETT5081**						
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. 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	**ANTENNA AND DESIGN TESTING**						
Course Code	**21ETT5082**						
Category	Ability Enhancement Course (EBC)						
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 a broadside array using MATLAB.
10	Design and implementation of an endfire array using MATLAB.
Demonstration Experiments (For CIE)	
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	**21ETT5082**						
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	**Microwave Lab**						
Course Code	**21ETT5084**						
Category	Ability Enhancement Course Lab (AEC Lab)						
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. To provide practical exposure to microwave components & bench set-ups.
2. To enhance practicle knowledge and to analyse working principles of various microwave components.

Sl. No.	Experiment Content
	Introduction to Microwave communication frequencies , bench-setups for various experiments.
1	Study of Gunn Diode characteristics.
2	Study of operation of Klystron oscillator with plot of Mode curves.
3	Measurement of impedance using slotted line Assembly.
4	Calibration of Variable waveguide attenuator.
5	Study and verify working principles of Circulator/Isolator.
6	Study and verify working principle of Directional coupler. Extraction of S-parameter.
7	Study and verify working principle of E-plane Tee. Determination of S- parameter.
8	Study and verify working principle of H-plane Tee. Determination of S- parameter.
9	Study and verify working principle of Magic Tee. Determination of S- parameter.
10	Measurement of phase shift for a ferrite phase shifter.

Course Outcomes (Course Skill Set):

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

CO1 : Understand the operation and organization of microwave bench set-up.

CO2: Operate microwave sources-GUNN and Klystron Oscillator.

CO3: Verify working principles of various microwave components.

CO4: Determine S-parameters of microwave passive devices.

CO-PO-PSO Mapping:

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

TEXT BOOKS:

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

2. Microwave Devices and Circuits- Liao / Pearson Education.

3.Microwave&RADAR Engineering – M.Kulkarni, Umesh Publications,2001,Reprint

Course Title	**Communication Systems II**						
Course Code	**21ETT501**						
Category	Professional Core Course (PCC)						
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 :

7. Understand the concept of signal processing of digital data and signal conversion to symbols at the transmitter and receiver.
8. Compute performance metrics and parameters for symbol processing and recovery in ideal and corrupted channel conditions.
9. Understand the principles of spread spectrum communications.
10. Understand the basic principles of information theory and various source coding techniques.
11. Build a comprehensive knowledge about various Source and Channel Coding techniques.
12.

UNIT No	Syllabus Content	No. of Teaching Hours
1	**Waveform Coding Techniques:** Introduction, Quantization noise and SNR, types of quantization, Adaptive Delta modulation, applications & Problems	07
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.	09
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.	09
4	**Information Theory:** Introduction, Measure of Information, Information Content of a Message, Average Information Content(Entropy) of Symbols in Long Independent Sequences, Average Information Content of Symbols in Long Dependent Sequences,	07

	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
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 : 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 :

	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:

2. 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	**Communication Systems Lab II**						
Course Code	**21ETL505**						
Category	Professional Core Course Lab (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

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

Sl. No.	Experiment Content
1	ASK generation and detection.
2	FSK generation and detection.
3	BPSK generation and detection.

4	QPSK generation and detection.
5	DPSK generation and detection.
6	Pulse Code modulation .
7	Write a program to find the entropy of information source generating independent message sequences.
8	Write a program to encode binary data using Shannon's theorem.
9	Write a program to encode binary data using Huffman code.
10	Write a 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.

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			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

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.

Course Title	**Computer Communication Network**						
Course Code	21ETT502						
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:

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

UNIT	Syllabus Content	No. of Teaching Hours
1	Layered tasks: OSI Model, Layers in OSI model, TCP/IP Suite, Addressing. Circuit switched Networks, Datagram Networks, Virtual-Circuit Networks.	8
2	Data Link Control : Cyclic codes: CRC Encoder & Decoder. Framing, Flow & Error Control, 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 and 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 protocols: User Datagram protocol: User Datagram, UDP operation, UDP Applications. Transmission Control Protocol: TCP Services, TCP Features, Segment.	8

	Congestion Control & QOS: Congestion Control. Scheduling & Traffic Shaping- Leaky Bucket & Token Bucket.	

PRACTICAL COMPONENT OF IPCC	
Sl No.	**III. 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.
IV.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: Explain 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: Explain different Ethernet standards of Wired and Wireless LANs.
CO4: Implement routing in network layer using different algorithms and analyze IPV4 and IPV6 formats and transitions.
CO5: Acquire the knowledge of UDP and TCP Protocols in Transport Layer

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:

2. **Data Communication and Networking,** B Forouzan, 4th Ed, TMH , 2006.

REFERENCE BOOKS / WEBLINKS :

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

Sub Title : SATELLITE COMMUNICATION		
Sub Code:21ETT503	**No. of Credits : 3=3:0:0 (L-T-P)**	**No. of lecture hours/week : 3**
Exam Duration : 3 hours	**CIE + SEE = 50 + 50 =100**	**Total No. of Contact Hours : 39**

Course Objectives:

After completing the course, the students should:

6. Analyse the different orbits and orbital parameters.
7. Understand antenna look angles and eclipse.
8. Understand different link budget analysis.
9. Understand various subsystems and controls.
10. 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

Note : Three assignments are evaluated for 5 marks: Assignment – 1 from units 1 and 2. Assignment - 2 from units 3 and 4 , Assignment – 3 from unit 5.

Course Outcomes:

6. Analyze different types of orbits and orbital parameters.

7. To calculate look angle for a satellite .
8. Compute different types of losses in satellite communication.
9. Able to analyze different subsystems
10. Have knowledge of earth segment.

Cos	Mapping with Pos
CO1	PO1,PO2,PO5,PO6
CO2	PO1,PO2,PO5,PO8
CO3	PO1,PO4,PO5,PO6
CO4	PO1,PO2,PO6,PO8
CO5	PO2,PO5,PO6,PO9

TEXT BOOKS:

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

REFERENCE BOOKS/WEBLINKS:

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

Course Title	**MICROWAVE & ANTENNA ENGINEERING**						
Course Code	**21ETT504**						
Category	Professional Core Course (IPCC)						
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: This course will enable students to:

6. understand basics of microwave communication, concepts and frequencies
7. Analysis of microwave devices-S-Matrix representation and working principle of passive and active devices.
8. Understand the basic concepts of antenna theory.
9. Analyze the Array of point sources and evaluation of fields
10. Identify antenna types for specific applications.

UNIT	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, relevant problems. (Text-1) (L1, L2, L3)	6
2	**Microwave Devices : Passive Devices**-Introduction, Working principle and S-Matrix representation of Microwave Tee Junctions, Directional couplers, Isolators and Circulators. **Solid State Devices :** Working principle of GUNN diode, IMPATT diode, BARITT Diode, PIN diode, Parametric amplifier. (Text-2) (L1, L2, L3)	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: 2.1-2.7, 2.9-2.11, 2.13).	
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. (Text 3: 5.1-5.6, 5.9, 5.13) **Electric Dipole:** Introduction, Short Electric dipole, Fields of a short dipole. Radiation resistance of a short dipole. Thin linear antenna (field analysis). (Text 3: 6.1-6.5)	

5.	**Loop and Horn antenna:** Introduction: Small loop, Comparison of far fields of small loops and Short dipole. Radiation resistance of small loop, Horn Antennas, Rectangular antennas. (Text 3: 7.1,7.2, 7.3,7.7,7.19, 7.20) **Antenna Types:** The Helix geometry, Helix modes, Practical design consideration for mono-filar axial mode Helical Antenna, Parabolic Reflector, The paraboloidal Reflector (Text 3: 8.3, 8.4, 8.5, 8.8, 9.5, 9.7)	

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 in building the RF system.
CO5: Identify various antenna configurations for suitable applications.

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 Devices and circuits- Liao / Pearson Education.
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&RADAREngineering – M.Kulkarni, Umesh Publications,2001,reprint
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	**Embedded System Design & ARM Processor**						
Course Code	**21ETT602**						
Category	IPCC						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	3	0	2	0	5	52	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
1	**Typical Embedded System:** Definition, Embedded systems vs. General Computing Systems, Core of the Embedded System, Memory, Sensors and Actuators, Communication Interface, Embedded Firmware, Other System Components, PCB and Passive Components.	11
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.	10
3	**ARM-32bit Microcontroller:** ARM Cortex-M3 Processor-Introduction, Overview of the Cortex-M3, Cortex-M3 Basics, Instruction Sets.	10
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, Device Drivers, How to choose an RTOS.	10

5.	**Trends in the Embedded Industry:** Processor trends in embedded system, Embedded OS trends, Development Language Trends, Open Standards, Frameworks and Alliances, Bottlenecks. **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.	11

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
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 Weily, 2008

Course Title	**Embedded System Design & ARM Processor**						
Course Code	**21ETT602**						
Category	IPCC						
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

5. Develop the embedded C level programming of ARM Cortex M3 Processor
6. Understand Interfacing of different modules to LPC1768 MCU

Sl. No.	Experiment Content
1	Write a C program to Output the message using UART of LPC1768.
2	Write a C Program to interface LED using LPC 1768.
3	Write a C Program to interface Relay using LPC 1768.
4	Write a C Program for Stepper motor rotation using LPC 1768.
5	Write a C Program for DC motor rotation using LPC 1768.
6	Write a C program to interface a Real Time Clock (RTC) of LPC 1768.
7	Write a program to read on-chip ADC value and display it on UART terminal using LPC 1768.
8	.Write a C programs to interface a DAC of LPC 1768.
9	Write a C program to demonstrate the use of an External interrupt in

	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 YIu," The Definite Guide to the ARM Cortex M3" ,Second Edition,Newnes,2008

Course Title	**Wireless and Cellular Communication**						
Course Code	**21ETT603**						
Category	Professional Core Course (PCC)						
Scheme and Credits	No. of Hours/Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	3	0	0	0	5	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. To provide good understanding of cellular communication, wireless channel issues and understanding of future cellular technology.
2. Understand the different propagation mechanisms of wireless signals.
3. Understand the concepts of different multiple access techniques used for wireless communication.
4. Explain the system architecture of LTE and E-UTRAN, the layer of LTE, based on the use of OFDMA and SC-FDMA principles.
5. Understand the basics of LTE standardization and Analyze the main factors affecting LTE performance including mobile speed and transmission bandwidth.

UNIT	Syllabus Content	No. of Teaching Hours
1	**Mobile Radio Propagation -** Large Scale Path Loss - Free Space Propagation Model, Relating Power to Electric Field, Three Basic Propagation Mechanisms -Reflection (Ground Reflection), Diffraction, Scattering. **Fading and Multipath -** Broadband wireless channel, Delay Spread and Coherence Bandwidth, Doppler Spread and Coherence Time, Angular spread and Coherence Distance (text 1-2.4) Statistical Channel Model of a Broadband Fading Channel **The Cellular Concept -** Cellular Concept , Analysis of Cellular Systems, Sectoring	8
2	**GSM and TDMA Technology** **GSM System overview-** Introduction, GSM Network and System Architecture, GSM Channel Concept. **GSM System Operations-** GSM Identities, System Operations-Traffic cases, GSM Infrastructure Communications (UM Interface)	7
3	**CDMA Technology** **CDMA System Overview -** Introduction, CDMA Network and System Architecture **CDMA Basics-**CDMA Channel Concepts, CDMA System (Layer 3) operations, 3GCDMA	8

4	**LTE-4G** **Key Enablers for LTE 4G-** OFDM, SC-FDE, SC-FDMA, Channel Dependent Multiuser Resource Scheduling, Multi-Antenna Techniques, Flat IP Architecture, LTE Network Architecture. **Multi-Carrier Modulation** - Multicarrier concepts, OFDM Basics, OFDM in LTE, Timing and Frequency Synchronization, Peak to Average Ratio.	8
5.	**LTE - 4G** **OFDMA and SC-FDMA** - Multiple Access for OFDM Systems, OFDMA, SCFDMA, Multiuser Diversity, OFDMA and SC-FDMA in LTE, OFDMA system Design Considerations. **The LTE Standard-** Introduction to LTE and Hierarchical Channel Structure of LTE, Downlink OFDMA Radio Resources, Uplink SC-FDMA Radio Resources.	8

Course Outcomes :

CO1- Understand the Communication theory both Physical and networking associated with GSM, CDMA& LTE 4G systems.

CO2- Explain concepts of propagation mechanisms like Reflection, Diffraction, Scattering in wireless channels.

CO3- Develop a scheme for idle mode, call set up, call progress handling and call tear down in a GSM cellular network.

CO4- Develop a scheme for idle mode, call set up, call progress handling and call tear down in a CDMA cellular network.

CO5- Understand the Basic operations of Air interface in a LTE 4G system.

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. "Fundamentals of LTE"Arunabha Ghosh, Jan Zhang, JeffereyAndrews, Riaz Mohammed, Pearson education (Formerly Prentice Hall, Communications Engg and Emerging Technologies), ISBN-13: 978-0-13- 703311-9.
2. "Introduction to Wireless Telecommunications Systems andNetworks", Gary Mullet, First Edition, Cengage Learning India Pvt Ltd., 2006, ISBN -13: 978-81-315-0559-5.

REFERENCE BOOKS / WEBLINKS :

1. "Wireless Communications: Principles and Practice" Theodore Rappaport, 2nd edition, Prentice Hall Communications Engineering and Emerging Technologies Series, 2002, ISBN 0-13-042232-0.
2. LTE for UMTS Evolution to LTE-Advanced' Harri Holma and Antti Toskala, Second Edition - 2011, John Wiley & Sons, Ltd. Print ISBN: 9780470660003.2.

Course Title	**Wireless and Cellular Communication Lab**						
Course Code	**21ETL603**						
Category	Professional Core Course Lab (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:

1. To provide practical exposure to design, setting up, execute and analyze Baseband communication and CDMA Techniques.
2. To gain the knowledge and practical exposure to propagation models and LTE Systems.

Sl. No.	Experiment Content
Study of wireless Communications using Communication Trainer Kits	
1	Baseband Communication
2	Code Division Multiple Access (CDMA) - Multipath
3	Code Division Multiple Access (CDMA) – Multiuser
4	Global System for Mobile Communication (GSM) (Using WiCOMM-T - Wireless Digital Communication Training system – SDR Platform)
5	Spread Spectrum – DSSS Modulation & Demodulation (Using Emona 101 Tranier Kit)
Wireless Path loss Computations - Study of Propagation Path loss Models : Indoor & Outdoor(Using MATLAB Programming)	
6	Free Space Propagation – Path Loss Model
7	Outdoor Propagation – Okumura Model
Antenna Design Concept (using Trainer Kit)	
8	Dipole & Yagi – Uda Antennas
9	Study of 4G LTE & IMS Wireless Network Simulation
10	LTE simulation using NS3

Course outcomes (Course Skill Set):

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

CO1 : Design and testing of CDMA basics and spread spectrum techniques using kit/ MATLab.

CO2: Design and modelling of Indoor and Outdoor propagation models.

CO3: Understand the concept of Antennas and learn using antenna.

CO4: Understand the Basic operations of Air interface in a LTE 4G system and to verify using simulator.

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)

Suggested Learning Resources:

1. "Wireless Communications: Principles and Practice" Theodore Rappaport, 2nd edition, Prentice Hall Communications Engineering and Emerging Technologies Series, 2002, ISBN 0-13-042232-0.
2. LTE for UMTS Evolution to LTE-Advanced' Harri Holma and Antti Toskala, Second Edition - 2011, John Wiley & Sons, Ltd. Print ISBN: 9780470660003.2.
3. Principles of Mobile Communication Second Edition by Gordon L. Stüber Georgia Institute of Technology Atlanta, Georgia USA, Kluwer Academic Publishers.

Course Title	**Artificial Intelligence**						
Course Code	21ETT6041						
Category	Professional elective (PE)						
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: This course will enable students to:

1. Gain a historical perspective of AI and its foundations.
2. Become familiar with basic principles of AI toward problem solving
3. Get to know approaches of inference, perception, knowledge representation, and learning.

UNIT	Syllabus Content	No. of Teaching Hours
1	**Introduction to AI**: history, Intelligent systems, foundation and sub area of AI , applications, current trend and development of AI. **Problem solving**: state space search and control strategies. **Chapter 1 and 2**	7
2	**Problem reduction and Game playing :** Problem reduction, game playing, Bounded look-ahead strategy, alpha-beta pruning, Two player perfect information games **Chapter 3**	8
3	**Logic concepts and logic Programming: propositional calculus, Propositional logic, natural deduction system, semantic tableau system, resolution refutation, predicate logic, Logic programming.** **Chapter 4**	8
4	**Advanced problem solving paradigm: Planning:** types of planning sytem, block world problem, logic based planning, Linear planning using a goal stack, Means-ends analysis, Non linear planning strategies, learning plans **Chapter 6.**	8

5.	**Knowledge Representation , Expert system** Approaches to knowledge representation, knowledge representation using semantic network, extended semantic networks for KR, Knowledge representation using Frames. Expert system: introduction phases, architecture ES verses Traditional system **Chapter 7 and 8 (8.1 to 8.4)**	8

Course Outcomes :

CO1: Apply the knowledge of Artificial Intelligence to write simple algorithm for agents.
CO2: Apply the AI knowledge to solve problem on search algorithm.
CO3: Develop knowledge base sentences using propositional logic and first order logic.
CO4: Apply first order logic to solve knowledge engineering process.

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
CO2	3	3											2	2	2
CO3	3	3											2	2	2
CO4	3	3											2	2	2
CO5	3	3											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: Saroj Kaushik, Artificial Intelligence, Cengage learning, 2014
Reference Books:
1. Elaine Rich, Kevin Knight, Artificial Intelligence, Tata McGraw Hill
2. Nils J. Nilsson, Principles of Artificial Intelligence, Elsevier, 1980
3. StaurtRussel, Peter Norvig, Artificial Intelligence: A Modern Approach, Pearson Education, 3rd Edition,
2009
4. George F Lugar, Artificial Intelligence Structure and strategies for complex, Pearson Education, 5th
Edition, 2011

Course Title	**Cryptography**						
Course Code	21ETT6042						
Category	Professional elective (PE)						
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 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 Modesof 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.

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, Evaluation Criteria for Advanced Encryption Standard, The AES Cipher (In brief).	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 SignatureAlgorithm. **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, .	08

	Firewalls: Firewalls Design Principles, firewall characteristics, types of firewalls, firewall configurations, Trusted Systems, data access control, concept of trusted systems.	

Note :

1. In Unit 5 is identified for blended learning.
2. Students submit three assignments covering five units with higher level questions.

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.

CO-PO-PSO Mapping:

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

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/

Course Title	**Multimedia Communication**						
Course Code	21ETT6043						
Category	Professional Elective(PE)						
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.	08

5	**MULTIMEDIA INFORMATION NETWORKS:** Introduction, LANS, Ethernet, Token Ring, Bridges, FDDI High- Speed LANS, LAN Protocol	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

Fundamentals of Multimedia – Ze-Nian Li, Mark S Drew, and Jiangchuan Liu.

1.

Course Title	**RADAR ENGINEERING**						
Course Code	21ETT6044						
Category	Professional Elective (PE)						
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 become familiar with fundamentals of RADAR.
2. To gain knowledge in depth knowledge about the different types of RADAR and their operations
3. Understanding the signal detection in RADAR and various detection techniques.
4. To become familiar with RADAR navigation techniques.
5. To become familiar with satellite navigation and hybrid navigation.

UNIT	Syllabus Content	No. of Teaching Hours
1	**Basics of Radar:**Introduction, Maximum Unambiguous Range, Radar Waveforms, Definitions with respect topulse 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.	8
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.	8
3	**MTI and Pulse Doppler Radar:**Introduction, Principle, Doppler Frequency Shift, Simple CW Radar, Sweepto Sweep subtraction and Delay Line Canceler, MI1 Radar with- Power Amplifier Transmitter, Delay Line Cancelers Frequency Response of Single Delay- Line Canceller, Blind Speeds, Clutter Attenuation, MI1 Improvement Factor, N- Pulse Delay-Line Canceller, Digital MTI Processing-Blind phases, I and QChannels, Digital MTI Doppler signal processor, Moving Target Detector- Original MTD.	9

4	**Tracking Radar:**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 ofTrackers.	8
5.	Applications: Secondary surveillance, Ground Penetrating Radar, Multistatic, Over the Horizon, Radar Beacons(22.8)Remote sensing and Meteorological radars.	6

Course Outcomes :

1. Describe the radar fundamentals.
2. Analyze the radar signals.
3. To become familiar with working principle of pulse Doppler radars, their applications and limitations.
4. To become familiar various radar transmitters and receivers.
5. To become familiar with satellite navigation and hybrid navigation.

CO-PO-PSO Mapping:

	PO1	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*	*PO12*	*PSO1*	*PSO2*	*PSO3*
CO1	3	2	2	1	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	-	-	-	3	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	-	-	-	3	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. Introduction to Radar Systems- Merrill Skolink, 3e,TMH, 2001
2. Merrill I Skolnik, "Radar handbook", 3rd Edition, Mc Graw-Hill, 2008.

REFERENCES

1. M J B Scanlan, "Modern Radar Techniques", Macmillan publications, 1987.
2. Peyton Z Peebles, "Radar principles", 1st Edition, Wiley-Inter science, 2008.
3. Principles of Modem Radar: Basic Principles-Mark A. Rkhards, James A. Scheer,William.A. Holm.Yesdee, 2013.

Course Title	**Mobile Communication**						
Course Code	21ETT6051						
Category	Open elective (OE)						
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 speech coding and 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:** Histroy & Evolution of mobile radio communication, Different generation of WirelessCellular Networks 1G,2G, 3G ,4G & 5G. Examples of Wireless Communication System.**Cellular Concept:** Frequency reuse. Channel Assignment Stratergies, 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. **Digital modulation:** Overview , line coding, pulse shaping techniques, linear modulation techniques.	08
4	**Speech coding:** Characteristic, quantization, ADPCM, frequency domain coding	08

	of speech, vocoders, linear predictive coders. **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.	
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 ceular technology. (**Text 2**)	08

Note : Three assignments are evaluated for 5 marks: Assignment – 1 from units 1 and 2. Assignment - 2 from units 3 and 4 , Assignment – 3 from unit 5.

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 speech coding and 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
CO1	3	3			3	3							2	2	2
CO2	3	3			3			3					2	2	2
CO3	3			3	3	3							2	2	2
CO4	3	3				2		2					2	2	2
CO5	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: 2nd 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)

Course Title	WIRELESS SENSOR NETWORKS						
Course Code	**21ETT6052**						
Category	Open Elective (OE)						
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: This course will enable students to:

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 topology control in for Wireless Sensor Networks.
5. To study positioning of nodes in Wireless Sensor Networks
6. To study different platform and tools for Wireless Sensor Networks.

UNIT	Syllabus Content	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.	9
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.	9
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.	9
4	**INFRASTRUCTURE ESTABLISHMENT** Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control.	6
5.	**SENSOR NETWORK PLATFORMS AND TOOLS** Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node-level Simulators, State-centric programming.	6

Course Outcomes :

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. Studied topology,control , positioning of nodes,different platforms and tools for Wireless Sensor Networks.

CO-PO-PSO Mapping:

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

NOTE : Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) **2**: Moderate (Medium) **3**: Substantial (High1)

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, ZantiTaiev. "Wireless Sensor Networks", Spinger 1st Edition 2004.

REFERENCE BOOKS:

1. Anna Hac, "Wireless Sensor Network Designs", John Wiley, 2003.
2. KazemSohraby, Daniel Minoli, and TaiebZnati, "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 applications", Spingerverlag, 2007.

Course Title	**Basic of VLSI Design**						
Course Code	**21ETT6053**						
Category	OPEN elective (PE)						
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 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. **MOS TRANSISTOR THEORY:** Introduction, MOS Device Design Equations.	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. 4Transistor Dynamic Memory, One Transistor Dynamic Memory, 4 Transistor Dynamic & 6 Transistor Static, Memory elements. Memory cell arrays.	7

Course Outcomes:

1. An ability to apply to apply knowledge about basic MOS technology.
2. An ability to design and implement MOS transistor, layout and symbolic diagrams.
3. An ability to design architectural issues and basic circuit concepts.
4. An ability to identify scaling models and their limitations with subsystem process illustration.
5. 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	3		2	2			2					2	2	2
CO2	3	3	2	2		2							2	2	2
CO3		3	2	2		2							2	2	2
CO4	3	3		2	2								2	2	2
CO5		3	3	3	3					3			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. 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	**Embedded System Design & ARM Processor**						
Course Code	**21ETT6054**						
Category	OE						
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: 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, Communication Interface, Embedded Firmware, Other System Components, PCB and Passive Components.(L1,L2)	10
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.	7
3	**ARM-32bit Microcontroller:** ARM Cortex-M3 Processor-Introduction, Overview of the Cortex-M3, Cortex-M3 Basics, Instruction Sets. (L1,L2,L3)	7
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, Device Drivers, How to choose an RTOS.	8

5.	**Trends in the Embedded Industry:** Processor trends in embedded system, Embedded OS trends, Development Language Trends, Open Standards, Frameworks and Alliances, Bottlenecks. **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.	7

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
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 Weily, 2008

Sub Title : Microwave Engineering		
Sub Code: 18ET71	**No of Credits : 4=4:0:0 (L-T-P)**	**No of lecture hours/week : 4**
Exam Duration : 3 hours	**CIE + SEE = 50 + 50 =100**	**Total No of Contact Hours : 52**

Course Objectives :

1. To study the principle of working of microwave generators and applications.
2. To study the working of passive microwave devices and its applications.
3. To understand the working principle of various solid state microwave devices
4. To study the impact of microstrip lines.
5. To understand various principles of radars as an important microwave application.

UNIT No	Syllabus Content	No. of Hours Teaching
1	**Microwave Communication:** Introduction to microwave communication; frequency bands; Microwave sources- Klystrons, Travelling Wave Tubes, Magnetron Oscillator; Applications; Relevant problems.	12
2	**S-Matrix Representation of Microwave Passive Devices :** Introduction ;S-Matrix representation of multiport networks- Microwave Tee Junctions, Directional couplers; Waveguide bends, Corners, Twists , Phase-shifters, Microwave Attenuators , Isolators and Circulators; Relevant problems.	10
3	**Solid State Microwave Devices :** Introduction; Transfer Electron Devices: GUNN diode – GaAs Diode, Avalanche Transit Time Devices : IMPATT Diode, BARITT Diode. Other diodes : PIN diode , Crystal diode ; Relevant problems.	08
4	**Microwave Strip Lines :** Introduction to Microstrip Lines; Parallel strip lines; Coplanar strip-lines; Shielded strip-lines; Relevant problems.	10

5.	**Introduction to Radar**: Origins of Radar, Basic Radar, Simple form of Radar equation, Radar block diagram, Radar frequencies, Doppler and MTI Radar, Digital MTI Processing, Delay line cancellers, Moving Target detector (MTD); Relevant problems	12

Note: (1) Five assignments are evaluated for 5 marks: Assignment – 1 from units 1 , Assignment 2 from Unit 2, Assignment - 3 from units 3, Assignment 4 from Unit 4 and Assignment – 5 from unit 5.

(2) Unit 3 is identified for Blended learning

Course Outcomes :

1. To analyze microwave generators with numericals.
2. To analyze and represent S -matrix of various passive microwave devices.
3. To analyze the working principle of microwave solid state devices
4. To analyze the design of strip lines
5. To analyze various radars with numericals.

COs	**Mapping with Pos**
CO1	PO1,PO2,PO5,PO6
CO2	PO1,PO2,PO5,PO8
CO3	PO1,PO4,PO5,PO6
CO4	PO1,PO2,PO6, PO8
CO5	PO2,PO5,PO6,PO9

TEXT BOOKS:

1. Microwave Engineering-Annapurna Das, Sisir K Das, 2nd Ed., TMH Publication, 2010.
2. Microwave Devices and circuits- Liao, 3rd Ed., Pearson Education, 2009.
3. Introduction to Radar systems-Merrill L Skolnik, 3rd Ed., TMH, 2001.

REFERENCE BOOK:

1. Microwave & RADAR Engineering– M. Kulkarni, 2nd Ed., Umesh Publications, 2001.
2. Microwave Engineering–David M Pozar, 3rd Ed., John Wiley India Pvt. Ltd., 2008.
3. http://webee.technion.ac.il/people/schachter/Teaching/Microwaves%202011 -2012-locked.pdf

Sub Title: WIRELESS AND MOBILE NETWORKS		
Sub Code: 18ET72	**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.
5. To study WWANs, cellular networks, Satellite Network, Applications, ad-hoc networks, Sensor network.

UNIT No.	Syllabus Content	No. of Hours Teaching
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

Note: (1) Five assignments are evaluated for 5 marks: Assignment – 1 from units 1 , Assignment 2 from Unit 2, Assignment - 3 from units 3, Assignment 4 from Unit 4 and Assignment – 5 from unit 5.

(2) Unit 3 is identified for Blended learning

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.

CO5: Determine the applications of Wireless communication networks, Adhoc networks and Sensor Networks.

Cos	Mapping with POs
CO1	PO2, PO5
CO2	PO2, PO4,PO5
CO3	PO5
CO4	PO2,PO8
CO5	PO5

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.

Professional Elective -3

Sub Title : Optical Communication & Networks		
 **Sub Code: 18ET731**	**No of Credits : 3=3:0:0 (L-T-P)**	**No of lecture hours/week : 3**
Exam Duration : 3 hours	**CIE + SEE = 50 + 50 =100**	**Total No of Contact Hours : 39**

Course Objectives:

1. To understand the environment of optical communication and networks.
2. To study the components ,both active and passive required in the optical domain.
3. To study the design concepts of optical networks.
4. To study the requirements of WDM networks.
5. To understand the functions required for maintenance and control of optical networks.

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Unit No	Syllabus	No. of Teaching hours
1	**OVERVIEW OF OPTICAL FIBER COMMUNICATION:** Introduction, Historical development, general system, advantages, disadvantages, and applications of optical fiber communication, Ray theory, step index fibers, graded index fibers, single mode fiber, cutoff wave length, mode field diameter.	08
2	**TRANSMISSION CHARACTERISTICS OF OPTICAL FIBERS:** Introduction, Attenuation, material absorption characteristics in silica glass fibers ,linear scattering losses, non-linear scattering losses, fiber bend loss, dispersion, chromatic dispersion, Inter modal dispersion, overall fiber dispersion.	08
3	**OPTICAL SOURCES AND DETECTORS:** Introduction, LED's (4.2; 4.2.1;4.2.4), LASER diodes (4.3,4.3.4), Photo detectors (6.1-6.1.1,6.1.2), Photo detector noise (6.2-6.2.1,6.2.2) **ANALOG AND DIGITAL LINKS:** Analog Systems: – Introduction, Overview of analog links, CNR, RIN (9.2.3), Digital links – Introduction, point–to–point links, System considerations, link power budgets (8.1.2), rise-time budget (8.1.3)	08

4	**INTRODUCTION TO OPTICAL NETWORKS**: Telecommunication network architecture (1.1), Optical networks (1.3), Multiplexing techniques (1.3.1), Second-generation optical networks (1.3.2), The Optical Layer (1.4), Transperancy and All-optical networks (1.5), optical packet switching (1.6), Network Evolution (1.8 – 1.8.1 to 1.8.4), Non-linear effects (2.5) - SPM (2.5.5), CPM (2.5.7) , Four Wave Mixing (2.5.8)	08
5	**CONTROL AND MANAGEMENT :** Network management functions (8.1, - 8.1.1 to 8.1.3), Optical layer services and interfacing (8.2), Layers within the optical layer (8.3), Multivendor interoperability (8.4), Performance and fault management (8.5, - 8.5.1 to 8.5.4), Optical safety (8.7, - 8.7.1)	07

Note: Three assignments are evaluated for 5 marks: Assignment – 1 from units 1 and 2. Assignment - 2 from units 3 and 4 , Assignment – 3 from unit 5.

Unit 3: Blended learning

Course Outcomes:

1. To analyse the need for optical communication and networking.
2. To analyse the working principle of various components of optical networks.
3. To analyse the impact of design considerationsof optical networks.
4. To analyse the components required for WDM networks.
5. To analyse the maintenance and control functions required for optical networks.

Cos	Mapping with PO s
CO1	PO1,PO2, PO5, PO10
CO2	PO1, PO2, PO5, PO10
CO3	PO1, PO2, PO5, PO10
CO4	PO1, PO2, PO10
CO5	PO1, PO2, PO5, PO10

TEXT BOOKS:

1. **Optical Fiber Communications**– – John M. Senior, Pearson Education. 3rd Edition, 2010.
2. **Optical Fiber Communication** – Gerd Keiser, 4th Ed., MGH, 2008.
3 **Optical networks: A practical perspective Third Edition** – Rajiv Ramaswamy, Kumar N Sivarajan, Galen H. Sasaki ,Morgan Kauffman 1998 & 2010.
4. **Optical Communication Networks–** Biswajit Mukherjee TMG 1998.

REFERENCE BOOK:

1. **Fiber Optic communication** – Joseph C Palais: 4th Edition, Pearson Education
2. Optical networks – Ulysees Black, Pearson education 2007.

Sub Title : MOBILE COMMUNICATION		
Sub Code: 18ET732	**No. of Credits : 3=3:0:0 (L-T-P)**	**No. of lecture hours/week : 3**
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 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 speech coding and 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:** Histroy & Evolution of mobile radio communication, Different generation of WirelessCellular Networks 1G,2G, 3G ,4G & 5G. Examples of Wireless Communication System.**Cellular Concept:** Frequency reuse. Channel Assignment Stratergies, 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. **Digital modulation:** Overview , line coding, pulse shaping techniques, linear modulation techniques.	08
4	**Speech coding:** Characteristic, quantization, ADPCM, frequency domain coding	08

	of speech, vocoders, linear predictive coders. **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.	
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 ceular technology. (**Text 2**)	08

Note : Three assignments are evaluated for 5 marks: Assignment – 1 from units 1 and 2. Assignment - 2 from units 3 and 4 , Assignment – 3 from unit 5.

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 speech coding and GSM concepts for wireless communication.
5. Learn about 3G wireless technology

Cos	Mapping with Pos
CO1	PO1,PO2,PO5,PO6
CO2	PO1,PO2,PO5,PO8
CO3	PO1,PO4,PO5,PO6
CO4	PO1,PO2,PO6,PO8
CO5	PO2,PO5,PO6,PO9

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: 2nd 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)

Sub Title : ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING		
Sub Code: 18ET733	**No. of Credits : 3=3:0:0 (L-T-P)**	**No. of lecture hours/week : 3**
Exam Duration : 3 hours	**CIE + SEE = 50 + 50 =100**	**Total No. of Contact Hours : 39**

Course Objectives: The objectives are to

- Understand concepts and techniques that are core to Machine Learning.
- Apply learning techniques and decision trees.
- Acquire knowledge of neural networks, Bayesian techniques and instant based learning..
- Implement and work with state of the art tools in Machine Learning.

Unit No.	Syllabus	No. of Teaching hours
1	**Learning:** Designing Learning systems, Perspectives and Issues, Concept Learning, Version Spaces and Candidate Elimination Algorithm, Inductive bias.	8
2	**Decision Tree and ANN**: Decision Tree Representation, Hypothesis Space Search, Inductive bias in decision tree, issues in Decision tree. Neural Network Representation, Perceptrons, Multilayer Networks and Back Propagation Algorithms.	8
3	**Bayesian and Computational Learning**: Bayes Theorem, Bayes Theorem Concept Learning, Maximum Likelihood, Minimum Description Length Principle, Bayes Optimal Classifier, Gibbs Algorithm, Naïve Bayes Classifier.	8
4	**Instant Based Learning and Learning set of rules**: K- Nearest Neighbour Learning, Locally Weighted Regression, Radial Basis Functions, Case-Based Reasoning. Sequential Covering Algorithms, Learning Rule Sets, Learning First Order Rules, Learning Sets of First Order Rules, genetic algorithms.	8
5	**Analytical Learning and Reinforced Learning**: Perfect Domain Theories, Explanation Based Learning, Inductive-Analytical Approaches, FOCL Algorithm, Reinforcement Learning.	7

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

1. Explain different supervised and unsupervised machine learning algorithms.
2. Explore and apply the fundamentals of machine learning techniques.
3. Implement and apply different supervised and unsupervised machine learning algorithms.
4. Analyze the strength and weakness of different machine learning models to solve real world problems.
5. Carry out projects based on Machine Learning.

Cos	Mapping with Pos
CO1	PO1, PO2, PO3, PO4, PO5, PO12
CO2	PO1, PO2, PO3, PO4, PO5, PO12
CO3	PO1, PO2, PO3, PO4, PO5, PO12
CO4	PO1, PO2, PO3, PO4, PO5, PO12
CO5	PO1, PO2, PO3, PO4, PO5, PO12

TEXT BOOKS:

1. Introduction to Machine Learning- Ethem Alpaydin, 2nd Ed., PHI Learning Pvt. Ltd., 2013.

REFERENCE BOOKS/WEBLINKS:

1. The Elements of Statistical Learning-T. Hastie, R. Tibshirani, J. H. Friedman, Springer; 1st edition, 2001.
2. Machine Learning, Amit Kumar Das, SaikatDutt, Subramanian Chandramouli, Pearson Education India, April 2018.

Professional Elective -4

Sub Title: SPREAD SPECTRUM COMMUNICATION		
Sub Code: 18ET741	**No. of Credits : 3=3:0:0 (L-T-P)**	**No. of lecture hours/week : 3**
Exam Duration : 3 hours	**CIE + SEE = 50 + 50 =100**	**Total No. of Contact Hours: 39**

Course Objectives: The objectives are to

- Understand the concept of Spread Spectrum and study various types of Spread spectrum sequences and their generation.
- Explain the principles of Code Division Multiple Access (CDMA) and use of Spread spectrum concept in CDMA
- Learn various Code tracing loops for optimum tracking of wideband signals viz spread spectrum signals
- Understand the procedure for synchronization of receiver for receiving the Spread spectrum signal.
- Study the performance of spread spectrum systems in Jamming environment, systems with Forward Error Correction and Multiuser detection in CDMA cellular radio.

Unit No.	**Syllabus**	**No. of Teaching hours**
1	**Introduction to Spread Spectrum Systems:** Fundamental Concepts of Spread Spectrum Systems, Pseudo Noise Sequences – generation, properties, Direct Sequence Spread Spectrum, Frequency Hop Spread Spectrum, Hybrid Direct Sequence Frequency Hop Spread Spectrum, Code Division Multiple Access. Binary Shift Register Sequences for Spread Spectrum Systems: Introduction, Definitions, Mathematical Background and Sequence Generator Fundamentals, Maximal Length Sequences, Gold Codes.	8
2	**Cellular Code Division Multiple Access (CDMA) Principles:** Introduction, Wide Band Mobile Channel, The Cellular CDMA System, Single User Receiver in a Multi User Channel, CDMA System Capacity, Multi-User Detection in CDMA Cellular Radio: Optimal Multi-User Detection, Linear Suboptimal	

	Detectors, Interference Combat Detection Schemes, Interference Cancellation Techniques.	
3	**Code Tracking Loops:** Introduction, Optimum Tracking of Wideband Signals, Base Band Delay-Lock Tracking Loop, Tau-Dither Non- Coherent Tracking Loop, Double Dither Non-Coherent Tracking Loop.	7
4	**Initial Synchronization of the Receiver Spreading Code:** Introduction, Problem Definition and the Optimum Synchronizer, Serial Search Synchronization Techniques, Synchronization using a Matched Filter and correlation filter, Synchronization by Estimated the Received Spreading Code.	8
5	**Performance of Spread Spectrum Systems in Jamming Environments:** Spread Spectrum Communication System Model, Performance of Spread Spectrum Systems without Coding. Performance of Spread Spectrum Systems with Forward Error Correction: Elementary Block Coding Concepts, Optimum Decoding Rule, Calculation of Error Probability, Elementary Convolution Coding Concepts, Viterbi Algorithm, Decoding and Bit-Error Rate.	8

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

- Explain generation of PN sequence and their significance in spread spectrum systems.
- Explain various types of Spread spectrum systems and their applications.
- Apply concepts of spread spectrum communication to solve communication problems.
- Analyze the performance of Spread spectrum systems in Jamming environment and systems with Forward Error Correction.
- Implement the spread spectrum techniques to carry out projects.

COs	**Mapping with POs**
CO1	PO1, PO2, PO3, PO4, PO12
CO2	PO1, PO2, PO3, PO4, PO12
CO3	PO1, PO2, PO3, PO4, PO12
CO4	PO1, PO2, PO3, PO4, PO12
CO5	PO1, PO2, PO3, PO4, PO12

TEXT BOOKS:

1. Rodger E Ziemer, Roger L. Peterson and David E Borth, “Introduction to Spread Spectrum Communication”- Pearson Education, 1st Edition, 1995.
2. Mosa Ali Abu-Rgheff, “Introduction to CDMA Wireless Communications.” Elsevier Publications, 2008.

REFERENCE BOOKS:

1. George R. Cooper, Clare D. Mc Gillem, "Modern Communication and Spread Spectrum", McGraw Hill, 1986.
2. Andrew j. Viterbi, "CDMA: Principles of spread spectrum communication", Pearson Education, 1st Edition, 1995.
3. Kamilo Feher, "Wireless Digital Communications", PHI, 2009.
4. Andrew Richardson, "WCDMA Design Handbook", Cambridge University Press, 2005.
5. Steve Lee, "Spread Spectrum CDMA", McGraw Hill, 2002.

Sub Title : Digital Image Processing		
SubCode: 18ET742	**No. of Credits : 3=3:0:0 (L-T-P)**	**No. of lecture hours/week : 3**
Exam Duration : 3	**CIE + SEE = 50 + 50 =100**	**No. of working hours: 39**

Course Objectives : The objectives are to

1. Understand the basic principles and methods of digital image processing.
2. Be able to formulate solutions to general image processing problems.
3. To learn various image enhancement techniques.
4. To study segmentation techniques used in different applications.
5. 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, Linear and Nonlinear operations,	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 fo image, Smoothing Frequency Domain Filters, Sharpening Frequ	7

	domain filters, homomorphic filtering.	
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**

Note: (1) Five assignments are evaluated for 5 marks: Assignment – 1 from units 1 , Assignment 2 from Unit 2, Assignment - 3 from units 3, Assignment 4 from Unit 4 and Assignment – 5 from unit 5.

(2) Unit 4 is identified for Blended learning

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

1. Explain the representation of a digital image.
2. Understand the effect of applying various enhancement techniques in spatial domain.
3. Analyze the impact of frequency domain techniques on images.
4. Analyze computer-vision applications with various segmentation techniques.
5. Know the applicability of various color-models.

Cos	Mapping with Pos
CO1	PO1, PO3, PO9,PO10
CO2	PO2, PO3, PO9
CO3	PO3, PO9,PO10
CO4	PO3, PO9,PO10
CO5	PO3, PO9,PO10

TEXT BOOKS

1. Rafel 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

Sub Title : INTERNET OF THINGS		
Sub Code:18ET743	**No. of Credits : 3 = 3 : 0 : 0 (L-T-P)**	**No. of lecture hours/week : 3**
Exam Duration : 3 hours	**CIE + SEE = 50 + 50 =100**	**Total No. of Contact Hours : 39**

Objectives:

1. To study the basics framework and architecture of Internet of Things (IoT).
2. To gain knowledge of IoT design principles.
3. To understand the Internet connectivity principles in IoT.
4. To study sensor & RFID technology for IoT.
5. To gain knowledge on IoT Design Methodology

Unit No.	Syllabus	No. of Teaching Hours
1	**Internet of things: An overview-** Internet of things, IoT Conceptual Framework, IoT Architectural view, Technology behind IoT, Sources of IoT, M2M Communication. (Text Book 1)	8
2	**Design Principles Of Connected Devices:** Introduction, IoT/M2Msystems layers and design standardization, Communication Technologies, Data enrichment, data consolidation and device management at gateway. (Text Book 1)	7
3	**Internet Connectivity Principles:** Introduction, Internet connectivity, Internet based communication, IP addressing in the IoT, Media Access control, Application Layer protocols.	9
4	**Sensors, Participatory sensing, RFIDs, and Wireless Sensor Networks:** Introduction, Sensor Technology, Participatory sensing, Industrial IoT, Automotive IoT, Actuator, Sensor data communication protocols, Radio Frequency Identification Technology, Wireless Sensor Network	9

	Technology.(Text Book 1)	
5	**IoT Platforms Design Methodology:** Introduction, IoT Design Methodology, Case Study on IoT System for Weather Monitoring.(Text Book 2)	6

Note: (1) Five assignments are evaluated for 5 marks: Assignment – 1 from units 1 , Assignment 2 from Unit 2, Assignment - 3 from units 3, Assignment 4 from Unit 4 and Assignment – 5 from unit 5.

(2) Unit 3 is identified for Blended learning

Course Outcomes:

1. Illustrate the knowledge of framework and architecture of IoT.
2. Apply IoT Design principles.
3. Describe the Internet connectivity principles in IoT.
4. Apply sensor and RFID technology for IoT.
5. Demonstrate the Design Methodology of IoT and Illustrate the case study.

TEXT BOOKS:

1."**Internet of Things – Architecture and Design Principles",** Raj Kamal, 2017 McGraw Hill publications.

2.Vijay Madisetti and Arshdeep Bahga, **"Internet of Things (A Hands-on-Approach)",** 1st Edition, VPT, 2014.(**ISBN-13:** 978-8173719547)

REFERENCE MATERIALS:

1. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, **"From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence",** 1st Edition, Academic Press, 2014.(**ISBN-13:** 978-0124076846)

Cos	Mapping with Pos
CO1	PO1, PO2,PO3, PO4,PO5,PO6,PO8
CO2	PO2,PO3, PO4,PO5,PO8,PO10
CO3	PO2, PO3
CO4	PO2, PO3
CO5	PO6,PO10

Open Elective -C

Subject Title : Wireless Sensor Networks		
Sub Code : 18ET751	**No. of credits : 3=3:0:0(L-T-P)**	**No. of hrs/week : 3**
Exam duration : 3hrs	**CIE + SEE = 50 + 50 =100**	**Total No. of Contact Hours : 39**

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 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	09

	Merit, Gateway Concepts.	
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

Note: (1) Five assignments are evaluated for 5 marks: Assignment – 1 from units 1 , Assignment 2 from Unit 2, Assignment - 3 from units 3, Assignment 4 from Unit 4 and Assignment – 5 from unit 5.

(2) Unit 3 is identified for Blended learning

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.

COs	**Mapping with Pos**
CO1	PO1, PO2, PO5
CO2	PO1, PO2, PO4
CO3	PO1, PO2, PO5
CO4	PO1, PO2
CO5	PO1, PO2, PO6, PO7, PO8

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”, Spinger 1st Edition 2004.

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 applications", Spinger verlag, 2007.

Sub Title :MULTIMEDIA COMMUNICATION		
Sub Code: 18ET752	**No. of Credits : 3=3:0:0 (L-T-P)**	**No. of lecture hours/week : 3**
Exam Duration : 3 hours	**CIE + SEE = 50 + 50 =100**	**Total No. of Contact Hours : 39**

Course Objectives :

1. To study the different types of Media and their representation in different forms.
2. To explain the different compression techniques for Text with examples.
3. To understand the different compression techniques for Image with examples.
4. To analyze the different compression techniques for Audio.
5. To study the different compression techniques for video.

UNIT No	Syllabus	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 – Arithmetic coding, Lempel-ziv and Welsh coding, Image compression- GIFF, TIFF, Digitized documents and Pictures, JPEG.	07
3	**AUDIO COMPRESSION:** Introduction, audio compression, LPC, Code excited LPC, Perceptual coding, MPEG Audio coders, Dolby Audio coders.	07

	VIDEO COMPRESSION : Video compression principles, H.261, H.263, MPEG, MPEG-1, MPEG-2, and MPEG-4.	
4	**THE INTERNET**: IP addresses, ARP, RARP, Routing Algorithms-Flooding, Distance vector Routing, Link State & Hierarchical Routing, ICMP, Broadcast Routing, Multicast Routing.	09
5	**BROADBAND ATM NETWORKS:** Cell format and Switching principles, Switching architectures, Protocol architectures. **TRANSPORT PROTOCOLS**: TCP, UDP, RTP and RTCP.	09

Note:

1. Unit 5 Broadband ATM Networks is identified for blended learning.
2. Students submit three assignments covering five units with higher level questions upto level 4.

Course Outcomes : Students will be able to:

1. Acquire the knowledge of types of Multimedia networks and applications.
2. Illustrate representation of the information of text, images, audio and video.
3. Analyze the text and image, Audio and Video compression using different techniques and Standards.
4. Analyze the various Routing algorithms.
5. Acquire the knowledge different Architectures and Protocols.

Cos	**Mapping with Pos**
CO1	PO1,PO5
CO2	PO1,PO2,PO5
CO3	PO2, PO6,PO8
CO4	PO2,PO10
CO5	PO1,PO2,PO10

TEXT BOOK:

1. **Multimedia Communications: Applications, Networks, Protocols, and Standards** – Fred Halsall, Pearson Education, Asia, Second Indian reprint 2002.

REFERENCE BOOKS:

1. **Multimedia Information Networking** –, Nalin K. Sharda, PHI, 2003.
2. **Multimedia Fundamentals: Vol 1-Media Coding and Content Processing** – RalfSteinmetz, KlaraNarstedt, Pearson Education, 2004.
3. **Multimedia Systems Design** – Prabhat K. Andleigh, KiranThakrar, PHI, 2004

Subject Title : Microwave Lab		
Sub Code : 18ETL76	**No of credits : 1= 0:0:1 (L-T-P)**	**No of hrs/week : 3**
Exam duration : 3hrs	**CIE+SEE = 50 + 50 =100**	

Course Objectives:

1. To study characteristics of microwave source.
2. To study and calculate various parameters of a KPS.
3. To study characteristics of various passive elements used in microwaves.
4. To estimate the scattering matrix parameters of passive microwave components.
5. To study and plot radiation pattern of microwave antennas.

LIST OF EXPERIMENTS

1. Working of Gunn Diode source and characteristics
2. Working of Klystron source with Mode curves
3. Measurement of impedance using slotted line Assembly.
4. Calibration of crystal detector.
5. Calibration of Variable waveguide attenuator.
6. Finding Isolation and Insertion loss of Circulator/Isolator.
7. Finding the parameters of Directional coupler. Extraction of S-parameter.
8. Finding the parameters of E-plane H-plane & Magic tee. Extraction of S- parameter.
9. Measurement of phase shift for a ferrite phase shifter.
10. Field intensity measurement of a Horn antenna.
11. Field intensity measurement of a Parabolic dish

12. Demonstration and study of various microstrip antennas.

Course Outcome :

After going through this course the student will be able to :

1. To understand and realize practically the working of microwave sources.
2. To practically plot mode curves of KPS and calculate various parameters
3. To determine parameters of various microwave passive devices
4. To compare practical and theoretical scattering matrices for various passive devices.
5. To realize practical BW and Directivity of microwave antennas

Cos	Mapping with Pos
CO1	PO3,PO5,PO6,PO8
CO2	PO3,PO5,PO6,PO8
CO3	PO3,PO5,PO6,PO8
CO4	PO3,PO4,PO5,PO6,PO8
CO5	PO3,PO4,PO5,PO6,PO8

Subject Title : Wireless and Mobile Communication Networks Lab		
Sub Code : 18ETL77	**No of credits : 1= 0:0:1 (L-T-P)**	**No of hrs/week : 3**
Exam duration : 3hrs	**CIE+SEE = 50 + 50 =100**	

Course Objectives :.

1. To familiarize students with the Generation of DPSK & QPSK Schemes using Matlab.
2. Implementation of GSM & CDMA, using NS2/NS3.
3. Simulation of Outdoor & Indoor Propagation model.
4. Configuration of a WiMAX, UTMS, GSM, WSN, VoIP Networks and to analyse the Packet drop probability & Throughput using Qualnet.
5. Implementation of PN sequence using Matlab

List of Experiments

1. Generation of DPSK and QPSK schemes using Matlab

2. Implementation and Study of GSM & CDMA using NS2/NS3

3. Simulation of Okumura/Hata Path Loss for Outdoor propagation Model

a. MATLAB program to calculate the path loss for Okumura outdoor propagation model.

b. To simulate the Okumura path loss model using MATLAB.

c. To obtain graphical representation by varying various parameters and by considering various terrains.

4. Simulation of Log-distance Path Loss for Indoor Propagation Model

a. MATLAB program to calculate the path loss for Okumura outdoor propagation model.

b. To simulate the Okumura path loss model using MATLAB.

c. To obtain graphical representation by varying various parameters and by considering various terrains.

5. Configuration of a Wi-MAX N/W using Qualnet

a. To find the delay in MAC layer,

b. To analyse the Packet drop probability & Throughput

6. **Configuration of a UMTS N/W using Qualnet**

a. To find out the delay in call establishment, call drop probability and call disconnection during handoff.

b. To analyse the Packet drop probability & Throughput

7. Configuration of a GSM N/W using Qualnet

a. To find out the delay in call establishment, call drop probability and call disconnection during handoff.

b. To analyse the Packet drop probability & Throughput

8. Configuration of a WSN using Qualnet

a. Increase the number of co-ordinators and nodes in the same area and observe the performance at physical and MAC layers.

b. To analyse the Packet drop probability & Throughput

9. Configuration of a WSN for different energy models using Qualnet

a. To analyse the Packet drop probability & Throughput & Observe the performance at application and physical layers

b. To analyse the energy required for sending & receiving packets.

10. Configuration of VoIP N/W using Qualnet

a. To find out the delay in call establishment, call drop probability and call disconnection during handoff.

b. To analyse the Packet drop probability & Throughput

11. Implementation and study on PN Sequence Generation using Matlab.

Course Outcome :

After going through this course the student will be able to :

1. Generate DPSK & QPSK Schemes using Matlab.
2. Implement GSM & CDMA, using NS2/NS3.
3. Simulate the Outdoor & Indoor Propagation model.
4. Configure a WiMAX, UTMS, GSM, WSN, VoIP Networks and analyse the Packet drop probability & Throughput using Qualnet.
5. Implementation of PN sequence using Matlab.

Sub. Title : PROJECT WORK PHASE-I		
Sub. Code: 18ETP78	**No. of Credits : 0=0:0:0 (L-T-P)**	**No. of lecture hours/week : 3**
Exam Duration : 3 hours	**CIE+SEE=50+50=100**	

1. Project group should comprise of 3 or 4 students and should not exceed 4 students.
2. Project proposal(synopsis) submitted by the student must be related to the field of telecommunication.
3. Project should be based on recent technology.
4. Evaluation will be done on the basis literature survey, learning the prerequisite tool, documentation and presentation

Sub. Title : INTERNSHIP		
Sub. Code: 18ETI79	**No. of Credits : - =- :-:- (L-T-P)**	**No. of lecture hours/week : -**
Exam Duration : 3 hours	**CIE+SEE= -**	

1. Internship is conducted for individual student or groups, enhances practical knowledge regarding technical and social aspects.

2. Student document their internship period as a report and submit it to the department.
3. Evaluation will be done on the basis of relevance of the topic, presentation skills, depth of knowledge and documentation.

Sub. Title : Project Work Phase-II		
Sub. Code: 18ETP82	**No. of Credits : 12=0:0:12 (L-T-P)**	**No. of lecture hours/week : 3**
Exam Duration : 3 hours	**CIE+SEE=50+50=100**	

Process of Conduction and Evaluation :

1. Project group should comprise of 3 or 4 students and should not exceed 4 students.
2. Project proposal(synopsis) submitted by the student must be related to the field of telecommunication.
3. Project should be based on recent technology.
4. Evaluation will be done on the basis of implementation, results, documentation and presentation

Sub. Title : SUBJECT SEMINAR		
Sub. Code: 18ETS83	**No. of Credits : 2**	**No. of lecture hours/week : -**
Exam Duration : 3 hours	**CIE+SEE=50+00=50**	

Process of Conduction and Evaluation :

1. Subject seminar is conducted for individual student.
2. Student should submit a recent topic to the coordinator which needs to be approved by a panel comprising of HOD and coordinator.
3. Evaluation will be done on the basis of relevance of the topic, presentation skills, depth of knowledge and documentation

Sub. Title : INTERNSHIP		
Sub. Code: 18ETI84	**No. of Credits : - 2=-0 :0-:2 (L-T-P)**	**No. of lecture hours/week : -**
Exam Duration : 3 hours	**CIE+SEE=50+50=100**	

Process of Conduction and Evaluation :

1. Internship is conducted for individual student or groups, enhances practical knowledge regarding technical and social aspects.
2. Student document their internship period as a report and submit it to the department.
3. Evaluation will be done on the basis of relevance of the topic, presentation skills, depth of knowledge and documentation.