NAGARJUNA
COLLEGE OF ENGINEERING & TECHNOLOGY

An Autonomous College under VTU

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

VISION

To transform the students as leaders in Electronics & Communication Engineering to achieve professional excellence in the challenging future

MISSION

M1: To create an environment for the students to have strong academic fundamentals and enable them to be life-long learners.

M2: To provide modern tools to students in the field of electronics and communicationto meet real-world challenges.

M3: To develop Communication skills, leadership qualities, teamwork, and skills forcontinuing education of e students.

M4: To inculcate Ethics, Human values, and skills for solving societal problems and environmental protection.

M5: Validate engineering knowledge through innovative research projects to enhance their employability and entrepreneurship skills.

III to VIII Semesters
NEP Scheme and Syllabus
With effect from Academic Year 2022-2023

Program Educational Objectives (PEOs)

PEO-1: Graduates of Electronics and Communication engineering will be using the basic academic knowledge of design and analysis required in the industry for sustainable societal growth.

PEO-2: Graduates of Electronics and Communication engineering will be able to design project based learning and team based learning.

PEO-3: Graduates in Electronics and Communication engineering will demonstrate good communication skills, dynamic leadership qualities with concern for environmental protection.

PEO-4: Electronics and Communication engineering graduates will be capable of pursuing higher studies, take up research and development work blended with ethics and human values.

PEO-5: Electronics and Communication engineering graduates will have the ability to get employed and become entrepreneurs thereby switching over from responsive engineering to creative engineering.

Program Outcomes and Program Specific Outcomes as defined by the Program

Program Outcome:

PO1: Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and electronics and communication engineering principles to the solution of complex problems in electronics and communication engineering.

PO2: Problem Analysis: Identify, formulate, research literature, and analyze complex electronics and communication engineering problems reaching substantiated conclusions using first principles of mathematics, and engineering sciences.

PO3: Design/Development of Solutions: Design solutions for complex electronics and communication engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct Investigations of Complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions related to electronics and communication engineering problems.

PO5: Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex electronics and communication engineering activities with an understanding of the limitations.

PO6: The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional electronics and communication engineering practice.

PO7: Environment and Sustainability: Understand the impact of the professional electronics and communication engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the electronics and communication engineering practice.

PO9: Individual and Teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex electronics and communication engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life Long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO):

PSO1: Graduate will be able to identify, analyze& solve the problems related to Electronics and Communication Engineering by applying the fundamental knowledge of Electronics and Communication.

PSO2: Graduate will demonstrate an ability to investigate, design and develop both software and hardware using significant knowledge of modern tools in Electronics and Communication Engineering.

PSO3: Graduate will be able to apply their knowledge to assess societal, environmental, health, safety issues with professional ethics and can also pursue higher studies, involve in research activities, be employable or entrepreneur.

NAGARJUNA COLLEGE OF ENGINEERING AND TECHNOLOGY

B.E. in Electronics and Communication Engineering (ECE)

Scheme of Teaching and Examinations 2022

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

(Effective from the academic year 2022 - 23)

III SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	21MAT31	Fourier series, Transforms and Numerical Techniques	TD- Maths PSB-Maths	3	0	0		03	50	50	100	3
2	21ECI32	Digital System Design using Verilog	TD: ECE PSB: ECE	3	0	2		03	50	50	100	4
3	21ECI33	Basic Signal Processing	TD: ECE PSB: ECE	3	0	2		03	50	50	100	4
4	21ECT34	Analog Electronic Circuits	TD: ECE PSB: ECE	3	0	0		03	50	50	100	3
5	21ECL35	Analog Electronics Lab	TD: ECE PSB: ECE	0	0	2		03	50	50	100	1
6	21UHV36	Social Connect and Responsibility	Any Department	0	0	1		01	50	50	100	1
7	21CIP37	Constitution of India and Professional Ethics	TD and PSB HSMC	1	0	0		01	50	50	100	1
8	21EC38X	Ability Enhancement Course - III	TD: Concerned department PSB: Concerned Board	If offered as Theory Course				01	50	50	100	1
				1	0	0						
				If offered as lab. course				02				
				0	0	2						
								Total	**400**	**400**	**800**	**18**

9	**Scheduled activities for III to VIII semesters**	21NS83	National Service Scheme (NSS)	NSS	All students have to register for any one of the course namely National Service Scheme, Physical Education (PE)(Sports and Athletics) and Yoga with the concerned coordinator of the course during the first week of III semester. The activities shall be carried out between III semester to VIII semester (for 5 semesters). SEE in the above courses shall be conducted during VIII semester examinations and the accumulated CIE marks shall be added to the SEE marks. Successful completion of the registered course 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.
		21PE83	Physical Education (PE)(Sports and Athletics)	PE	
		21YO83	Yoga	Yoga	

Course prescribed to lateral entry Diploma holders admitted to III semester B.E./B.Tech programs

1	21MATDIP31	Additional Mathematics – I	Maths	02	02	--	--	---	100	---	100	0

Ability Enhancement Course – III

21EC381	LD Lab using Pspice / MultiSIM	21EC383	LIC Lab using Pspice / MultiSIM
21EC382	AEC Lab using Pspice / MultiSIM	21EC384	LabVIEW Programming Basics

NAGARJUNA COLLEGE OF ENGINEERING AND TECHNOLOGY

B.E. in Electronics and Communication Engineering (ECE)

Scheme of Teaching and Examinations 2021

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

(Effective from the academic year 2021 - 22)

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 Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	21MAT41	Applied Calculus and Probability Distribution	TD, PSB-Maths	3	0	0		03	50	50	100	3
2	21ECI42	Digital Signal Processing	TD: ECE PSB: ECE	3	0	2		03	50	50	100	4
3	21ECI43	Circuits & Controls	TD: ECE PSB: ECE	3	0	2		03	50	50	100	4
4	21ECT44	Communication Theory	TD: ECE PSB: ECE	3	0	0	1	03	50	50	100	3
5	21BET45	Biology For Engineers	BT, CHE, PHY	2	0	0		02	50	50	100	2
6	21ECL46	Communication Laboratory I	TD: ECE PSB: ECE	0	0	2		03	50	50	100	1
7	21KSK47 / 21KBK47	Samskrutika Kannada / Balake Kannada	HSMC	1	0	0		01	50	50	100	1
8	21EC48X	Ability Enhancement Course- IV	TD and PSB: Concerned department	If offered as theory Course: 1	0	0		01	50	50	100	1
				If offered as lab. course: 0	0	2		02				
9	21UHV49	Universal Human Values	Any Department	1	0	0		01	50	50	100	1
10	21INT49	Inter/Intra Institutional Internship	Evaluation By the appropriate authorities	Completed during the intervening period ofII and III semesters by students admitted to first year of BE./B.Tech and during the intervening period of IIIand IV semesters by Lateral entry students admitted to III semester.				3	100	--	100	2
								Total	**550**	**450**	**1000**	**22**

Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs

1	NCMC 21MATDIP41	Additional Mathematics - II	Maths	02	02	--	--	--	100	--	100	0

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

21KSK37/47 Samskrutika Kannada is for students who speak, read and write Kannada and 21KBK37/47 Balake Kannada is for non-Kannada speaking, reading, and writing students.

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with Practicals of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from practical part of IPCCshall be included in the SEE question paper.For more details the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech.) 2021-22 may be referred.

Non – credit mandatory course (NCMC):

Additional Mathematics - II:

(1) Lateral entry Diploma holders admitted to III semester of B.E./B.Tech., shall attend the classes during the IV semester to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks. These courses are slated for CIE only and have no SEE.

(2) Additional Mathematics I and II 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 of degree.

(3) Successful completion of the course Additional Mathematics II shall be indicated as satisfactory in the grade card. Non-completion of the courses Additional Mathematics II shall be indicated as Unsatisfactory.

Ability Enhancement Course – IV

21EC481	Embedded C Basics	21EC483	Octave / Scilab for signals
21EC482	C++ Basics	21EC484	DAQ using LabVIEW

Internship of 04 weeks during the intervening period of IV and V semesters; 21INT68Innovation/ Entrepreneurship/ Societal based Internship.

(1) All the students shall have to undergo a mandatory internship of 04 weeks during the intervening period of IV and V semesters. The internship shall be slated for CIE only and will not have SEE. The letter grade earned through CIE shall be included in the VI semester grade card.The internship shall be considered as a head of passing and shall be considered for vertical progression and for the award of degree. Those, who do not take up / complete the internship shall be considered under F (fail) grade and shall have to complete during subsequently after satisfying the internship requirements.

(2) Innovation/ Entrepreneurship Internship shall be carried out at industry, State and Central Government /Non-government organizations (NGOs), micro, small and medium enterprise (MSME), Innovation centres or Incubation centres. Innovation need not be a single major breakthrough; it can also be a series of small or incremental changes. Innovation of any kind can also happen outside of the business world.

Entrepreneurship internships offers a chance to gain hands on experience in the world of entrepreneurship and helps to learn what it takes to run a small entrepreneurial business by performing intern duties with an established company. This experience can then be applied to future business endeavours. Start-ups and small companies are a preferred place to learn the business tack ticks for future entrepreneurs as learning how a small business operates will serve the intern well when he/she manages his/her own company. Entrepreneurship acts as a catalyst to open the minds to creativity and innovation. Entrepreneurship internship can be from several sectors, including technology, small and medium-sized, and the service sector.

(3) Societal or social internship.

Urbanization is increasing on a global scale; and yet, half the world's population still resides in rural areas and is devoid of many things that urban population enjoy. Rural internship is a work-based activity in which students will have a chance to solve/reduce the problems of the rural place for better living.

As proposed under the AICTE rural internship programme, activities under Societal or social internship, particularly in rural areas, shall be considered for 40 points under AICTE activity point programme.

Nagarjuna College of Engineering and Technology

B.E. in Electronics and Communication Engineering (ECE)

Scheme of Teaching and Examinations 2021

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

(Effective from the academic year 2021 - 22)

V SEMESTER

Sl.No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	PCC 21ECT51	Digital Communication	TD: ECE PSB: ECE	3	0	0	0	03	50	50	100	3
2	IPCC 21ECI52	Microcontroller & ARM Microprocessor	TD: ECE, CSE PSB: ECE	3	0	2	0	03	50	50	100	4
3	PCC 21ECT53	Information Theory and Coding	TD: ECE PSB: ECE	3	0	0	0	03	50	50	100	3
4	PCC 21ECT54	Basic VLSI Design	TD: ECE PSB: ECE	3	0	0	0	03	50	50	100	3
5	PCC 21ECL55	Digital Communication Lab		0	0	2	0	03	50	50	100	1
6	AEC 21ECR56	Research Methodology & Intellectual Property Rights	TD: Any Department PSB: As identified by University	2	0	0	0	02	50	50	100	2
7	HSMC 21ENV57	Environmental Studies	TD: Civil/ Environmental /Chemistry/ Biotech. PSB: Civil Engg	1	0	0	0	1	50	50	100	1
8	AEC 21EC58X	Ability Enhancement Course-V	Concerned Board	If offered as Theory courses: 1	0	0	0	01	50	50	100	1
				If offered as lab. courses: 0	0	2	0	02				
								Total	**400**	**400**	**800**	**18**

Ability Enhancement Course - V

21EC581	IoT (Internet of Things) Lab	21EC583	VLSI Design Lab
21EC582	Communication Simulink Toolbox	21EC584	Microwaves toolbox

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.

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VI SEMESTER

Sl.No	Course and Course Code	Course Title	Teaching Department (TD)and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical	Theory Lecture	Tutorial	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	PCC 21ECT61	Data Communication	TD: ECE PSB: ECE	3	0	0	0	03	50	50	100	3
2	IPCC 21ECI62	Object Oriented Programming with Java & Data Structures	TD: ECE PSB: ECE	3	0	2	0	03	50	50	100	4
3	PCC 21ECT63	Microwave Theory & Antennas	TD: ECE PSB: ECE	3	0	0	0	03	50	50	100	3
4	PEC 21EC64x	Professional Elective Course-I	TD: ECE PSB: ECE					03	50	50	100	3
5	OEC 21EC65x	Open Elective Course-I	Concerned Department					03	50	50	100	3
6	PCC 21ECL66	Data Communication Lab		0	0	2	0	03	50	50	100	1
7	MP 21ECMP67	Mini Project		Two contact hours /week forinteraction between the faculty and students.				--	100	--	100	2
8	INT 21INT68	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

21EC641	Nanoelectronics (L:T:P :S: 2:2:0:0)	21EC643	Python Programming (L:T:P :S: 2:2:0:0)
21EC642	Cryptography (L:T:P :S: 2:2:0:0)	21EC644	Micro Electro Mechanical Systems (L:T:P :S: 3:0:0:0)

Open Electives – I offered by the Department to other Department students

21EC651	Communication Engineering (L:T:P :S: 3:0:0)	21EC653	Basic VLSI Design (L:T:P :S: 3:0:0:0)
21EC652	Microcontrollers (L:T:P :S: 3:0:0:0)	21EC654	Electronic Circuits with Verilog (L:T:P :S: 2:0:2:0)
21EC655	Sensors & Actuators (L:T:P :S: 3:0:0:0)		

Note: HSMC: Humanity and Social Science & Management Courses, **IPCC:** Integrated Professional Core Course, **PCC:** Professional Core Course, **PEC:** Professional Elective Courses, O**EC**–Open Elective Course, **MP** –Mini Project, INT –Internship.
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). 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 out of five courses. 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

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(Effective from the academic year 2021 - 22)

Swappable VII and VIII SEMESTER

VII SEMESTER

Sl.No	Course and Course Code	Course Title	Teaching Department (TD)and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	PCC 21ECT71	Advanced VLSI	TD: ECE PSB: ECE	2	0	2	0	3	50	50	100	3
2	PCC 21ECT72	WirelessCommunication	TD: ECE PSB: ECE	2	0	0	0	3	50	50	100	2
3	PEC 21EC72X	Professional elective Course-II	TD: ECE PSB: ECE					3	50	50	100	3
4	PEC 21EC73X	Professional elective Course-III	TD: ECE PSB: ECE					3	50	50	100	3
5	OEC 21EC74X	Open elective Course-II	Concerned Department					3	50	50	100	3
6	Project 21ECP75	Project work		Two contact hours /week for interaction between the faculty and students.				3	100	100	200	10
								Total	**350**	**350**	**700**	**24**

Professional Elective - II

21EC721	Power Electronics (L:T:P :S: 2:0:2:0)	21EC724	Biomedical Signal Processing (L:T:P:S: 3:0:0:0)
21EC722	Digital Image Processing (L:T:P :S: 2:0:2:0)	21EC725	Speech Signal Processing (L:T:P:S: 3:0:0:0)
21EC723	DSP Algorithms & Architecture (L:T:P:S: 3:0:0:0)		

Professional Elective - III

21EC731	IoT & Wireless Sensor Networks (L:T:P:S: 3:0:0:0)	21EC734	Machine Learning with Python (L:T:P :S: 2:0:2:0)
21EC732	Network Security (L:T:P:S: 3:0:0:0)	21EC735	Multimedia Communication (L:T:P:S: 2:0:2:0)
21EC733	Fabrication technology (L:T:P:S: 3:0:0:0)		

Open Electives - II offered by the Department to other Department students

21EC741	Optical & Satellite Communication (L:T:P:S: 3:0:0:0)	21EC744	Nanotechnology (L:T:P:S: 3:0:0:0)
21EC742	ARM Embedded Systems (L:T:P :: 3:0:0)	21EC745	E-waste Management (L:T:P:S: 3:0:0:0)
21EC743	Basic Digital Image Processing (L:T:P:S: 2:0:2:0)		

Note: PCC: Professional Core Course, **PEC:** Professional Elective Courses, **OEC**–Open Elective Course, **AEC** –Ability Enhancement Courses.
L –Lecture, T – Tutorial, P- Practical / Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

Note: VII and VIII semesters of IV year of the programme

(1) Institutions can swap VII and VIII Semester Scheme of Teaching and Examinations to accommodate research internship/ industry internships 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 programme.

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

(i) To encourage independent learning and the innovative attitude of the students.

(ii) To develop interactive attitude, communication skills, organization, time management, and presentation skills.

(iii) To impart flexibility and adaptability.

(iv) To inspire team working.

(v) To expand intellectual capacity, credibility, judgment and intuition.

(vi) To adhere to punctuality, setting and meeting deadlines.

(vii) To install responsibilities to oneself and others.

(viii) To train students to present the topic of project work in a seminar without any fear, face the audience confidently, enhance communicationskills, involve in group discussion to present and exchange ideas.

CIE procedure for Project Work:

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

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

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

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

TECHNICAL SEMINAR (21XXS81): 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 thequalifying 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 of degree.

VIII SEMESTER

Sl.No	Course and Course Code		Course Title	Teaching Department	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	Seminar21EC81		Technical Seminar		One contact hour /week for interaction between the faculty and students.				--	100	--	100	01
2	INT 21INT82		Research Internship/ Industry-Internship		Two contact hours /week for interaction between the faculty and students.				03 (Batch wise)	100	100	200	15
3	NCMC	21NS83	National Service Scheme (NSS)	NSS	Completed during the intervening period of III semester to VIII semester.				--	50	50	100	0
		21PE83	Physical Education (PE) (Sports and Athletics)	PE									
		21YO83	Yoga	Yoga									
									Total	**250**	**150**	**400**	**16**

Bachelors of Engineering

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

SEMESTER – III

TRANSFORM CALCULUS, FOURIER SERIES AND NUMERICAL TECHNIQUES			
Course Code	21MAT31	CIE Marks	50
Teaching Hours/Week (L: T: P: S) (2:2:0:0)	Credits (2:2:0:0)	SEE Marks	50
Total Hours of Pedagogy	40 hours	Total Marks	100
Credits	03	Exam Hours	03

Course objectives:

- The goal of the course Transform Calculus, Fourier series and Numerical techniques -21MAT 31 is
- To have an insight into solving ordinary differential equations by using Laplace transformtechniques
- Learn to use the Fourier series to represent periodical physical phenomena in engineeringanalysis.
- To enable the students to study Fourier Transforms and concepts of infinite Fourier Sine and Cosine transforms and to learn the method of solving difference equations by the z-transformmethod.
- To develop proficiency in solving ordinary differential equations arising in engineeringapplications, using numerical methods.
- To understand the method of solving the variational problems.

Teaching-Learning Process (General Instructions)

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

1. In addition to the traditional lecture method, different types of innovative teaching methods maybe adopted so that the delivered lessons shall develop students theoreticaland applied mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will also be responsible for assigning homework, grading assignments andquizzes, and documenting students' progress.
5. Encourage the students for group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways:
   a) As an introduction to new topics (pre-lecture activity).
   b) As a revision of topics (post-lecture activity).
   c) As additional examples (post-lecture activity).
   d) As an additional material of challenging topics (pre-and post-lecture activity).
   e) As a model solution of some exercises (post-lecture activity).

Module-1

Laplace Transform: Definition and Laplace transforms of elementary functions (statementsonly). Problems on Laplace's Transform of $e^{at}f(t)$, $t^n f(t)$, $\frac{f(t)}{t}$. Laplace transforms of Periodic functions (statement only) and unit-step function – problems.

Inverse Laplace transforms definition and problems, Convolution theorem to find the inverse Laplace transforms (without Proof) problems. Laplace transforms of derivatives, solution of differentialequations. 08 Hours

Self-study: Solution of simultaneous first-order differential equations.

[Text 1:21.1, 21.2, 21.3, 21.4, 21.5, 21.7, 21.9, 21.10,21.12, 21.14, 21.15, 21.17]

(RBT Levels: L1, L2 and L3)

Module-2

Fourier Series: Introduction to infinite series, convergence and divergence. Periodic functions, Dirichlet's condition. Fourier series of periodic functions with period 2π and arbitrary period. Halfrange Fourier series. Practical harmonic analysis. 08 Hours

Self-study: Convergence of series by D' Alembert's Ratio test and, Cauchy's root test.

[Text 1: 9.3, 10.1, 10.2, 10.3, 10.4, 10.5, 10.6, 10.7, 10.11]

(RBT Levels: L1, L2 and L3)

Module-3

Infinite Fourier Transforms: Infinite Fourier transforms definition, Fourier sine and cosine transforms.Inverse Fourier

transforms, Inverse Fourier cosine and sine transforms. Problems.

Z-Transforms: Difference equations, z-transform-definition, Standard z-transforms, Damping and shifting rules,Problems. Inverse z-transform and applications to solve difference equations. **08 Hours**

Self Study: Initial value and final value theorems, problems.

[Text 1: 22.1, 22.2, 22.4, 22.5, 23.1, 23.2, 23.3, 23.5, 23.6, 23.7, 23.15, 23.16, 31.1, 31.2]

(RBT Levels: L1, L2 and L3)

Module-4

Numerical solutions of simultaneous first order differential equations: Picards method,Taylor's series method and Runge-Kutta method. (No derivations of formulae).

Second-order differential equations: Runge-Kutta method and Milne's predictor and Corrector method. (No derivations of formulae). **08 Hours**

Self Study: Solution of Laplace's equation using standard five-point formula.

[Text 1: 32.1, 32.11, 32.12. Text 2: 21.3]

(RBT Levels: L1, L2 and L3)

Module-5

Calculus of Variations: Functionals, Euler's equation, Problems on extremals of functional. Geodesics on a plane, Variational problems. **08 Hours**

Self Study: Hanging chain problem.

[Text 1: 35.1, 35.2, 35.3, 35.4, 35.5]

(RBT Levels: L1, L2 and L3)

Teaching-Learning Process for all modules	Chalk and Talk/PowerPoint presentation/YouTube videos.

Course Outcomes:

After successfully completing the course, the students will be able

1. To solve ordinary differential equations using Laplace transform.
2. Demonstrate the Fourier series to study the behaviour of periodic functions and theirapplications in system communications, digital signal processing and field theory.
3. To use Fourier transforms to analyze problems involving continuous-time signals and toapply Z-Transform techniques to solve difference equations
4. To solve mathematical models represented by initial or boundary value problems involvingordinary differential equations
5. Determine the extremals of functionals using calculus of variations and solve problemsArising in dynamics of rigid bodies and vibrational analysis.

Assessment Details (both CIE and SEE)

Component		Weightage (%)	
CIE's	CIE 1- At the end of 5th week	20	60
	CIE 2 - At the end of 10th week	20	
	CIE 3 - At the end of 15th week	20	
AAT's	AAT-1- At the end of 4th week	10	40
	AAT-2- At the end of 9th week	10	
	AAT-3- At the end of 13th week	20	
Continuous Internal Evaluation Total Marks: 100. Reduced to 50 Marks			
Semester End Examination (SEE) Total Marks: 100. Reduced to 50 Marks			

Suggested Learning Resources:

Text Books:

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

Reference Books:

1. **B.V. Ramana:** "Higher Engineering Mathematics" McGraw-Hill Education, 11th Ed.
2. **Srimanta Pal & Subodh C.** Bhunia: "Engineering Mathematics" Oxford University Press,3rd Reprint,

2016.

3. **N.P Bali and Manish Goyal**: "A textbook of Engineering Mathematics" Laxmi Publications, Latest edition.
4. **C. Ray Wylie, Louis C. Barrett:** "Advanced Engineering Mathematics" McGraw – HillBook Co.Newyork, Latest ed.
5. **Gupta C.B, Sing S.R and Mukesh Kumar:** "Engineering Mathematic for Semester I andII", Mc-Graw Hill Education(India) Pvt. Ltd 2015.
6. **H.K.Dass and Er. Rajnish Verma:** "Higher Engineering Mathematics" S.Chand Publication(2014).
7. **James Stewart: "**Calculus" Cengage publications, 7th edition, 4th Reprint 2019.

E-Resources:

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

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes
- Assignments
- Seminars

CO- PO Mapping :

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
21MAT31.1	3	1										
21MAT31.2	3	3										
21MAT31.3	3	2										
21MAT31.4	3	3										
21MAT31.5	2	2										

SEMESTER - III

Digital System Design Using Verilog			
Course Code	**21ECI32 (IC)**	**CIE Marks**	**50**
Teaching Hours/Week (L: T: P: S) (3:0:2:0)	**Credits (3:0:1:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40 hours Theory + 13 Lab slots**	**Total Marks**	**100**
Credits	**04**	**Exam Hours**	**03**

Course objectives:

This course will enable students to:

1. Understand the concepts of simplifying Boolean expression using K-map techniques and Quine-McCluskey minimization techniques.
2. Gain knowledge of designing combinational logic circuits.
3. Analyze the operation of different types of sequential logic circuits.
4. Apply concepts of the Verilog HDL-data flow model for the design of digital systems.
5. Evaluate Behavioral & Structural models for the design of digital systems.

Teaching-Learning Process (General Instructions)

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

- Lecture method (L) does not mean only traditional lecture method, but a different type of teachingmethods may be adopted to develop the outcomes.
- Show Video/animation films to explain the different concepts of Linear Algebra & Signal Processing.
- Encourage collaborative (Group) Learning in the class.
- Ask at least three HOTS (Higher Order Thinking) questions in the class, which promotes critical thinking.
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
- Topics will be introduced in a multiple representation.
- Show the different ways to solve the same problem and encourage the students to come up withtheir own creative ways to solve them.
- Discuss how every concept can be applied to the real world - and when that's possible, it helpsimprove the students' understanding.
- Adopt Flipped class technique by sharing the materials / Sample Videos prior to the class and have discussions on the that topic in the succeeding classes.
- Give Programming Assignments.

Module-1

Simplification of Boolean functions: Definition of combinational logic, Canonical forms, Generation of switching equations from truth tables, Karnaugh maps- up to 4 variables, Quine-McCluskey Minimization Technique, Quine-McCluskey using Don't Care Terms.

08 Hours

Module-2

Combinational Logic circuits:

General approach to Combinational Logic Design, Parallel adder and subtractor, carry look ahead adder, Magnitude Comparator, Decoders, Encoders and Multiplexers.

08 Hours

Module-3

Flip-Flops and its Applications: The Master-Slave Flip-flops (Pulse-Triggered flip-flops): SR flip-flops, JK flip flops, Characteristic equations, Registers, Binary Ripple Counters, Synchronous Binary Counters, Counters based on Shift Registers, Design of Synchronous mod-n Counter using clocked T, JK and SR flip-flops. **08 Hours**

Module-4

Introduction to Verilog: Structure of Verilog Module, Operators, Data types, Types of Descriptions, simulation and synthesis, brief comparison of VHDL and Verilog.

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

08 Hours

Module-5

Verilog Behavioral Description: Structure, Variable Assignment Statement, Sequential statements, Verilog Behavioral Description of Multiplexers.

Verilog Structural description: Highlights of Structural description, Organization of structural description, Structural description of ripple carry adder.

08 Hours

Teaching-Learning Process for all modules	**Chalk and Talk, Power point presentation, flip teaching, YouTube videos**

PRACTICAL COMPONENTS

Sl. No	**Experiments**
	HARDWARE EXPERIMENTS using Logic Design
1	Simplify the given Boolean expressions and realize using Logic Gates.
2	Realize Adder/Subtractor (Full/half) circuits using Logic Gates.
3	Realize the following Code converters using Gates. a) Gray to binary and vice versa b) Binary to excess3 and vice versa
	SOFTWARE EXPERIMENTS using Xilinx Tool
4	Realize 4-bit ALU using Verilog Program.
5	Realize using Verilog Behavioral description: 8:1 mux, 3:8 decoder
6	Realize using Verilog Behavioral description: 2-bit Comparator.
7	Realize using Verilog Behavioral description: Flip-flops: a) JK type b) SR type c) T type d) D type
8	Realize Counters - up/down (BCD and binary) using Verilog Behavioral description.

Course Outcomes

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

1. Simplify Boolean functions using K-map and Quine-McCluskey minimization techniques.
2. Analyze and design combinational logic circuits like Adders, Encoders, Decoders, Multiplexers & Comparators.
3. Apply the concepts of Flip Flops (SR, D, T, and JK) to design Registers and Counters.
4. Design Combinational circuits (adders, subtractors, multiplexers) and sequential circuits using Dataflow Verilog descriptions.
5. Develop Combinational circuits (adders, subtractors, multiplexers) and sequential circuits using behavioral and structural Verilog descriptions.

Assessment Details (both CIE and SEE)

Component		**Weightage (%)**		
CIE's	CIE 1 5th week	20	60	Average of 3 tests for 20 marks
	CIE 2 10th week	20		
	CIE 3 15th week	20		
AAT's	AAT-1 10th week			10
	Lab Test	50		Reduced to 10
	Lab Record	20		10
Continuous Internal Evaluation Total Marks :100. Reduced to 50 Marks				
Semester End Examination (SEE) Total Marks :100. Reduced to 50 Marks				

Suggested Learning Resources:

Text Books:

1. John M Yarbrough: "Digital Logic Applications and Design", 3rd Edition, Cengage Learning, New Delhi, Reprint, 2012, ISBN-13: 978-81-315-0058-3, ISBN-10: 81315-0058-6.
2. Donald D Givone "Digital Principles and Design", 1st Edition, Tata McGraw Hill, New Delhi, Reprint, 2005, ISBN: 0-07-052906-X.
3. Nazeih M. Botros: "HDL Programming (VHDL and Verilog)", (Chapters 1-5), Dreamtech Press Publishers, New Delhi, 2018, ISBN-13: 9788177226973.

Reference Books:

1. Charles H Roth, Kinney LL, John EB "Fundamentals of Logic Design", Enhanced Seventh Edition, Cengage Learning;

2020, ISBN-1 :1337620351, ISBN-13 : 978-1337620352

2. J. Bhaskar: "A Verilog HDL Primer", 2nd Edition, BS Publications, Hyderabad, 2016, ISBN: 8178000121.

3. Fundamentals of HDL, by Cyril P R, Pearson/Sanguine 2010, ISBN-10 : 8131732479, ISBN-13 : 978-8131732472

E-Resources:

1. http://nptel.ac.in/courses/117106086/
2. http://www.asic-world.com/digital/tutorial.html
3. https://www.wiziq.com/tutorials/digital-electronics
4. http://www.xilinx.com/video/hardware/basic-hdl-coding-techniques.html
5. http://www.academia.edu/1492361/VHDL_BASICS_WITH_EXAMPLES
6. http://www.referencedesigner.com/tutorials/verilog/verilog_01.php

SEMESTER - III

Basic Signal Processing			
Course Code	**21ECI33 (IC)**	**CIE Marks**	**50**
Teaching Hours/Week (L: T: P: S) (3:0:2:0)	**Credits (3:0:1:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40 hours Theory + 13 Lab slots**	**Total Marks**	**100**
Credits	**04**	**Exam Hours**	**03**

Course objectives:
This course will enable students to:

1. Understand the basic types of continuous-time and discrete-time signals and operations on signals.
2. Study the convolution operation on discrete LTI system..
3. Analyze the classification and operation of different types of signals.
4. Apply the concepts of classification and time domain operations.
5. Evaluate the Z transform and LTI properties.

Teaching-Learning Process (General Instructions)

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

- Lecture method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
- Show Video/animation films to explain the different concepts of Linear Algebra & Signal Processing.
- Encourage collaborative (Group) Learning in the class.
- Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking.
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
- Topics will be introduced in a multiple representation.
- Show the different ways to solve the same problem and encourage the students to come up withtheir own creative ways to solve them.
- Discuss how every concept can be applied to the real world - and when that's possible, it helpsimprove the students' understanding.
- Adopt Flipped class technique by sharing the materials / Sample Videos prior to the class and have discussions on the that topic in the succeeding classes.
- Give Programming Assignments.

Module-1

Introduction and Classification of signals: Definition of signal and systems with examples, classification of signals with examples.
Elementary signals/Functions: Exponential, sinusoidal, step, impulse and ramp functions
Basic Operations on signals: Amplitude scaling, addition, multiplication, time scaling, time shift, and time reversal. Expression of triangular, rectangular, and other waveforms in terms of elementary signals

08 Hours

Module-2

Time domain representation of LTI System: Impulse response, convolution sum. Computation of convolution sum for unit step and unit step, unit step and exponential, exponential and exponential, unit step and rectangular, and rectangular and rectangular.
LTI system Properties in terms of impulse response: System interconnection, Memory less, Causal, Stable, Invertible and Deconvolution and step response

08 Hours

Module-3

Solution of Difference equation representation of an LTI System: Solutions for Difference equation, Block diagram representation-direct form-I and direct form- II difference equations.
Fourier Representation of Periodic Signals: Introduction to CTFS and DTFS, definition, properties (No derivation) and basic problems.

08 Hours

Module-4

Fourier Representation of a periodic Signals and its properties: Introduction to Fourier Transform and DTFT, Definition and basic problems.

Properties of Fourier Transform: Linearity, Timeshift, Frequency shift, Scaling, Differentiation and Integration, Convolution and Modulation, Parseval's theorem

08 Hours

Module-5

The Z-Transforms: Z transform, properties of the region of convergence, properties of the Z-transform, Inverse Z-transform, Causality and stability, Transform analysis of LTI systems.

08 Hours

Teaching-Learning Process for all modules	**Chalk and Talk, Power point presentation, flip teaching, YouTube videos**

PRACTICAL COMPONENTS

Sl. No	Experiments
1	MATLAB program to generate the basic signals: Sine, Unit step, Unit Impulse
2	MATLAB program to perform the basic operations: Amplitude scaling, addition, multiplication, time scaling
3	MATLAB program to verify the properties Linear-nonlinear and Time variant -invariant
4	MATLAB program to find the convolution sum of two given sequences.
5	MATLAB program to find the impulse response for the given difference equation.
6	MATLAB program to perform fourier transform of a signal
7	MATLAB program to verify the properties of fourier transform of a signal.
8	MATLAB program to find the Z transform of a signal.

Course Outcomes

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

- Describe the classification of signals and basic operations on signals.
- Determine the linearity, causality, time-invariance and stability properties of continuous and discrete time systems.
- Determine the linearity, causality, time-invariance and stability properties of continuous and discrete time systems.
- Analyze the response of the LTI system using convolution sum
- Evaluate the Region of Convergence of a given signal and inverse z-transform.

Assessment Details (both CIE and SEE)

Component		Weightage (%)		
CIE's	CIE 1 5th week	20	60	Average of 3 tests for 20 marks
	CIE 2 10th week	20		
	CIE 3 15th week	20		
AAT's	AAT-1 10th week			10
	Lab Test	50		Reduced to 10
	Lab Record	20		10
Continuous Internal Evaluation Total Marks :100. Reduced to 50 Marks				
Semester End Examination (SEE) Total Marks :100. Reduced to 50 Marks				

Suggested Learning Resources:

Text Books:

1. Simon Haykin: "Signals and Systems", 4th Edition, John Wiley India Pvt. Ltd, Re-print, 2004, ISBN: 978-81-265-1265-2.

2. Michael J Roberts: "Fundamentals of Signals and Systems", 2nd Edition, Tata Mc Graw-Hill, 2010, ISBN: 978-0-07-070221-9.

Reference Books:

1. Alan V Oppenheim, Alan S, Willsky and Hamid Nawab: “Signals and Systems”, 2nd Edition, Pearson Education Asia / PHI, Indian Reprint, 2002, ISBN: 81-203-1246-5.
2. H.P Hsu, R. Ranjan, “Signals and Systems”, Scham’s Outlines, TMH, 1995, ISBN-13: 978-0-07- 060171-0.

E-Resources:

1.http://link.springer.com/chapter/10.1007/978-1-4020-6272-8_4#page-1
2.http://www.thefouriertransform.com/
3. http://lpsa.swarthmore.edu/LaplaceZTable/LaplaceZFuncTable.html

SEMESTER - III

Analog Electronic Circuits			
Course Code	**21ECT34**	**CIE Marks**	**50**
Teaching Hours/Week (L: T: P: S) (3:0:0:0)	**Credits (3:0:0:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40 hours Theory**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course objectives:

This course will enable students to:

1. Explain various BJT and FET parameters, connections and configurations.
2. Design and demonstrate the diode circuits and transistor amplifiers.
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.

Teaching-Learning Process (General Instructions)

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

1. Lecture method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Show Video/animation films to explain evolution of communication technologies.
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Show the different ways to solve the same problem and encourage the students to come up with theirown creative ways to solve them.
7. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

BJT Biasing: Introduction**,** Biasing in BJT amplifier circuits: The Classical Discrete circuit bias (Voltage-divider bias), Biasing using a collector to base feedback resistor.

Small signal operation and Models: Collector current and transconductance, Base current and input resistance, Emitter current and input resistance, voltage gain, hybrid π model.

08 Hours

Module-2

MOSFETs: Biasing in MOS amplifier circuits: Fixing VGS, Fixing VG, Drain to Gate feedback resistor.

Small signal operation and modeling: The DC bias point, signal current in drain, voltage gain, small signal equivalent circuit models, trans conductance.

MOSFET Amplifier configuration: Basic configurations, characterizing amplifiers, CS amplifier with and without source resistance RS, Source follower.

Oscillators: FET based Phase shift oscillator, LC and Crystal Oscillators (no derivation)

08 Hours

Module-3

Feedback Amplifier: General feedback structure, Properties of negative feedback, The Four Basic Feedback Topologies, The series-shunt, series-series, shunt-shunt and shunt-series amplifiers (Qualitative Analysis without practical circuits).

Output Stages and Power Amplifiers: Introduction, Classification of output stages, Class A output stage, Class B output stage: Transfer Characteristics, Power Dissipation, Power Conversion efficiency, Class AB output stage, Class C tuned Amplifier (Block Diagram based only).

08 Hours

Module-4

Op-Amp Circuits: Op-amp DC and AC Amplifiers, DAC - Weighted resistor and R-2R ladder, ADC- Successive approximation type, Small Signal half wave rectifier, Active low pass Filters, Band-pass filters.

555 Timer and its applications: Monostable and Astable Multivibrators.

08 Hours

Module-5

Overview of Power Electronic Systems: Power Electronic Systems, Power Electronic Converters, and Applications.

Thyristors: Static Anode-Cathode characteristics and Gate characteristics of SCR, Turn-ON methods, Turn-off Mechanism, Turn-OFF Methods.

Gate Trigger Circuit: Resistance Firing Circuit, Resistance capacitance firing circuit, Unijunction Transistor: Basic operation and UJT Firing Circuit.

08 Hours

Teaching-Learning Process for all modules	**Chalk and Talk, PowerPoint presentation, flip teaching, YouTube videos**

Course Outcomes

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

1. Analyze the characteristics of BJTs and FETs for switching and amplifier circuits.
2. Design and analyze FET amplifiers and oscillators with different circuit configurations and biasing conditions.
3. Explain the feedback topologies and approximations in the design of amplifiers and oscillators.
4. Design of circuits using linear ICs for wide range applications such as ADC, DAC, filters.
5. Explain the power electronic device components and its functions for basic power electroniccircuits.

Assessment Details (both CIE and SEE)

Component		Weightage (%)	
CIE's	CIE 1 5th week	20	60
	CIE 2 10th week	20	
	CIE 3 15th week	20	
AAT's	AAT-1 10th week	10	
	AAT-2	10	
	AAT-3	20	
Continuous Internal Evaluation Total Marks: 100. Reduced to 50 Marks			
Semester End Examination (SEE) Total Marks: 100. Reduced to 50 Marks			

Suggested Learning Resources:

Text Books:

1. Microelectronic Circuits, Theory and Applications, Adel S Sedra, Kenneth C Smith, 6th Edition, Oxford, 2015. ISBN:978-0-19-808913-1
2. Op-Amps and Linear Integrated Circuits, Ramakant A Gayakwad, 4th Edition, Pearson Education, 2018. ISBN: 978-93-325-4991-3
3. Electronic Principles, Albert Malvino, David J Bates, 7th Edition, McGraw Hill Education (India) Private Limited, 2017, ISBN:978-0-07-063424-4.

SEMESTER - III

Analog Electronics Lab			
Course Code	**21ECL35**	**CIE Marks**	**50**
Teaching Hours/Week (L: T: P: S) (0:0:2:0)	**Credits (0:0:1:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**13 lab slots**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

Course objectives:

This laboratory course enables students to:

1. Understand the electronic circuit schematic and its working
2. Realize and test amplifier and oscillator circuits for the given specifications
3. Realize the op-amp circuits for the applications such as implement mathematical functions and precision rectifiers.
4. Study the static characteristics of SCR and test the RC triggering circuit.
5. Use suitable ICs based on the specifications and functions.

Sl. No.	Experiments
1	Design and set up the BJT common emitter voltage amplifier with and without feedback anddetermine the gain- bandwidth product, input and output impedances.
2	Design and set-up BJT RC oscillator
3	Design and set up the circuits using op-amp: i) Adder ii) Comparator
4	Design and set up the circuits using op-amp: i) Integrator ii) Differentiator
5	To design Second order active LPF and HPF.
6	Obtain the static characteristics of SCR and test SCR Controlled HWR using RC triggering circuit.
7	Design and set-up BJT Crystal Oscillator.
8	Test the Half wave precision rectifiers using op-amp.
9	Design and test Monostable Multivibrator using 555 Timer
10	Design and test Astable Multivibrator using 555 Timer

Course outcomes (Course Skill Set):

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

1. Design and analyze the BJT/FET amplifier circuits.
2. Design and analyze the BJT/FET oscillator circuits.
3. Design and test Op-amp circuits to realize the mathematical computations.
4. Demonstrate the basic electronic circuit experiments using SCR.
5. Design and test the Opamp circuits to realize the precision rectifiers.

Assessment Details (both CIE and SEE)

Continuous Internal Assessment of Laboratory/Practical Courses		
Lab Test 1	Lab Test 2	Lab Records
15 marks	15 marks	20 marks
Semester End Examination **(**SEE)		50 marks

Suggested Learning Resources:

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

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

3. Fundamentals of Logic Design, Charles H Roth Jr., Larry L Kinney, Cengage Learning, 7th Edition.

SEMESTER – III

Social Connect & Responsibilities			
Course Code	**21UHV36**	**CIE Marks**	**50**
Teaching Hours/Week (L: T: P: S) (0:0:2:0)	**Credits (0:0:1:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**26 hours**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

Course objectives:

This course will enable students to:

1. To do a deep dive into societal challenges being addressed by NGO(s), social enterprises & The government and build solutions to alleviate these complex social problems through immersion, design & technology.
2. Provide knowledge about Plant life, its origin, appearance, and usage in daily life and also about planting, and adopting trees.
3. To realize the culture, craft forms, and history of the city by exploring monuments or architecture.
4. Understand the concept of Organic Farming which improves livelihood opportunities and income and also know about waste management which boosts the community's resiliency.
5. Provide a formal platform for students to conserve water and connect to their surroundings.
6. Enable to recognize of culinary practices and indigenous materials of the typical region used for cooking.

Teaching-Learning Process (General Instructions)

The students are expected to have the ability to:

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

Module-1

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 photoblog describing the plant's origin, its usage in daily life, and its appearance in folklore and literature.

04 Hours

Module-2

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, photoblog and documentary on evolution and practice of various craft forms.

03 Hours

Module-3

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

04 Hours

Module-4

Water Conservation: knowing the present practices in the surrounding villages and implementation in the campus, documentary or photo blog presenting the current practices.

04 Hours

Module-5

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

03 Hours

Activities

Jamming session, open mic, and poetry: Platform to connect to others. Share the stories with others. Share the experience of Social Connect. Exhibit the talent like playing instruments, singing, one-act play, art-painting, and fine art.

Pedagogy

The pedagogy will include interactive lectures, inspiring guest talks, field visits, social immersion, and a course project. Applying and synthesizing information from these sources to define the social problem to address and take up the solution as the course project, with your group. Social immersion with NGOs/social sections will be a key part of the course. Will all lead to the course project that will address the needs of the social sector?

Assessment details (Both CIE and SEE)

The report should be signed by the mentor. The report shall be evaluated on the basis of the following criteria and/or other relevant criteria pertaining to the activity completed.

- Marks allotted for the Activity Completed are out of 50.
- Planning and scheduling the social connect
- Information/Data collected during the social connect
- Analysis of the information/data
- Report writing

Considering all above points allotting the marks as mentioned below:

Excellent	80 to 100

Good	60 to 79
Satisfactory	40 to 59
Unsatisfactory and fail	< 39

Continuous Internal Assessment of Laboratory/Practical Courses		
Activities	Report	Total
40 marks	10 marks	**50 marks**
Semester End Examination (SEE)		**50 marks**

SEMESTER - III

Constitution of India, Professional Ethics and Human Rights			
Course Code	**21CIP37**	**CIE Marks**	**50**
Teaching Hours/Week (L: T: P: S) (1:0:0:0)	**Credits (1:0:0:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**13 hours Theory**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

Course objectives:

This course will enable students to:

1. The basic information about the Indian constitution.
2. The fundamental rights and duties of a citizen.
3. Special privileges of socially and economically weaker sections of society.
4. Individual role and ethical responsibility towards society.
5. Understand the categories in the Indian Government

Teaching-Learning Process (General Instructions):

- These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.
- In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied to current scenario and improve their skills.
- Gain knowledge of fundamental concepts of democracy.
- Analyze the political situations based on the fundamental rights.
- Encourage the students for group learning to improve their creative and analytical skills.
- Show short related video lectures in the following ways:
  - ✓ As an introduction to new topics (pre-lecture activity).
  - ✓ As a revision of topics (post-lecture activity).
  - ✓ As additional examples (post-lecture activity).

Module-1

Introduction to the Constitution of India, The Making of the Constitution and Salient features of the Constitution. Preamble to the Indian Constitution, Fundamental Rights & its limitations.

03 Hours

Module-2

Directive Principles of State Policy & Relevance of Directive Principles of State Policy, Fundamental Duties. Union Executives – President, Prime Minister, Parliament, Supreme Court of India.

03 Hours

Module-3

State Executives – Governor, Chief Minister, State Legislature High Court of State. Electoral Process in India, Amendment Procedures, 42nd, 44th, 74th, 76th, 86th, & 91st Amendments.

02 Hours

Module-4

Special Provision for SC & ST, Special Provision for Women, Children & Backward Classes, Emergency Provisions. Human Rights- Working of National Human Rights Commission in India, Powers and functions of Municipalities, Panchayats and Co - Operative Societies.

03 Hours

Module-5

Scope & Aims of Engineering Ethics, Responsibility of Engineers, Impediments to Responsibility. Risks, Safety and liability of Engineers, Honesty, Integrity & Reliability in Engineering.

02 Hours

Teaching-Learning Process for all modules	**Chalk and Talk, Power point presentation, flip teaching, YouTube videos**

Course Outcomes

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

1. Familiarize with fundamental rights and duties.

2. Recognize the Electoral Process.
3. Get exposed to legislature and judiciary.
4. Realize special provisions given for women, children and weaker section of society.
5. Exhibit Engineering ethics and responsibilities of Engineers

Assessment Details (both CIE and SEE)

Component		Weightage (%)	
CIE's	CIE 1 5th week	20	60
	CIE 2 10th week	20	
	CIE 3 15th week	20	
AAT's	AAT-1 10th week	10	
	AAT-2	10	
	AAT-3	20	
Continuous Internal Evaluation Total Marks: 100. Reduced to 50 Marks			
Semester End Examination (SEE) Total Marks: 100. Reduced to 50 Marks			

Suggested Learning Resources:

Text Books:

1. Durga Das Basu, "Introduction to the Constitution of India", Lexis Nexis Publications; 22nd Edition, 2015, ISBN-13: 978-9351434467.
2. Charles E. Haries, Michael S Pritchard and Michael J. Robins, "Engineering Ethics", Thomson Wadsworth, 2nd Edition, 2003, ISBN-13: 978-9812436764.

Reference Books:

1. M.V. Pylee, "An Introduction to Constitution of India", Vikas Publishing, 2002, 1st Edition, ISBN-13: 978-8125918325.
2. M. Govindarajan, S. Natarajan, V.S. Senthilkumar, "Engineering Ethics", PHI Learning Private Limited, New Delhi, 2nd Edition, 2013, ISBN-13: 978-8120348165
3. Brij Kishore Sharma, "Introduction to the Constitution of India", PHI Learning Private Limited, New Delhi, 7th Edition, 2015, ISBN-13: 978-8120350892.

E-Resources:

1. http://www.cgsird.gov.in/constitution.pdf
2. http://indiacode.nic.in/coiweb/welcome.html

SEMESTER - III

LD (Logic Design) Lab using Pspice / MultiSIM			
Course Code	**21ECL381**	**CIE Marks**	**50**
Teaching Hours/Week (L: T:P: S) (0:0:2:0)	**Credits (0:0:1:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**13 lab slots**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

Course objectives:

1. Gain the concepts of De Morgan's Theorem, SOP, and POS forms.
2. Understand the concepts of designing and analyzing combinational logic circuits.
3. Experiment with the concepts of analysis of sequential logic circuits.
4. Analyze and design any given synchronous sequential circuits.
5. Implement the digital design concepts with open source software

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.
4	Design and implementation of BCD to Excess-3 code conversion and vice-versa using Pspice/Multisim.
5	Design and implement of IC 7485 5-bit magnitude comparator using Pspice/Multisim.
6	To Realize Adder & Subtractor using IC 74153 (4:1 MUX) and 4-variable function using IC74151 (8:1MUX) using Pspice/Multisim.
7	To realize Adder and Subtractor using IC 74139/ 74155N (Demux/Decoder) and Binary to Gray code conversion & vice versa using 74139/ 74155N using Pspice/Multisim.
8	SR, Master-Slave JK, D & T flip-flops using NAND Gates using Pspice/Multisim.
9	Design and realize the Synchronous counters (up/down decade/binary) using Pspice/Multisim.

Course outcomes (Course Skill Set):

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

1. Demonstrate the truth table of various expressions and combinational circuits using logic gates.
2. Design various combinational circuits such as adders, subtractors, comparators, multiplexers andcode converters.
3. Construct flips-flops, counters and shift registers.
4. Design and implement synchronous counters.
5. Realize the design theory and implementation concept using open source software.

Assessment Details (both CIE and SEE)

Continuous Internal Assessment of Laboratory/Practical Courses		
Lab Test 1	Lab Test 2	Lab Records
15 marks	15 marks	20 marks
Semester End Examination (SEE)		**50 marks**

Suggested 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.

SEMESTER - III

AEC (Analog Electronic Circuits) Lab using Pspice / MultiSIM			
Course Code	**21ECL382**	**CIE Marks**	**50**

Teaching Hours/Week (L: T:P: S) (0:0:2:0)	Credits (0:0:1:0)	SEE Marks	50
Total Hours of Pedagogy	13 lab slots	Total Marks	100
Credits	01	Exam Hours	03

Course objectives:

1. To provide practical exposure to the students on designing, setting up.
2. Executing and debugging various electronic circuits using simulation software.
3. To give the knowledge on simple applications of analog electronic circuits.
4. To provide practical exposure to the students in setting up the circuits.
5. Give the practical exposure on applications of analog electronic circuits.

Sl. No	Experiments using Pspice/MultiSIM software
1	Experiments to realize diode clipping (single, double ended) circuits.
2	Experiments to realize diode clamping (positive, negative) circuits.
3	Experiments to realize Full wave rectifier without filter (and set-up to measure the ripple factor, Vp-p, Vrms, etc.).
4	Design and conduct an experiment on Series Voltage Regulator using Zener diode to determineline/load regulation characteristics.
5	Realize BJT Darlington Emitter follower without bootstrapping and determine the gain, input andoutput impedances (other configurations of emitter follower can also be considered).
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.
7	Design and set-up the oscillator circuits (Hartley, Colpitts, etc. using BJT/FET) and determine thefrequency of oscillation.
8	Design and set-up the crystal oscillator and determine the frequency of oscillation.
9	Experiment to realize Input and Output characteristics of BJT Common emitter configuration and evaluation of parameters.
10	Experiments to realize Transfer and drain characteristics of a MOSFET.

Course outcomes (Course Skill Set):

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

1. Understand the circuit schematic and its working.
2. Study the characteristics of different electronic devices.
3. Design and test simple electronic circuits as per the specifications using discrete electroniccomponents.
4. Compute the parameters from the characteristics of active devices.
5. Familiarize with EDA software which can be used for electronic circuit simulation.

Assessment Details (both CIE and SEE)

Continuous Internal Assessment of Laboratory/Practical Courses		
Lab Test 1	Lab Test 2	Lab Records
15 marks	15 marks	20 marks
Semester End Examination (SEE)		**50 marks**

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.

SEMESTER - III

LIC (Linear Integrated Circuits) Lab using Pspice / MultiSIM			
Course Code	21ECL383	CIE Marks	50
Teaching Hours/Week (L: T:P: S) (0:0:2:0)	Credits (0:0:1:0)	SEE Marks	50
Total Hours of Pedagogy	13 lab slots	Total Marks	100
Credits	01	Exam Hours	03

Course objectives:

1. To apply operational amplifiers in linear and nonlinear applications.
2. To acquire the basic knowledge of special function ICs.
3. To use Multisim/Pspice software for circuit design and simulation

Sl.No	**Experiments using Pspice / MultiSIM** Every experiment has to be designed, circuit to be drawn / constructed and executed in thespecified software. Results are also to be noted and inferred.
	Note: Standard design procedure to be adopted.
1	To realize using op-amp an Inverting Amplifier and Non-Inverting Amplifier
2	To realize using op-amps i) Summing Amplifier ii) Difference amplifier
3	To realize using op-amps i) Differentiator ii) Integrator
4	To realize using op-amps a Full wave Precision Rectifier
5	To realize using op-amps • Inverting and Non-Inverting Zero Crossing Detectors • Positive and Negative Voltage comparators
6	To realize using op-amp an Inverting Schmitt Trigger
7	To design and implement using op-amp a RC Phase Shift Oscillator
8	To design and implement 4 - bit R-2R Digital to Analog Converter

Course outcomes (Course Skill Set):

After studying this course, students will be able to;

1. Sketch/draw circuit schematics, construct circuits, analyze and troubleshoot circuits containingop-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, Precision 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.

Assessment Details (both CIE and SEE)

Continuous Internal Assessment of Laboratory/Practical Courses		
Lab Test 1	Lab Test 2	Lab Records
15 marks	15 marks	20 marks
Semester End Examination (SEE)		**50 marks**

Suggested Learning Resources:

1. Op-Amps and Linear Integrated Circuits, Ramakant A Gayakwad, 4th Edition, Pearson Education, 2018.

SEMESTER - III

LabVIEW Programming Basics			
Course Code	**21ECL384**	**CIE Marks**	**50**
Teaching Hours/Week (L: T:P: S) (0:0:2:0)	**Credits (0:0:1:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**13 lab slots**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

Course objectives:

1. Understand the basics of virtual instrumentation concept and dataflow programming.
2. Analyze various front panel controls and indicators.
3. Apply and manipulate nodes and wires, various toolbars and pull-down menus in the block diagram.
4. Design simple projects using the functions available in Lab VIEW

5. Develop Real time Applications using LabVIEW software.

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

Course outcomes (Course Skill Set):

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

1. Understand to various functions available in Lab VIEW for engineering applications
2. Gain knowledge to create data acquisition, analysis and display operations
3. Analyze programming structures and data types that exist in Lab VIEW
4. Apply various editing and debugging techniques.
5. Create Real time user interfaces with charts, graph and buttons.

Assessment Details (both CIE and SEE)

Continuous Internal Assessment of Laboratory/Practical Courses		
Lab Test 1	Lab Test 2	Lab Records
15 marks	15 marks	20 marks
Semester End Examination (SEE)		**50 marks**

Suggested Learning Resources:

1. Jovitha Jerome , "Virtual Instrumentation using LABVIEW" , PHI, 2011, ISBN: 9788120340305
2. Sanjay Gupta & Joseph John, "Virtual Instrumentation Using Lab View" , Tata McGraw Hill. Publisher Ltd., 2nd Edition, New Delhi, 2010, ISBN : 978-0070700284

SEMESTER – IV

Digital Signal Processing			
Course Code	**21ECI42 (IC)**	**CIE Marks**	**50**
Teaching Hours/Week (L: T:P:S) (3:0:2:0)	**Credits (3:0:1:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40 hours Theory + 13 Lab slots**	**Total Marks**	**100**
Credits	**04**	**Exam Hours**	**03**

Course objectives:

This course will enable students to:

1. Understand the basics of Fourier Transform and its relation with other transforms.
2. Explain the Properties of Discrete Fourier Transform and Linear Filtering methods.
3. Design and develop FIR filter using window technique.
4. Analyze the performance of IIR filters.
5. Understand the DSP architecture and analyzing the performance of Digital signal processor.

Teaching-Learning Process (General Instructions)

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

- Lecture method (L) does not mean only traditional lecture method, but a different type of teaching methods may be adopted to develop the outcomes.
- Show Video/animation films to explain the different concepts of Linear Algebra & Signal Processing.
- Encourage collaborative (Group) Learning in the class.
- Ask at least three HOTS (Higher Order Thinking) questions in the class, which promotes critical thinking.
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
- Topics will be introduced in a multiple representation.
- Show the different ways to solve the same problem and encourage the students to come up withtheir own creative ways to solve them.
- Discuss how every concept can be applied to the real world - and when that's possible, it helpsimprove the students' understanding.
- Adopt Flipped class technique by sharing the materials / Sample Videos prior to the class and have discussions on the that topic in the succeeding classes.
- Give Programming Assignments.

Module-1

Discrete Fourier Transforms (DFT): Frequency domain sampling and Reconstruction of Discrete Time Signals, The Discrete Fourier Transform, DFT as a linear transformation, Properties of the DFT: Periodicity, Linearity and Symmetry properties, Multiplication of two DFTs and Circular Convolution.

08 Hours

Module-2

Additional DFT Properties, **Linear filtering methods based on the DFT:** Use of DFT in Linear Filtering, Filtering of Long data Sequences. Fast-Fourier-Transform (FFT) algorithms: Efficient Computation of the DFT: Radix-2 FFT algorithms for the computation of DFT and IDFT decimation in-time.

08 Hours

Module-3

Design of FIR Filters: Characteristics of practical frequency-selective filters, Symmetric and Anti-symmetric FIR filters, Design of Linear-phase FIR (low pass and High pass) filters using windows -Rectangular, Hamming, Hanning, Bartlett windows. Structure for FIR Systems: Direct form, Cascade form, and Lattice structures.

08 Hours

Module-4

IIR Filter Design: Infinite Impulse response Filter Format, Bilinear Transformation Design Method, Analog Filters using Low pass prototype transformation, Normalized Butterworth Functions, Bilinear Transformation and Frequency Warping, Bilinear Transformation Design Procedure, Digital Butterworth(LowpassandHighpass)FilterDesignusingBLT.RealizationofIIRFiltersinDirectformIandII.

Filter Comparison: Comparison between Analog Filters and Digital Filters.

08 Hours

Module-5

Digital Signal Processors: DSP Architecture, DSP Hardware Units, Fixed point format, Floating point Format, IEEE Floating point formats, Fixed point digital signal processors, FIR and IIR filter implementations in Fixed point systems.

Digital Signal Processors: Architecture of Digital Signal Processors (TMS320CXX family), How DSP processor is important than the microprocessor.

08 Hours

Teaching-Learning Process for all modules	**Chalk and Talk, Power point presentation, flip teaching, YouTube videos**

PRACTICAL COMPONENT OF IPCC

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

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. ComputationofcircularconvolutionoftwogivensequencesusingDFTandIDFT
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 low pass FIR filter to meet given specifications.
9. DesignandimplementationofhighpassFIRfiltertomeetgivenspecifications.
10. To compute N-Point DFT of a given sequence using DSK6713 simulator

Course outcomes (Course Skill Set)

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

1. Understand the use of Discrete Fourier Transform in signal processing.
2. Apply DFT techniques in linear filtering and spectral analysis.
3. Evaluate convolution using FFT algorithms.
4. Analyze digital IIR filters and structure of IIR filters.
5. Design and analyze digital FIR filters and structure of FIR filters.

Assessment Details (both CIE and SEE)

Component		**Weightage (%)**		
CIE's	CIE 1 5th week	20	60	Average of 3 tests for 20 marks
	CIE 2 10th week	20		
	CIE 3 15th week	20		
AAT's	AAT-1 10th week			10
	Lab Test	50		Reduced to 10
	Lab Record	20		10
Continuous Internal Evaluation Total Marks :100. Reduced to 50 Marks				
Semester End Examination (SEE) Total Marks :100. Reduced to 50 Marks				

Suggested Learning Resources:

Text Books:

1. J. G. Proakis, D. G. Manolakis: "Digital Signal Processing: Principles, Algorithms and Applications", 4th Edition, Pearson Education Asia/Prentice Hall of India, 2002, ISBN-10:0131873741, ISBN-13: 978-0131873742.

2. Sanjit K. Mitra: "Digital Signal Processing", 4th Edition, Tata McGraw Hill, 2006, ISBN-10: 0073380490, ISBN-13: 978-0073380490.

Reference Books:

1. Oppenheim, Schafer: "Discrete Time Signal Processing", 3rd Edition, Pearson Education, 2003, ISBN-10: 0131988425, ISBN-13: 978-0131988422.

SEMESTER – IV

Circuits & Controls			
Course Code	**21ECI43**	**CIE Marks**	**50**
Teaching Hours/Week (L: T: P: S) (3:0:2:0)	**Credits: (3:0:1:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40 hours Theory + 13 Lab slots**	**Total Marks**	**100**
Credits	**04**	**Exam Hours**	**03**

Course objectives: This course will enable students to:

1. Understand mesh and nodal techniques to solve an electrical network and solve different problems related to Electrical circuits using Network Theorems.
2. Analyze the circuit parameters of Two port network and familiarize with the use of Laplace transforms to solve network problems.
3. Understand basics of control systems and design mathematical models using block diagram reduction, SFG, etc.
4. Apply Time domain and Frequency domain analysis.
5. Evaluate the stability of a given transfer functions using Root-Locus concepts and Compute the frequency response assessment for relative stability using Bode plots.

Teaching-Learning Process (General Instructions)

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

- Lecture method (L) does not mean only traditional lecture method, but a different type of teaching methods may be adopted to develop the outcomes.
- Show Video/animation films to explain the different concepts of Linear Algebra & Signal Processing.
- Encourage collaborative (Group) Learning in the class.
- Ask at least three HOTS (Higher Order Thinking) questions in the class, which promotes critical thinking.
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
- Topics will be introduced in a multiple representation.
- Show the different ways to solve the same problem and encourage the students to come up withtheir own creative ways to solve them.
- Discuss how every concept can be applied to the real world - and when that's possible, it helpsimprove the students' understanding.
- Adopt Flipped class technique by sharing the materials / Sample Videos prior to the class and have discussions on the that topic in the succeeding classes.
- Give Programming Assignments.

Module-1

Basic concepts and network theorems: Types of Sources, Loop analysis, Nodal analysis with independent DC and AC Excitations. Super position theorem, Thevenin's theorem, Norton's Theorem.

8 Hours

Module-2

Network Topology: Graph of a network, Concept of tree and co-tree, incidence matrix, tie-set, tie-set and cut- set schedules.

Two port networks: Short- circuit Admittance parameters, Open- circuit Impedance parameters, Transmission parameters. **8 Hours**

Module-3

Analysis of Electrical Systems: Types of control systems, effect of feedback systems, differential equation of electrical systems, Introduction to block diagrams, transfer functions.

8 Hours

Module-4

Time Response analysis: Time response of first order systems. Time response of second order systems, time response specifications of second order systems, Routh stability criterion.

8 Hours

Module-5

Frequency Domain analysis and stability: Correlation between time and frequency response and Bode plots.
State Variable Analysis: Introduction to state variable analysis: Concepts of state, state variable and state models. State model for Linear continuous –Time systems, solution of state equations.

8 Hours

Teaching-Learning Process for all modules	**Chalk and Talk, Power point presentation, flip teaching, YouTube videos**

PRACTICAL COMPONENTS

Using suitable hardware and simulation software, demonstrate the operation of the following circuits:

Sl.No.	**Experiments**
1	Verification of Superposition theorem
2	Verification of Thevenin's theorem
3	Verification of Norton's theorem
4	Determination of time response specification of a second order Under damped System, for different damping factors.
5	Determination of frequency response of a second order System
6	Determination of frequency response of a lead lag compensator
7	Using Suitable simulation package study of speed control of DC motor using i) Armature control ii) Field control
	Demonstration Experiments (For CIE only, not for SEE)
8	Using suitable simulation package, obtain the time response from state model of a system.
9	Implementation of PI, PD Controllers.
10	Implement a PID Controller and hence realize an Error Detector.

Course Outcomes

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

1. Analyze and solve Electric circuit, by applying, loop analysis, Nodal analysis and applying network Theorems.
2. Evaluate two port parameters of a network and Apply Laplace transforms to solve electric networks.
3. Deduce transfer function of a given physical system, from differential equation representation or Block Diagram representation and SFG representation.
4. Calculate time response specifications and analyze the stability of the system.
5. Analyze the effect of gain on system behavior using root loci and perform frequency response Analysis and find the stability of the system.

Assessment Details (both CIE and SEE)

Component		**Weightage (%)**		
CIE's	CIE 1 5th week	20	60	Average of 3 tests for 20 marks
	CIE 2 10th week	20		
	CIE 3 15th week	20		
AAT's	AAT-1 10th week			10
	Lab Test	50		Reduced to 10
	Lab Record	20		10
Continuous Internal Evaluation Total Marks :100. Reduced to 50 Marks				
Semester End Examination (SEE) Total Marks :100. Reduced to 50 Marks				

Suggested Learning Resources:

Text Books:

1. Engineering circuit analysis, William H Hayt, Jr, Jack E Kemmerly, Steven M Durbin, Mc Graw Hill Education, Indian Edition 8e, ISBN 978-1259098635.
2. Control Systems Engineering, I J Nagrath, M. Gopal, New age international Publishers, Fifth edition, ISBN 978-9353165727.

Reference Books:

1. Network Analysis, M E Van Valkenburg, Pearson, 3e, ISBN-10 :8122434096.
2. Networks and Systems, D Roy Choudhury, New age international Publishers, second edition, ISBN-10 : 9788122427677

SEMESTER – IV

Communication Theory			
Course Code	**21ECT44**	**CIE Marks**	**50**
Teaching Hours/Week (L: T:P: S) (3:0:0:1)	**3:0:0:1**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40**	**Total Marks**	**100**
Credits	**3**	**Exam Hours**	**3**

Course objectives:

This course will enable students to

1. Understand and analyze concepts of Analog Modulation with frequency spectrum.
2. Study the generation and demodulation with linear and nonlinear concepts used in angle modulation.
3. Evolve the concept of SNR in the presence of channel induced noise and study Demodulation of analog modulated signals.
4. Understand and study the concepts of sampling and pulse modulation.
5. Evolve the concept of quantization noise for sampled and encoded signals and also study the concepts of reconstruction from these samples at a receiver.

Teaching-Learning Process (General Instructions)

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

- Lecture method (L) does not mean only traditional lecture method, but a different type of teaching methods may be adopted to develop the outcomes.
- Show Video/animation films to explain the different concepts of Linear Algebra & Signal Processing.
- Encourage collaborative (Group) Learning in the class.
- Ask at least three HOTS (Higher Order Thinking) questions in the class, which promotes critical thinking.
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
- Topics will be introduced in a multiple representation.
- Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
- Adopt Flipped class technique by sharing the materials / Sample Videos prior to the class and have discussions on the that topic in the succeeding classes.
- Give Programming Assignments.

Module-1

AMPLITUDE MODULATION: Introduction, Amplitude Modulation: Time & Frequency Domaindescription, switching modulator, Envelop detector.

DOUBLE SIDE BAND-SUPPRESSED CARRIER MODULATION: Time and Frequency Domain description, Ring modulator, Coherent detection, Costas Receiver, Quadrature Carrier Multiplexing.

SINGLE SIDE–BAND AND VESTIGIAL SIDEBAND METHODS OF MODULATION: SSB Modulation, VSB Modulation, Frequency Translation.

08 Hours

Module-2

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.

08 Hours

Module-3

NOISE: Shot Noise, Thermal noise, White Noise.

NOISE IN ANALOG MODULATION: Introduction, Receiver Model, Noise in DSB-SC receivers. Noise in AM receivers, FM threshold effect, Pre-emphasis, and De-emphasis in FM.

08 Hours

Module-4

SAMPLING: Introduction to digitize analog sources, The Low pass Sampling Process-Pulse Amplitude Modulation. Time Division Multiplexing, Pulse-Position Modulation, Generation of PPM Waves, Detection of PPM Waves.

08 Hours

Module-5

QUANTIZATION: The Quantization Random Process, Quantization Noise, Pulse–Code Modulation: Sampling, Quantization, Encoding, Regeneration, Decoding, Filtering, Multiplexing; Delta Modulation

08 Hours

Teaching-Learning Process for all modules	**Chalk and Talk, Power point presentation, flip teaching, YouTube videos**

Course Outcomes:

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

1. Understand the amplitude modulation techniques and perform time and frequencydomain transformations.
2. Identify the schemes for frequency modulation and demodulation of analog signals and compare the performance.
3. Characterize the influence of channel noise on analog modulated signals.
4. Understand the characteristics of pulse amplitude modulation and pulse position modulation.
5. Illustration of pulse code modulation systems and digital formatting representations used for Multiplexers.

Assessment Details (both CIE and SEE)

Component		**Weightage (%)**	
CIE's	CIE 1 5th week	20	60
	CIE 2 10th week	20	
	CIE 3 15th week	20	
AAT's	AAT-1 10th week	10	
	AAT-2	10	
	AAT-3	20	
Continuous Internal Evaluation Total Marks: 100. Reduced to 50 Marks			
Semester End Examination (SEE) Total Marks: 100. Reduced to 50 Marks			

Suggested Learning Resources:

Text Books:

1. Simon Haykins & Moher, Communication Systems, 5th Edition, John Wiley, India Pvt. Ltd, 2012, ISBN 978 -81–265– 151-7.

Reference Books

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, ISBN: 978-0-07-064811-1.

SEMESTER – IV

Biology For Engineers			
Course Code	**21BET45**	**CIE Marks**	**50**
Teaching Hours/Week (L: T:P: S) (2:0:0:0)	**2:0:0:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**26**	**Total Marks**	**100**
Credits	**2**	**Exam Hours**	**3**

Course objectives:

This course will enable students to

1. Understand Why Should Engineers Know Biology
2. Analyze the Chemical Composition of Living Forms
3. Explain the Human organ systems and bio-designs
4. Analyze the nature-bioinspired materials and mechanisms
5. Evolution and trends in bioengineering

Teaching-Learning Process (General Instructions)

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

- Explanation via real life problem, situation modelling, and deliberation of solutions, hands-on sessions, reflective and questioning /inquiry-based teaching.
- Instructions with interactions in classroom lectures (physical/hybrid).
- Use of ICT tools, including YouTube videos, related MOOCs, AR/VR/MR tools.
- Flipped classroom sessions (~10% of the classes).
- Industrial visits, Guests talks, and competitions for learning beyond the syllabus.
- Students' participation through audio-video-based content creation for the syllabus (as assignments).
- Students' seminars (in solo or group) /oral presentations.

Module-1

Science and Engineering Why Should Engineers Know Biology? : Introduction Need for Biology

Biomolecules and their applications (Qualitative):

Carbohydrates (cellulose-based water filters, PHA and PLA as bioplastics), Nucleic acids (DNA Vaccine for Rabies and RNA vaccines for Covid19, Forensics – DNA fingerprinting), Proteins (Proteins as food – whey protein and meat analogs, Plant based proteins), lipids (biodiesel, cleaning agents/detergents)

05 Hours

Module-2

Human organ systems and bio designs - 1 (Qualitative):

Brain as a CPU system (architecture, CNS and Peripheral Nervous System, signal transmission, EEG, Robotic arms for prosthetics. Engineering solutions for Parkinson's disease).Eye as a Camera system (architecture of rod and cone cells, optical corrections, cataract, lens materials, bionic eye).Heart as a pump system (architecture, electrical signalling - ECG monitoring and heart related issues, reasons for blockages of blood vessels, design of stents, pace makers, defibrillators)

05 Hours

Module-3

Human organ systems and bio-designs - 2 (Qualitative):

Lungs as purification system (architecture, gas exchange mechanisms, spirometry, abnormal lung physiology - COPD, Ventilators, Heart-lung machine).Kidney as a filtration system (architecture, mechanism of filtration, CKD, dialysis systems). Muscular and Skeletal Systems as scaffolds (architecture, mechanisms, bioengineering solutions for muscular dystrophy and osteoporosis).

05 Hours

Module-4

Nature-bioinspired materials and mechanisms (Qualitative):

Echolocation (ultrasonography, sonars), Photosynthesis (photovoltaic cells, bionic leaf). Bird flying (GPS and aircrafts), Lotus leaf effect (Super hydrophobic and self-cleaning surfaces), Plant burrs (Velcro), Shark skin (Friction reducing swim suits), Kingfisher beak (Bullet train). Human Blood substitutes -hemoglobin-based oxygen carriers (HBOCs) and perflourocarbons (PFCs).

05 Hours

Module-5

Trends in bioengineering (Qualitative):

Bioprinting techniques and materials, 3D printing of ear, bone and skin. 3D printed foods. Electrical tongue and electrical nose in food science, DNA origami and Biocomputing, Bioimaging and Artificial Intelligence

for disease diagnosis. Self- healing Bioconcrete (based on bacillus spores, calcium lactate nutrients and biomineralization processes) and Bioremediation and Biomining via microbial surface adsorption (removal of heavy metals like Lead, Cadmium, Mercury, Arsenic).

06 Hours

Teaching-Learning Process for all modules	**Chalk and Talk, Power point presentation, flip teaching, YouTube videos**

Course Outcomes:

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

- Understand Why Should Engineers Know Biology
- Analyze the Chemical Composition of Living Forms
- Explain the Human organ systems and bio designs
- Analyze the Nature-bioinspired materials and mechanisms
- Analyze the evolution and trends in bioengineering

Assessment Details (both CIE and SEE)

Component		**Weightage (%)**	
CIE's	CIE 1 5th week	20	60
	CIE 2 10th week	20	
	CIE 3 15th week	20	
AAT's	AAT-1 10th week	10	
	AAT-2	10	
	AAT-3	20	
Continuous Internal Evaluation Total Marks: 100. Reduced to 50 Marks			
Semester End Examination (SEE) Total Marks: 100. Reduced to 50 Marks			

Web links and Video Lectures (e-Resources):

- VTU EDUSAT / SWAYAM / NPTEL / MOOCS / Coursera / MIT-open learning resource
- https://nptel.ac.in/courses/121106008
- https://freevideolectures.com/course/4877/nptel-biology-engineers-other-non-biologists
- https://ocw.mit.edu/courses/20-020-introduction-to-biological-engineering-design-spring-2009
- https://ocw.mit.edu/courses/20-010j-introduction-to-bioengineering-be-010j-spring-2006
- https://www.coursera.org/courses?query=biology
- https://onlinecourses.nptel.ac.in/noc19_ge31/preview
- https://www.classcentral.com/subject/biology
- https://www.futurelearn.com/courses/biology-basic-concepts

Suggested Learning Resources:

- Human Physiology, Stuart Fox, Krista Rompolski, McGraw-Hill eBook. 16th Edition, 2022
- Biology for Engineers, Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi S., and Jaganthan M.K., Tata McGraw-Hill, New Delhi, 2012.
- Biology for Engineers, Arthur T. Johnson, CRC Press, Taylor and Francis, 2011
- Biomedical Instrumentation, Leslie Cromwell, Prentice Hall 2011.
- Biology for Engineers, Sohini Singh and Tanu Allen, Vayu Education of India, New Delhi, 2014.
- Biomimetics: Nature-Based Innovation, Yoseph Bar-Cohen, 1st edition, 2012, CRC Press.
- Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies, D. Floreano and C. Mattiussi, MIT Press, 2008.
- Bioremediation of heavy metals: bacterial participation, by C R Sunilkumar, N Geetha A C Udayashankar Lambert Academic Publishing, 2019.
- 3D Bioprinting: Fundamentals, Principles and Applications by Ibrahim Ozbolat, Academic Press, 2016. Electronic Noses and Tongues in Food Science, Maria Rodriguez Mende, Academic Press, 2016

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Group Discussion of Case studies
- Model Making and seminar/poster presentations.
- Design of novel device/equipment like Cellulose-based water filters, Filtration system mimicking the kidney, Bioremediation unit for E-waste management, AI and ML based Bioimaging.

SEMESTER – IV

Communication Laboratory I			
Course Code	**21ECL46**	**CIE Marks**	**50**
Teaching Hours/Week (L: T: P: S) (0:0:2:0)	**Credits (0:0:1:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**13 Lab slots**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

Course objectives:

This laboratory course enables students to:

1. Model an analog communication system signal transmission and reception.
2. Understand the Flat top sampling process.
3. Realize the electronic circuits to perform analog and pulse modulations and demodulations.
4. Understand the necessity of Pre-emphasis and de-emphasis used in FM system.
5. Understand the implementation of circuits using open-source software.

Sl. No.	Experiments
1	Design and construction of second order active low pass filter and plot the frequency response.
2	Design and construction of second order active high pass filter and plot the frequency response.
3	Design and construction of active band pass filter and plot the frequency response.
4	Design and construction of active band stop filter and plot the frequency response.
5	Illustration of Amplitude Modulation and Demodulation and also study the Spectral characteristics using SCILAB
6	Design and test Time Division Multiplexing and Demultiplexing of two bandlimited signals.
7	Design and conduct an experiment to generate Flat top sampling.
8	Design and conduct an experiment to generate Pulse amplitude modulation and demodulation.
9	Design and conduct an experiment for Pre-emphasis and de-emphasis.
10	Illustration of FM modulation and display the signal and its spectrum using SCILAB

Course outcomes (Course Skill Set):

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

1. Demonstrate the filtering process used in the modulation and demodulation.
2. Demonstrate amplitude modulation and demodulation.
3. Design and test the flat top sampling, Multiplexing, and Pulse Amplitude Modulation (PAM) with relevant circuits.
4. Demonstrate the Amplitude /Frequency modulation and demodulation operations using open-source software.

Assessment Details (both CIE and SEE)

Continuous Internal Assessment of Laboratory/Practical Courses		
Lab Test 1	Lab Test 2	Lab Records
15 marks	15 marks	20 marks
Semester End Examination **(**SEE)		50 marks

Suggested Learning Resources:

1. Louis E Frenzel, Principles of Electronic Communication Systems, McGraw Hill Education (India)Private Limited, 2016. ISBN-13- 978-0073373850.
2. B P Lathi, Zhi Ding, Modern Digital and Analog Communication Systems, Oxford University Press,2015, ISBN 978-0-19-538493-2.

SEMESTER – IV

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ			
ವಿಷಯ ಸಂಕೇತ (Course Code)	21KSK39/49	ನಿರಂತರ ಆಂತರಿಕ ಮೌಲ್ಯಮಾಪನದ	50

ಘಟಕ -2 ಆಧುನಿಕ ಪೂರ್ವದ ಕಾವ್ಯ ಭಾಗ	
1. ವಚನಗಳು : ಬಸವಣ್ಣ, ಅಕ್ಕಮಹಾದೇವಿ, ಅಲ್ಲಮಪ್ರಭು, ಆಯ್ದಕ್ಕಿ ಮಾರಯ್ಯ, ಜೇಡರದಾಸಿಮಯ್ಯ, ಆಯ್ದಕ್ಕಿ ಲಕ್ಕಮ್ಮ. 2. ಕೀರ್ತನೆಗಳು : ಅದರಿಂದೇನು ಫಲ ಇದರಿಂದೇನು ಫಲ - ಪುರಂದರದಾಸರು ತಲ್ಲಣಿಸದಿರು ಕಂಡ್ಯ ತಾಳು ಮನವೇ - ಕನಕದಾಸರು 3. ತತ್ವಪದಗಳು : ಸಾವಿರ ಕೊಡಗಳ ಸುಟ್ಟು - ಶಿಶುನಾಳ ಶರೀಫ	
ಬೋಧನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪಿಟಿ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವಿಡಿಯೋಗಳನ್ನು ಬಳಸುವುದು, ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆ ಚಟುವಟಿಕೆಗಳ ಮುಖಾಂತರ ಚರ್ಚಿಸುವುದು.
ಘಟಕ -3 ಆಧುನಿಕ ಕಾವ್ಯಭಾಗ	
1. ಡಿವಿಜಿ ರವರ ಮಂಕುತಿಮ್ಮನ ಕಗ್ಗದಿಂದ ಆಯ್ದ ಕೆಲವು ಭಾಗಗಳು 2. ಕುರುಡು ಕಾಂಚಾಣ : ದಾ.ರಾ. ಬೇಂದ್ರೆ 3. ಹೊಸಬಾಳಿನ ಗೀತೆ : ಕುವೆಂಪು	
ಬೋಧನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪಿಟಿ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವಿಡಿಯೋಗಳನ್ನು ಬಳಸುವುದು, ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆ ಚಟುವಟಿಕೆಗಳ ಮುಖಾಂತರ ಚರ್ಚಿಸುವುದು.
ಘಟಕ -4 ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯ	
1. ಡಾ. ಸರ್. ಎಂ. ವಿಶ್ವೇಶ್ವರಯ್ಯ : ವ್ಯಕ್ತಿ ಮತ್ತು ಐತಿಹ್ಯ - ಎ ಎನ್ ಮೂರ್ತಿರಾವ್ 2. ಕರಕುಶಲ ಕಲೆಗಳು ಮತ್ತು ಪರಂಪರೆಯ ವಿಜ್ಞಾನ : ಕರೀಗೌಡ ಬೀಚನಹಳ್ಳಿ	
ಬೋಧನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪಿಟಿ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವಿಡಿಯೋಗಳನ್ನು ಬಳಸುವುದು, ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆ ಚಟುವಟಿಕೆಗಳ ಮುಖಾಂತರ ಚರ್ಚಿಸುವುದು.
ಘಟಕ -5 ಕಥೆ ಮತ್ತು ಪ್ರವಾಸ ಕಥನ	
1. ಯುಗಾದಿ : ವಸುಧೇಂದ್ರ 2. ಮೆಗಾನೆ ಎಂಬ ಗಿರಿಜನ ಪರ್ವತ : ಹಿ.ಚಿ. ಬೋರಲಿಂಗಯ್ಯ	
ಬೋಧನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪಿಟಿ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವಿಡಿಯೋಗಳನ್ನು ಬಳಸುವುದು, ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆ ಚಟುವಟಿಕೆಗಳ ಮುಖಾಂತರ ಚರ್ಚಿಸುವುದು.

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ ಕಲಿಕೆಯಿಂದ ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಆಗುವ ಪರಿಣಾಮಗಳು (course Outcomes):

1. ಕನ್ನಡ ಭಾಷೆ, ಸಾಹಿತ್ಯ ಮತ್ತು ಕನ್ನಡದ ಸಂಸ್ಕೃತಿಯ ಪರಿಚಯವಾಗುತ್ತದೆ.
2. ಕನ್ನಡ ಸಾಹಿತ್ಯದ ಆಧುನಿಕ ಪೂರ್ವ ಮತ್ತು ಆಧುನಿಕ ಕಾವ್ಯಗಳು ಮತ್ತು ಸಂಸ್ಕೃತಿಯ ಬಗ್ಗೆ ಆಸಕ್ತಿಯು ಮೂಡುತ್ತದೆ.
3. ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯವಾಗುತ್ತದೆ.
4. ಕನ್ನಡ ಭಾಷಾಭ್ಯಾಸ, ಸಾಮಾನ್ಯ ಕನ್ನಡ ಹಾಗೂ ಆಡಳಿತ ಕನ್ನಡದ ಪದಗಳ ಪರಿಚಯವಾಗುತ್ತದೆ.

ಮೌಲ್ಯಮಾಪನದ ವಿಧಾನ (**Assessment Details- both CIE and SEE**) :

(methods of CIE - MCQ, Quizzes, Open book test, Seminar or micro project)
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The student has to obtain a minimum of 40% marks individually both in CIE and 35% marks in SEE to pass. Theory Semester End Exam (SEE) is conducted for 50 marks (01 hour duration). Based on this grading will be awarded.

Continuous Internal Evaluation:
Three Tests each of **20 Marks (duration 01 hour**)

a. First test at the end of 5th week of the semester
b. Second test at the end of the 10th week of the semester
c. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks : 1.** First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours**)
3. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**
CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

ಸೆಮಿಸ್ಟರ್ ಅಂತ್ಯದ ಪರೀಕ್ಷೆಯು ಈ ಕೆಳಗಿನಂತಿರುತ್ತದೆ - **Semester End Exam (SEE):**

SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject.
1. The question paper will have 50 questions. Each question is set for 01 mark.

SEE Pattern will be in MCQ Model for 50 marks. Duration of the exam is 01 Hour.

ಪಠ್ಯಪುಸ್ತಕ :

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ

ಡಾ. ಹಿ.ಚಿ.ಬೋರಲಿಂಗಯ್ಯ ಮತ್ತು ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ,

ಪ್ರಸಾರಾಂಗ, ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ.

SEMESTER – IV

ಬಳಕೆ ಕನ್ನಡ - baLake Kannada (Kannada for Usage)

ಕನ್ನಡ ಕಲಿಕೆಗಾಗಿ ನಿಗದಿಪಡಿಸಿದ ಪಠ್ಯಪುಸ್ತಕ - (Prescribed Textbook to Learn Kannada)

ವಿಷಯ ಸಂಕೇತ (Course Code)	21KBK39/49	ನಿರಂತರ ಆಂತರಿಕ ಮೌಲ್ಯಮಾಪನದ ಅಂಕಗಳು (Continuous Internal Evaluation Marks)	50
ಒಂದು ವಾರಕ್ಕೆ ಬೋಧನಾ ಅವಧಿ (Teaching Hours / Week (L:T:P: S)	0:2:0:1	ಸೆಮಿಸ್ಟರ್ ಅಂತ್ಯದ ಪರೀಕ್ಷೆಯ ಅಂಕಗಳು (Semester End Examination Marks)	50
ಒಟ್ಟು ಬೋಧನಾ ಅವಧಿ Total Hours of Pedagogy	25 ಗಂಟೆಗಳು	ಒಟ್ಟು ಅಂಕಗಳು (Total Marks)	100
ಕ್ರೆಡಿಟ್ಸ್ (Credits)	01	ಪರೀಕ್ಷೆಯ ಅವಧಿ (Exam Hours)	01 ಗಂಟೆ

ಬಳಕೆ ಕನ್ನಡ ಪಠ್ಯದ ಕಲಿಕೆಯ ಉದ್ದೇಶಗಳು (Course Learning Objectives):

- To Create the awareness regarding the necessity of learning local language for comfortable and healthy life.
- To enable learners to Listen and understand the Kannada language properly.
- To speak, read and write Kannada language as per requirement.
- To train the learners for correct and polite conservation.

ಬೋಧನೆ ಮತ್ತು ಕಲಿಕಾ ವ್ಯವಸ್ಥೆ (Teaching-Learning Process - General Instructions) :

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

1. ಬಳಕೆ ಕನ್ನಡವನ್ನು ತರಗತಿಯಲ್ಲಿ ಶಿಕ್ಷಕರು ಬೋಧಿಸಲು ವಿಟಿಯು ಸೂಚಿಸಿರುವ ಪಠ್ಯಪುಸ್ತಕವನ್ನು ಉಪಯೋಗಿಸಬೇಕು.
2. ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ತಯಾರಿಸಲು ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ಉತ್ತೇಜಿಸುವುದು ಮತ್ತು ತರಗತಿಯಲ್ಲಿ ಅವುಗಳನ್ನು ಚರ್ಚಿಸಲು ಅವಕಾಶ ಮಾಡಿಕೊಡುವುದು.
3. ಪ್ರತಿ ವಿದ್ಯಾರ್ಥಿ ಪುಸ್ತಕವನ್ನು ತರಗತಿಯಲ್ಲಿ ಬಳಸುವಂತೆ ನೋಡಿಕೊಳ್ಳುವುದು ಮತ್ತು ಪ್ರತಿ ಪಾಠ ಮತ್ತು ಪ್ರವಚನಗಳ ಮೂಲ ಅಂಶಗಳಿಗೆ ಸಂಬಂಧಪಟ್ಟಂತೆ ಪೂರಕ ಚಟುವಟಿಕೆಗಳಿಗೆ ತೊಡಗಿಸತಕ್ಕದ್ದು.
1. ಡಿಜಿಟಲ್ ತಂತ್ರಜ್ಞಾನದ ಮುಖಾಂತರ ಇತ್ತೀಚೆಗೆ ಡಿಜಿಟಲೀಕರಣ ಗೊಂಡಿರುವ ಭಾಷೆ ಕಲಿಕೆಯ ವಿಧಾನಗಳನ್ನು ಪಿಪಿಟಿ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ಮುಖಾಂತರ ಚರ್ಚಿಸಲು ಕ್ರಮಕೈಗೊಳ್ಳುವುದು. ಇದರಿಂದ ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ತರಗತಿಯಲ್ಲಿ ಹೆಚ್ಚು ಏಕಾಗ್ರತೆಯಿಂದ ಪಾಠ ಕೇಳಲು ಮತ್ತು ಅಧ್ಯಯನದಲ್ಲಿ ತೊಡಗಲು ಅನುಕೂಲವಾಗುತ್ತದೆ.
2. ಭಾಷಾಕಲಿಕೆಯ ಪ್ರಯೋಗಾಲಯದ ಮುಖಾಂತರ ಬಹುಬೇಗ ಕನ್ನಡ ಭಾಷೆಯನ್ನು ಕಲಿಯಲು ಅನುಕೂಲವಾಗುವಂತೆ ಕಾರ್ಯಚಟುವಟಿಕೆಗಳನ್ನು ಮತ್ತು ಕ್ರಿಯಾ ಯೋಜನೆಗಳನ್ನು ರೂಪಿಸುವುದು.

Module-1

1. Introduction, Necessity of learning a local language. Methods to learn the Kannada language.
2. Easy learning of a Kannada Language: A few tips. Hints for correct and polite conservation, Listening and Speaking Activities
3. Key to Transcription.
4. ವೈಯಕ್ತಿಕ, ಸ್ವಾಮ್ಯಸೂಚಕ/ಸಂಬಂಧಿತ ಸಾರ್ವನಾಮಗಳು ಮತ್ತು ಪ್ರಶ್ನಾರ್ಥಕ ಪದಗಳು - **Personal Pronouns, Possessive Forms, Interrogative words**

ಬೋಧನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪಿಟಿ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವಿಡಿಯೋಗಳನ್ನು ಬಳಸುವುದು, ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆ ಚಟುವಟಿಕೆಗಳ ಮುಖಾಂತರ ಚರ್ಚಿಸುವುದು.

Module-2

1. ನಾಮಪದಗಳ ಸಂಬಂಧಾರ್ಥಕ ರೂಪಗಳು, ಸಂದೇಹಾಸ್ಪದ ಪ್ರಶ್ನೆಗಳು ಮತ್ತು ಸಂಬಂಧವಾಚಕ ನಾಮಪದಗಳು - **Possessive forms of nouns, dubitive question and Relative nouns**
2. ಗುಣ, ಪರಿಮಾಣ ಮತ್ತು ವರ್ಣಬಣ್ಣ ವಿಶೇಷಣಗಳು, ಸಂಖ್ಯಾವಾಚಕಗಳು **Qualitative, Quantitative and Colour Adjectives, Numerals**
3. **ಕಾರಕ ರೂಪಗಳು ಮತ್ತು ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯಗಳು – ಸಪ್ತಮಿ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯ – (ಅ, ಅದು, ಅವ್ವ, ಅಲ್ಲಿ) Predictive Forms, Locative Case**

ಬೋಧನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪಿಟಿ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವಿಡಿಯೋಗಳನ್ನು ಬಳಸುವುದು, ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆ ಚಟುವಟಿಕೆಗಳ ಮುಖಾಂತರ ಚರ್ಚಿಸುವುದು.

Module-3

1. **ಚತುರ್ಥಿ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯದ ಬಳಕೆ ಮತ್ತು ಸಂಖ್ಯಾವಾಚಕಗಳು – Dative Cases, and Numerals**
4. **ಸಂಖ್ಯಾಗುಣವಾಚಕಗಳು ಮತ್ತು ಬಹುವಚನ ನಾಮರೂಪಗಳು – Ordinal numerals and Plural markers**
5. **ನ್ಯೂನ / ನಿಷೇಧಾರ್ಥಕ ಕ್ರಿಯಾಪದಗಳು ಮತ್ತು ವರ್ಣ ಗುಣವಾಚಕಗಳು Defective / Negative Verbs and Colour Adjectives**

ಬೋಧನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪಿಟಿ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವಿಡಿಯೋಗಳನ್ನು ಬಳಸುವುದು, ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆ ಚಟುವಟಿಕೆಗಳ ಮುಖಾಂತರ ಚರ್ಚಿಸುವುದು.

Module-4

1. ಅಪ್ಪಣೆ / ಒಪ್ಪಿಗೆ, ನಿರ್ದೇಶನ, ಪ್ರೋತ್ಸಾಹ ಮತು ಒತ್ತಾಯ ಅರ್ಥರೂಪ ಪದಗಳು ಮತ್ತು ವಾಕ್ಯಗಳು **Permission, Commands, encouraging and Urging words (Imperative words and sentences)**
2. ಸಾಮಾನ್ಯ ಸಂಭಾಷಣೆಗಳಲ್ಲಿ ದ್ವಿತೀಯ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯಗಳು ಮತ್ತು ಸಂಭವನೀಯ ಪ್ರಕಾರಗಳು **Accusative Cases and Potential Forms used in General Communication**
3. "ಇರು ಮತ್ತು ಇರಲ್ಲ" ಸಹಾಯಕ ಕ್ರಿಯಾಪದಗಳು, ಸಂಭಾವ್ಯಸೂಚಕ ಮತ್ತು ನಿಷೇಧಾರ್ಥಕ ಕ್ರಿಯಾ ಪದಗಳು - Helping Verbs "iru and iralla", Corresponding Future and Negation Verbs
6. ಹೋಲಿಕೆ (ತರತಮ) , ಸಂಬಂಧ ಸೂಚಕ ಮತ್ತು ವಸ್ತು ಸೂಚಕ ಪ್ರತ್ಯಯಗಳು ಮತ್ತು ನಿಷೇಧಾರ್ಥಕ ಪದಗಳ ಬಳಕೆ- Comparitive, Relationship, Identification and Negation Words

ಬೋಧನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪಿಟಿ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವಿಡಿಯೋಗಳನ್ನು ಬಳಸುವುದು, ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆ ಚಟುವಟಿಕೆಗಳ ಮುಖಾಂತರ ಚರ್ಚಿಸುವುದು.

Module-5

1. ಕಾಲ ಮತ್ತು ಸಮಯದ ಹಾಗೂ ಕ್ರಿಯಾಪದಗಳ ವಿವಿಧ ಪ್ರಕಾರಗಳು - ifferent types of forms of Tense, Time and Verbs
2. ದ್, -ತ್, - ತು, - ಇತು, - ಆಗಿ, - ಅಲ್ಲ, - ಗ್, -ಕ್, ಇದೆ, ಕ್ರಿಯಾ ಪ್ರತ್ಯಯಗಳೊಂದಿಗೆ ಭೂತ, ಭವಿಷ್ಯತ್ ಮತ್ತು ವರ್ತಮಾನ ಕಾಲ ವಾಕ್ಯ ರಚನೆ - Formation of Past, Future and Present Tense Sentences with Verb Forms
3. **Kannada Vocabulary List : ಸಂಭಾಷಣೆಯಲ್ಲಿ ದಿನೋಪಯೋಗಿ ಕನ್ನಡ ಪದಗಳು - Kannada Words in Conversation**

ಬೋಧನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪಿಟಿ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವಿಡಿಯೋಗಳನ್ನು ಬಳಸುವುದು, ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆ ಚಟುವಟಿಕೆಗಳ ಮುಖಾಂತರ ಚರ್ಚಿಸುವುದು.

ಬಳಕೆ ಕನ್ನಡ ಪಠ್ಯದ ಕಲಿಕೆಯಿಂದ ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಆಗುವ ಅನುಕೂಲಗಳು ಮತ್ತು ಫಲಿತಾಂಶಗಳು: **course Outcomes (Course Skill** Set): At the end of the Course, The Students will be able

1. To understand the necessity of learning of local language for comfortable life.
2. To Listen and understand the Kannada language properly.
3. To speak, read and write Kannada language as per requirement.
4. To communicate (converse) in Kannada language in their daily life with kannada speakers.
5. To speak in polite conservation.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Tests each of **20 Marks (duration 01 hour**)

a. First test at the end of 5th week of the semester
b. Second test at the end of the 10th week of the semester
c. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks : 1.** First assignment at the end of 4th week of the semester

7. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours**)

8. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

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

ಸೆಮಿಸ್ಟರ್ ಅಂತ್ಯದ ಪರೀಕ್ಷೆಯು ಈ ಕೆಳಗಿನಂತಿರುತ್ತದೆ - **Semester End Exam (SEE):**

SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject.

2. The question paper will have 50 questions. Each question is set for 01 mark.
3. SEE Pattern will be in MCQ Model for 50 marks. Duration of the exam is 01 Hour.

Textbook :

ಬಳಕೆ ಕನ್ನಡ

ಲೇಖಕರು : ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ

ಪ್ರಸಾರಾಂಗ, ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ.

SEMESTER – IV

Embedded C Basics			
Course Code	**21ECL481**	**CIE Marks**	**50**
Teaching Hours/Week (L: T: P: S) (0:0:2:0)	**Credits (0:0:1:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**13 Lab slots**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

Course objectives:

This laboratory course enables students to:

1. Learn assemble level programming concept.
2. To understand the basic knowledge of instruction set of 8051 Microcontroller.
3. Understand the basic programming of 8051 microcontroller..
4. Understand how to interface different input and output devices with processor.
5. To develop the microcontroller-based programs for various applications.

Sl. No.	Experiments
1	Conduct the following experiments by writing C Program using Keil micro vision simulator(any 8051 microcontroller can be chosen as the target).
2	Write a 8051 C program to add two 8 bit binary numbers.
3	Write a 8051 C program to multiply two 8/16 bit binary numbers.
4	Write a 8051 C program to find the sum of first 10 integer numbers.
5	Write a 8051 C program to find factorial of a given number.
6	Write a 8051 C program to find the square of a number (1 to 10) using look-up table.
7	Write a 8051 C program to find the largest/smallest number in an array of 8/16/32 numbers
8	Write a 8051 C program to count the number of ones and zeros in two consecutive memorylocations.
9	Write a 8051 C program to display “Hello World” message (either in simulation mode orinterface an LCD display).
10	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 (Course Skill Set):

At the end 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

Assessment Details (both CIE and SEE)

Continuous Internal Assessment of Laboratory/Practical Courses		
Lab Test 1	Lab Test 2	Lab Records
15 marks	15 marks	20 marks
Semester End Examination **(**SEE)		50 marks

Suggested Learning Resources:

1. “The 8051 Microcontroller: Hardware, Software and Applications”, V Udayashankara and M S Mallikarjuna Swamy, McGraw Hill Education, 1st edition, 2017.

SEMESTER – IV

C++ Basics			
Course Code	**21ECL482**	**CIE Marks**	**50**
Teaching Hours/Week (L: T: P: S) (0:0:2:0)	**Credits (0:0:1:0)**	**SEE Marks**	**50**

Total Hours of Pedagogy	13 Lab slots	Total Marks	100
Credits	01	Exam Hours	03

Course objectives:

This laboratory course enables students to:

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, polymorphism and function overloading.
4. Introduce the concepts of exception handling and multithreading.

Sl. No.	Experiments
1	Write a C++ program to find largest, smallest & second largest 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 define class name FATHER & SON that holds the income respectively. Calculate & display total income of a family using Friend function.
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 & theyhave 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 of an 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 specified 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. Write C++ program to solve simple and complex problems
2. Apply and implement major object-oriented concepts like message passing, function overloading,operator overloading and inheritance to solve real-world problems.
3. Use major C++ features such as Templates for data type independent designs and File I/O to dealwith large data set.
4. Analyze, design and develop solutions to real-world problems applying OOP concepts of C++

Assessment Details (both CIE and SEE)

Continuous Internal Assessment of Laboratory/Practical Courses		
Lab Test 1	Lab Test 2	Lab Records

15 marks	15 marks	20 marks
Semester End Examination **(**SEE)		50 marks

Suggested 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, 2006.

SEMESTER – IV

Octave / Scilab for Signals			
Course Code	**21ECL483**	**CIE Marks**	**50**
Teaching Hours/Week (L: T: P: S) (0:0:2:0)	**Credits (0:0:1:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**13 Lab slots**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

Course objectives:

This course will enable students to:

1. Gain the fundamental knowledge in the field of signals and processing.
2. Understand the basic foundation in electronic engineering.
3. Realize the mathematics fundamentals required for comprehending the operation and application of signal processing.
4. Apply the ethical and professional attitude by providing an academic environment inclusive of effective communication and teamwork.
5. Relate the 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 and Circular convolution 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 Autocorrelation of a given sequence. Verify the result using theoretical computations.
5	Determine the spectrum of FFT of a given Sequence. Verify the result using theoretical computations.
6	Design and implementation of FIR filter to meet given specifications.
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	Determine of N point DFT of a given sequence and to plot magnitude and phase spectrum.
10	Determine Linear convolution of two given sequences using DFT and IDFT.

Course outcomes (Course Skill Set):

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

1. Demonstrate the DSP concepts on signal generation and sampling using Scilab/Octave
2. Design and verify the computation of discrete signals using Scilab/Octave.
3. Demonstrate and verify the application of FFT/DFT algorithm for a given signal using Scilab/Octave.
4. Design and demonstrate programs to evaluate different types of low and high pass FIR filters using Scilab/Octave.
5. Design, demonstrate and visualize different types of IIR filters using Scilab/Octave programs.

Assessment Details (both CIE and SEE)

Continuous Internal Assessment of Laboratory/Practical Courses		
Lab Test 1	Lab Test 2	Lab Records
15 marks	15 marks	20 marks
Semester End Examination **(**SEE)		50 marks

Suggested Learning Resources:

Text Book:

1. John G Proakis and Vinay K Ingle “Digital Signal Processing Using MATLAB”, 3rd edition Cengage Learning, 2017, ISBN-13: 978-1-111-42737-5 , ISBN-10: 1-111-42737-2

SEMESTER – IV

DAQ using LabVIEW			
Course Code	**21ECL484**	**CIE Marks**	**50**
Teaching Hours/Week (L: T: P: S) (0:0:2:0)	**Credits (0:0:1:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**13 Lab slots**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

Course objectives:

This course will enable students to:

1. To understand the concepts of DAQ devices & its implementation.
2. Process the knowledge of loop constructs.
3. Fundamentals of graphical programming and use LabVIEW modules
4. Implement 'Timing' functions.
5. Input algebraic formulas via 'Formula Nodes' and 'Expression Nodes'.

Sl. No.	Experiments
1	Data acquisition using LabVIEW for temperature measurement with thermocouple.
2	Data acquisition using LabVIEW for temperature measurement with AD590.
3	Data acquisition using LabVIEW for temperature measurement with RTD.
4	Data acquisition using LabVIEW for temperature measurement with Thermistor.
5	Creation of a CRO using LabVIEW and measurement of frequency and amplitude from external source.
6	Create function generator using LabVIEW and display the amplitude and frequency on CRO (externally connected)
7	Demonstrate amplitude modulation considering modulating and carrier wave from external source.
8	Interface LEDs to DAQ output and implement counter.
9	Data acquisition using LabVIEW for load / strain measurement using suitable transducers.
10	Demonstrate binary to grey code converter (& vice versa) using DAQ card.
11	Data acquisition using LabVIEW for distance/humidity measurement using suitable transducers.
12	Reading audio input with Microphones and output using DAQ card.

Course outcomes (Course Skill Set):

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

1. Understand the knowledge of DAQ Device using LabVIEW
2. Build temperature indicating instruments using LabVIEW (NI DAQ)
3. Interface peripheral devices/instruments to LabVIEW
4. Build LabVIEW modules to sense and process audio inputs
5. Apply programming structures, data types, and the analysis and signal processing algorithms in LabVIEW

Assessment Details (both CIE and SEE)

Continuous Internal Assessment of Laboratory/Practical Courses		
Lab Test 1	Lab Test 2	Lab Records
15 marks	15 marks	20 marks
Semester End Examination **(**SEE)		50 marks

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.

SEMESTER – IV

Universal Human Values			
Course Code	**21UHV49**	**CIE Marks**	**50**
Teaching Hours/Week (L: T: P: S) (1:0:0:0)	**Credits (1:0:0:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**13 hours Theory**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

Course objectives:

This course will enable students:

1. To distinguish between values and skills, and understand the need, basic guidelines, content and process of value education.
2. To initiate a process of dialog within themselves to know what they really want to be in their life and profession
3. To understand the meaning of happiness and prosperity for a human being.
4. To facilitate and understand harmony at all the levels of human living, and live accordingly.
5. To help students, to design technologies that are holistic sustainable with the nature.

Module-1

Introduction to Value Education: Understanding the need, basic guidelines, content and process for Value Education-Self Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self-exploration, Continuous Happiness and Prosperity, Relationship and Physical Facilities, Understanding Happiness and Prosperity correctly.

03 Hours

Module-2

Harmony in the Human Being: Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer) , Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Swasthya.

03 Hours

Module-3

Harmony in the Family: Understanding harmony in the Family- the basic unit of human interaction, understanding values in human-human relationship; meaning of *Nyaya* and program for its fulfillmentto ensure *Ubhay-tripti*; Trust (*Vishwas*) and Respect (*Samman*) as the foundational values of relationship

02 Hours

Module-4

Harmony in the Society: Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society (Akhand Samaj), Universal Order (Sarvabhaum Vyawastha)- from family to world family!

03 Hours

Module-5

Harmony in the Nature (Existence): Understanding the harmony in the Nature, Interconnectedness and mutual fulfillment among the four orders of nature- recyclability andself-regulation in nature, Understanding Existence as Co-existence (*Sah-astitva*) of mutually interacting units in all-pervasive space.

02 Hours

Course outcomes:

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

1. Understand the significance of value inputs in a classroom and start applying them in their life and profession.
2. Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual etc.
3. Understand the value of harmonious relationship based on trust and respect in their life and profession.
4. Understand the role of a human being in ensuring harmony in society and nature.

Assessment Details (both CIE and SEE)

Component		Weightage (%)	
CIE's	CIE 1 5th week	20	60
	CIE 2 10th week	20	
	CIE 3 15th week	20	
AAT's	AAT-1 10th week	10	
	AAT-2	10	
	AAT-3	20	
Continuous Internal Evaluation Total Marks: 100. Reduced to 50 Marks			
Semester End Examination (SEE) Total Marks: 100. Reduced to 50 Marks			

Suggested Learning Resources:

Text Books:

1. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics.

Reference Books:

1. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins, USA

2. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.

3. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991

SEMESTER – V

Digital Communication			
Course Code	**21ECT51**	**CIE Marks**	**50**
Teaching Hours/Week (L: T: P: S) (3:0:0:0)	**Credits (3:0:0:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40 hours**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course objectives:

This course will enable students to:

1. Understand the fundamentals of baseband shaping techniques in Digital modulation.
2. Gain the concept of digital modulation and demodulation techniques.
3. Compute performance metrics and parameters for symbol processing and recovery in ideal and corrupted channel conditions.
4. Design and analyze the principles of Spread Spectrum modulation techniques.
5. Explain the Multi-user and Multi-access systems in communication systems.

Teaching-Learning Process (General Instructions)

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

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the different concepts of Digital communication.
3. Encourage collaborative (Group) Learning in the class.
4. Ask at least three HOTS (Higher Order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Topics will be introduced in a multiple representation.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
   f) Adopt Flipped class technique by sharing the materials / Sample Videos prior to the class and have discussions on the that topic in the succeeding classes.

Module-1

Base Band Shaping for Data Transmission: Discrete PAM signals (Line Codes), power Spectral density (PSD) of line codes: NRZ unipolar format, NRZ polar format, NRZ bipolar format, Manchester format. Baseband Transmission of binary data, Inter symbol Interference (ISI), Eye pattern, adaptive equalization.

08 Hours

Module-2

Digital Modulation Techniques: Phase shift Keying techniques using coherent detection: generation, detection and error probabilities of BPSK and QPSK, Frequency shift keying techniques using Coherent detection: BFSK generation, detection and error probability. Non coherent modulation technique-DPSK Modulation, Introduction to minimum Shift Keying (MSK) and Gaussian Minimum Shift Keying (GMSK).

08 Hours

Module-3

Signaling Communication through Band Limited AWGN Channels: Signaling over AWGN Channels- Introduction, Geometric representation of signals, Gram- Schmidt Orthogonalization procedure, Conversion of the continuous AWGN channel into a vector channel (without statistical characterization), Optimum receivers using coherent detection: ML Decoding, Correlation receiver, matched filter receiver.

08 Hours

Module-4

Spread Spectrum Modulation: Introduction and definition, pseudo-noise sequence generation, properties of maximum-length sequences. Direct sequence spread spectrum (DS-SS)-base band-based transmitter and receiver, Processing gain, Probability of error (statement only), Jamming margin. Frequency- hop Spread Spectrum: Slow Frequency Hopping, Fast frequency Hopping, comparison between slow frequency and fast frequency hopping.

08 Hours

Module-5

Multi-user Systems: Introduction, Multiuser Channels: The Uplink and Downlink model. Multiple Access: Frequency division multiple Access (FDMA), Time Division Multiple Access (TDMA), Code division Multiple Access(CDMA),Space Division Multiple Access(SDMA),Hybrid Techniques.

08 Hours

Teaching-Learning Process for all modules	**Chalk and Talk/PowerPoint presentation/YouTube videos.**

Course Outcomes:

On completion of this course students should be able to:

1. Understand the concepts of Base Band shaping Technique for data transmission.
2. Analyze different digital modulation techniques and choose the appropriate modulation technique for the given specifications.
3. Illustrate the symbol processing and performance parameters at the receiver under ideal and corrupted bandlimited channels.
4. Evaluate the spread spectrum modulation schemes and compute the performance parameters of communication system.
5. Interpret the need for Multi-user and Multiple-access Systems.

Assessment Details (both CIE and SEE)

Component		**Weightage (%)**	
CIE's	CIE 1- At the end of 5th week	20	60
	CIE 2 - At the end of 10th week	20	
	CIE 3 - At the end of 15th week	20	
AAT's	AAT-1- At the end of 4th week	10	40
	AAT-2- At the end of 9th week	10	
	AAT-3- At the end of 13th week	20	
Continuous Internal Evaluation Total Marks: 100. Reduced to 50 Marks			
Semester End Examination (SEE) Total Marks: 100. Reduced to 50 Marks			

Suggested Learning Resources:

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.

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.
3. Andrea Goldsmith, "Wireless Communications", Cambridge University Press 2005, ISBN: 978-0-521-70416-8.

E-Resources:

1. **https://nptel.ac.in/courses/108102096**
2. **https://www.tutorialspoint.com/digital_communication/digital_communication_useful_resources.htm**
3. **https://simplicable.com/en/digital-communication**
4. **https://ieeexplore.ieee.org/document/9599632**
5. **https://www.ni.com/en-in/innovations/white-papers/06/understanding-spread-spectrum-for-communications.html**

CO- PO Mapping:

POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C301.1	3	3	2	2	1	-	-	-	-	-	-	1	3	2	1
C301.2	3	3	2	2	2	-	-	-	-	1	-	1	3	2	1
C301.3	3	3	3	2	-	-	-	-	-	-	-	1	3	2	1
C301.4	3	3	2	2	2	-	-	-	-	1	-	1	3	2	1
C301.5	3	3	3	3	-	1	-	-	-	1	-	1	3	2	1

SEMESTER – V

Microcontroller & ARM Microprocessor			
Course Code	**21ECI52**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P:S) (3:0:2:0)	**Credits (3:0:1:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40 hours theory + 12 Lab slots**	**Total Marks**	**100**
Credits	**04**	**Exam Hours**	**03**

Course Objectives:

The goal of the course **Microprocessor and ARM Microcontroller** is:

1. Explain the basic organization of a computer system and the architecture of the 8085 microprocessor.
2. Demonstrate the functioning of memory systems and architectural, basics concepts of 8086.
3. Explicate the concepts of instruction sets in 8086 Assembly language programming.
4. Discuss the architectural characteristics as well as the instructions of the 32-bit microprocessor ARM Cortex M3.
5. Understand the ARM Cortex M3 programming instructions.

Teaching-Learning Process (General Instructions)

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

7. In addition to the traditional lecture method, different types of innovative teaching methods maybe adopted so that the delivered lessons shall develop students theoretical and applied mathematical skills.
8. State the need for Mathematics with Engineering Studies and Provide real-life examples.
9. Support and guide the students for self–study.
10. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress.
11. Encourage the students for group learning to improve their creative and analytical skills.
12. Show shortly related video lectures in the following ways:
    g) As an introduction to new topics (pre-lecture activity).
    h) As are vision of topics (post-lecture activity).
    i) As additional examples (post-lecture activity).
    j) As an additional material of challenging topics (pre-and post-lecture activity).
    k) As a model solution of some exercises (post-lecture activity).

Module-1

Basic Structure of Computers: Basic Operational Concepts, Bus Structures, Performance Processor Clock, Basic Performance Equation, Clock Rate, Performance Measurement.

Introduction to Microprocessor: Microprocessor architecture and its operations, Memory, Input & output devices, The 8085 MPU- architecture, Pins and signals, Timing Diagrams,

Text Book 1: Chapter 1 – 1.3, 1.4, 1.6 (1.6.1-1.6.4, 1.6.7),

Text Book 3: 1.1, 1.2, 1.4, 2.1, 2.9,3.1,3.2,3.3

08 Hours

Module-2

Memory System: Basic Concepts, Semiconductor RAM Memories, Read Only Memories, Speed, Size, and Cost, Cache Memories – Mapping Functions, Replacement Algorithms, Performance Considerations.

Introduction to 8086 Microprocessor: Microprocessor Evolution and types, 8086 Internal Architecture: The BIU and the Execution Unit, Segmentation, Pin Diagram of 8086, Introduction to Programming the 8086.

Text book 1: Chapter 5 – 5.1 to 5.4, 5.5 (5.5.1, 5.5.2), 5.6

Text book 4: chapter-2 -2.9, 2.11 to 2.16

08 Hours

Module-3

8086 Assembly Language Programming-1: Addressing Modes of 8086, Assembler Directives, Instruction Set of 8086. Data Transfer Instructions, Arithmetic Instructions, Bit Manipulation Instructions, Branching Instructions, Processor Control Instructions and String Instructions.

8086 Assembly Language Programming-2: Macros, Procedures, Assembly Language Programming Examples.

[Text 4 : 3.1, 6.1, 4.1 to 4.5, 5.1, 5.2]

08 Hours

Module-4

ARM Embedded Systems: Introduction, RISC design philosophy, ARM design philosophy, Embedded system hardware – AMBA bus protocol, ARM bus technology, Memory, Peripherals, Embedded system software – Initialization (BOOT) code, Operating System, Applications. ARM Processor Fundamentals, ARM core dataflow model, registers, current program status register Pipeline, Exceptions, Interrupts and Vector Table, Core extensions.
[Text book 2: Chapter 1,2]

10 Hours

Module-5

Introduction to the ARM Instruction set: Introduction, Data processing instructions, Load - Store instruction, Software interrupt instructions, Program status register instructions, Loading constants, ARMv5E extensions, Conditional Execution.

[Text book 2: Chapter 2,3]

06 Hours

Teaching-Learning Process for all modules	**Chalk and Talk/ Power Point presentation/ YouTube videos.**

PRACTICAL COMPONENT OF IPCC

Conduct the following experiments by writing Assembly Language Program (ALP) using ARM Cortex M3 Registers using an evaluation board/simulator and the required software tool.

1	Write an ALP to i) Multiply two 16-bit binary numbers. ii) Add two 64-bit numbers.
2	Write an ALP to find the sum of first 10 integer numbers.
3	Write an ALP to find factorial of a number.
4	Write an ALP to add an array of 16-bit numbers and store the 32-bit result in internal RAM.
5	Write an ALP to find the square of a number (1 to 10) using look-up table.
6	Write an ALP to find the largest/smallest number in an array of 32 numbers.
7	Write an ALP to arrange a series of 32-bit numbers in ascending/descending order.
8	i) Write an ALP to count the number of ones and zeros in two consecutive memory locations. ii) Write an ALP to Scan a series of 32-bit numbers to find how many are negative.

Demonstration Experiments (For CIE only not for SEE)

Conduct the following experiments on an ARM CORTEX M3 evaluation board using evaluation version of Embedded 'C' & Keil µvision-4 tool/compiler.

9	Interface a Stepper motor and rotate it in clockwise and anti-clockwise direction.
10	Interface a DAC and generate Triangular and Square waveforms.
11	Display the Hex digits 0 to F on a 7-segment LED interface, with a suitable delay in between.
12	Interface a simple Switch and display its status through Relay, Buzzer and LED.

Course Outcomes:

After successfully completing the course, the students will be able

1 To realize the fundamental organization of computer systems and 8085 architecture.

2 Analyze the functioning of memory systems and concepts of 8086.

3 Identify the different attributes used in 8086 assembly language programming.

4 Describe the architectural features and instructions of 32-bit microcontroller ARM CortexM3.

5 Apply the knowledge gained for Programming ARM Cortex M3 for different applications.

Assessment Details (both CIE and SEE)
Assessment Details (both CIE and SEE)

Component		**Weightage (%)**		
CIE's	CIE 1 5th week	20	60	Average of 3 tests for 20 marks
	CIE 2 10th week	20		
	CIE 3 15th week	20		
AAT's	AAT-1 10th week			10
	Lab Test	30		Reduced to 10
	Lab Record	20		10
Continuous Internal Evaluation Total Marks :100. Reduced to 50 Marks				
Semester End Examination (SEE) Total Marks :100. Reduced to 50 Marks				

Suggested Learning Resources:

TextBooks:

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Computer Organization, 5th Edition, Tata McGraw Hill, 2002. (Listed topics only from Chapters 1, 2, 4, 5, 8).
2. Andrew N Sloss, Dominic System and Chris Wright, "ARM System Developers Guide", Elsevier, Morgan Kaufman publisher, 1st Edition, 2008.
3. Ramesh Gaonkar, "Microprocessor Architecture, Programming, and Applications with the 8085", 6th Edition, Penram International Publication (India) Pvt. Ltd.,2013.
4. Douglas V. Hall, "Microprocessors and Interfacing: Programming and Hardware", Revised 2nd Edition, TMH, 2006, ISBN: 978-0-07-060167-3

E-Resources:

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- **Quizzes**
- Assignments
- Seminars

CO-PO Mapping:

POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C302.1	3	2	3	-	-	-	-	-	-	-	1	-
C302.2	3	2	3	-	-	-	-	-	-	-	1	-
C302.3	3	3	2	-	2	-	-	-	-	-	1	-
C302.4	2	2	2	-	-	-	-	-	-	-	1	-
C302.5	3	3	2	1	2	-	-	-	-	-	1	-

SEMESTER – V

Information Theory and Coding			
Course Code	**21ECT53**	**CIE Marks**	**50**
Teaching Hours/Week (L: T: P: S) (3:0:0:0)	**Credits (3:0:0:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40 hours**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course objectives:

This course will enable students to:

1. Apply basics of information theory to compute entropy, and information rate and study advanced algebraic Coding.
2. Illustrate different coding techniques and determine their efficiency.
3. Categorize various channels for information transmission and interpret Shannon's theorem in Continuous channels.
4. Design various Block Codes for error detection and convolutional codes for error correction.
5. Design different codes for Channel performance improvement against burst errors

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various techniques.
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Adopt Problem-Based Learning (PBL), which fosters students' Analytical skills, develops thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
7. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
8. Incorporate programming examples given under Activity based learning.

Module-1

Error Control Coding: Introduction to Error control Coding, Types of Errors, Examples, Types of codes, Linear Block Codes, Matrix description, Error detection and correction, Encoder Linear Block Codes, Syndrome calculation circuit Linear Block Codes. Hamming Weight, Hamming Distance and minimum distance of LBC, Single Error correcting Hamming code

08 Hours

Module-2

Binary Cyclic Codes: Introduction, Types of binary cyclic codes, Algebraic Structure of Cyclic codes, Encoding using an (n-k) bit shift register of cyclic codes, Syndrome Calculation circuit of cyclic codes,

08 Hours

Module-3

Convolution codes: Convolution Encoder, Time domain approach, Transform domain approach, Code Tree, Trellis and State Diagram.

08 Hours

Information Channels: Joint and Conditional Entropies, Mutual information, Shannon Theorem, Capacity of| channels, Symmetric channels, Binary symmetric channel (BSC), Continuous Channels: Entropy of continuous signals, Maximization of entropy.

08 Hours

Module 4

Source Coding: Encoding of the Source Output, Shannon's Encoding Algorithm, Shannon-Fano Encoding Algorithm, Huffman coding. Huffman coding (ternary), Introduction to Communication channels, Shannon's – Fano Ternary Code, Huffman Ternary and Quaternary code

08 Hours

Module-5

Introduction to Information theory: Measure of information , Average information, Content of symbols in long independent sequences, Mark off statistical model for information source , Mark off statistical model for information source problems, Entropy and information rate of mark-off source, Communication Channels, Discrete Communication Channels

08 Hours

Teaching-Learning Process for all modules	**Chalk and Talk/ PowerPoint presentation/ YouTube videos.**

Course Outcomes:

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

On successful completion of this module, students should be able to:

1. Apply the fundamentals of information theory and perform source coding for given message
2. Apply different source output using encoding algorithms and decoding techniques with error Detection and Correction
3. Determine the channel capacity of different channels and also the mutual information.
4. Implement the error control coding, methods of controlling errors and Error correction & Detection.
5. Encode using bit shift register, syndrome calculate and complete knowledge of BCH and burst error correcting codes.

Assessment Details (both CIE and SEE)

Component		**Weightage (%)**	
CIE's	CIE 1- At the end of 5th week	20	60
	CIE 2 - At the end of 10th week	20	
	CIE 3 - At the end of 15th week	20	
AAT's	AAT-1- At the end of 4th week	10	40
	AAT-2- At the end of 9th week	10	
	AAT-3- At the end of 13th week	20	
Continuous Internal Evaluation Total Marks: 100. Reduced to 50 Marks			
Semester End Examination (SEE) Total Marks: 100. Reduced to 50 Marks			

Suggested Learning Resources:

TEXT BOOK:

1. K. Sam Shanmugam: "Digital and Analog Communication Systems", John Wiley India Pvt. Ltd., 2008, ISBN-10: 8126509147, ISBN-13: 9788126509140.

2. Simon Haykin: "Digital Communication", John Wiley India Pvt. Ltd., 2008. ISBN-10: 0471647357, ISBN-13: 978-0471647355.

5. REFERENCE BOOKS:

1. Dr. P. S. Satyanarayana: "Concepts of Information Theory & Coding", Publication, Dynaram, 2005, ISBN-13:1234567150966

2. Bernard Sklar, Digital Communications Fundamentals and Applications, Prentice Hall International, 2001, ISBN-10: 0130847887, ISBN-13: 978-0130847881.

3. Shu Lin, Costello ,"Error Control coding : Fundamentals and Applications", New Jersey, 1983, ISBN-10: 0130426725, ISBN-13: 978-0130426727.

E-Resources:

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- **Quizzes**
- Assignments
- Seminar

CO- PO Mapping:

POS / Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C303.1	3	3	1	-	--	-	-	-	-	-	1	1
C303.2	2	3	3	-	--	-	-	-	-	-	1	1
C303.3	3	3	2	1	--	-	-	-	-	-	1	1
C303.4	2	3	3	1	--	-	-	-	-	-	1	2
C303.5	3	1	3	1	1	-	-	-	-	-	1	2

SEMESTER – V

BASIC VLSI DESIGN			
Course Code	**21ECT54**	**CIE Marks**	**50**
Teaching Hours/Week (L: T: P: S) (3:0:0:0)	**Credits (3:0:0:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40 hours**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course objectives:

This course will enable students to:

1. Gain knowledge of MOS transistor theory and CMOS technologies.
2. Obtain knowledge on architectural choices and performance trade-offs involved in designing and realizing the circuits in CMOS technology.
3. Cultivate the concepts of subsystem design processes.
4. Demonstrate the concepts of CMOS testing.
5. Impart the knowledge of Memory, Registers and aspects of system Timing

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various techniques.
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Adopt Problem-Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
7. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
8. Incorporate programming examples given under Activity based learning.

Module-1

Introduction: A Brief History, MOS Transistors, MOS Transistor Theory, Ideal I-V Characteristics, Non- ideal I-V Effects, DC Transfer Characteristics of CMOS inverter
(1.1, 1.3, 2.1, 2.2, 2.4, 2.5 of TEXT2).
Fabrication: nMOS Fabrication, CMOS Fabrication [P-well process, N-well process, Twin tub process], BiCMOS Technology
(1.7, 1.8, 1.10 of TEXT1).

08 Hours

Module-2

MOS and BiCMOS Circuit Design Processes: MOS Layers, Stick Diagrams, Design Rules and Layout.
Basic Circuit Concepts: Sheet Resistance, Area Capacitances of Layers, Standard Unit of Capacitance, Some Area Capacitance Calculations, Delay Unit, Inverter Delays, Driving Large Capacitive Loads
(3.1 to 3.3, 4.1, 4.3 to 4.8 of TEXT1).

08 Hours

Module-3

Scaling of MOS Circuits: Scaling Models & Scaling Factors for Device Parameters
Subsystem Design Processes: Some General considerations, An illustration of Design Processes,
Illustration of the Design Processes: Regularity, Design of an ALU Subsystem
(5.1, 5.2, 7.1, 7.2, 8.2, 8.3, 8.4.1, 8.4.2 of TEXT1).

08 Hours

Module-4

CMOS Logic Structures: Mirror Circuits, Pass Transistor Logic, Pseudo NMOS logic, Tri state Circuits, Dynamic CMOS Logic, Charge sharing problems, remedies, Clocked CMOS Logic, CMOS Domino Logic.
Subsystem Design: Data path Operators, Bit adder, Ripple Carry Adder, Carry Look ahead adder, Carry skip adder, Carry select adder, Carry save adder, Multiplier

08 Hours

Module-5

Memory, Registers and Aspects of system Timing: System Timing Considerations, Some commonly used Storage/Memory elements (9.1, 9.2 of TEXT1).
Testing and Verification: Introduction, Logic Verification, Logic Verification Principles, Manufacturing Test Principles, Design for testability (12.1, 12.1.1, 12.3, 12.5, 12.6 of TEXT 2).

08 Hours

Teaching-Learning Process for all modules	**Chalk and Talk/PowerPoint presentation/YouTube videos.**

Course Outcomes:

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

1. Demonstrate understanding of MOS transistor theory, CMOS fabrication flow and technology scaling.
2. Draw the basic gates using the stick and layout diagrams with the knowledge of physical design aspects.
3. Interpret Memory elements along with timing considerations.
4. Demonstrate the FPGA based system design.
5. Interpret testing and testability issues in VLSI Design.

Assessment Details (both CIE and SEE)

Component		**Weightage (%)**	
CIE's	CIE 1- At the end of 5th week	20	60
	CIE 2 - At the end of 10th week	20	
	CIE 3 - At the end of 15th week	20	
AAT's	AAT-1- At the end of 4th week	10	40
	AAT-2- At the end of 9th week	10	
	AAT-3- At the end of 13th week	20	
Continuous Internal Evaluation Total Marks: 100. Reduced to 50 Marks			
Semester End Examination (SEE) Total Marks: 100. Reduced to 50 Marks			

Text Books:

3. "Basic VLSI Design"- Douglas A Pucknell & Kamran Eshraghian, PHI, 3rd Edition.
4. "CMOS VLSI Design- A Circuits and Systems Perspective", Neil H E Weste, David Harris, Ayan Banerjee, 3rd Edition, Pearson Education.
5. "FPGA Based System Design", Wayne Wolf, Pearson Education, 2004, Technology and Engineering.
6. John P. Uyemura, "Introduction to VLSI Circuits and Systems", John Wiley,First edition, 2003.ISBN: 0471127043

E-Resources:

- https://nptel.ac.in/courses/117101058
- https://nptel.ac.in/courses/117106093
- https://youtu.be/9SnR3M3CIm4
- https://nptel.ac.in/courses/108/107/108107129
- VTU e-Shikshana Program
- VTU EDUSAT Program

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- **Quizzes, Assignments, Seminars**

CO- PO Mapping:

POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C304.1	2	2	3	--	--	--	--	--	--	--	2	2
C304.2	3	1	2	--	2	--	--	--	--	--	3	3
C304.3	2	2	3	1	2	--	--	--	--	--	2	3
C304.4	3	2	2	1	2	--	--	--	--	--	1	3
C304.5	3	3	3	--	--	--	--	--	--	--	2	3

SEMESTER – V

Digital Communication Lab			
Course Code	**21ECL55**	**CIE Marks**	**50**
Teaching Hours/Week (L: T: P: S) (0:0:2:0)	**Credits (0:0:1:0)**	**SEE Marks**	**50**
Credits	**01**	**Exam Hours**	**03**

Course objectives:

This laboratory course enables students to:

1. Gain the practical knowledge of different digital modulation techniques.
2. Understand the design concept used in digital modulation.
3. Design a discrete component level concept for digital communication.
4. Simulate modulation Techniques using MATLAB Lab/Scilab.
5. Implement the digital modulations design concepts with open-source software.

Sl. No.	Experiments
	Implement the following using discrete components
1	Construct an experiment for Time Division Multiplexing of two band limited signals.
2	Design and testing of an Amplitude Shift Keying generation and detection.
3	Conduct an experiment for Frequency Shift Keying generation and detection.
4	Design and testing of Phase Shift Keying generation and detection.
5	Verification of sampling theorem using Flat-top sampling
	Implement the following in MATLAB/Scilab/Python or any other Suitable software
6	Amplitude Shift Keying modulation and demodulation.
7	Frequency Shift Keying modulation and demodulation.
8	Phase Shift Keying modulation and demodulation.
9	Quadrature Phase Shift Keying modulation.

Course outcomes (Course Skill Set):

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

1. Understand the basic knowledge necessary for transmitting and receiving information.
2. Analyze the TDM for two band limited signal.
3. Design and Implement the ASK, FSK and PSK generation and detection.
4. Analyze the outputs by changing the important parameters at the input.
5. Realize the design theory and implementation concept using open-source software

Assessment Details (both CIE and SEE)

Continuous Internal Assessment of Laboratory/Practical Courses		
Lab Test 1	Lab Test 2	Lab Records
15 marks	15 marks	20 marks
Semester End Examination **(**SEE)		50 marks

SEMESTER – V

RESEARCH METHODOLOGY AND IPR			
Course Code	**21ECR56**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P: S)	**2:0:0:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40**	**Total Marks**	**100**
Credits	**02**	**Exam Hours**	**03**

Prerequisites: Literature survey, Requirement analysis

Course objectives:

1. To give an overview of the research methodology and explain the technique of defining a research problem
2. To explain the functions of the literature review in research.
3. To explain carrying out a literature search, its review,developing theoretical and conceptual frameworks and writing a review and research reports.
4. To explain various forms of the intellectual property, its relevance and business impact inthe changing global business environment.
5. To discuss leading International Instruments concerning Intellectual Property Rights.

Teaching-Learning Process (General Instructions)

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

1. Lecturer method (L) need not to be only a traditional lecture method, but alternativeeffective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotescritical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills,develop design thinking skills such as the ability to design, evaluate, generalize,andanalyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic andencourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module – I

Research Methodology: Introduction, Meaning of Research, Objectives of Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Research Process, Criteria of Good Research, Problems Encountered by Researchers inIndia.

Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration.

Text Book 1 - Chapter 1, 2 **08 Hours**

Module – II

Reviewing the literature: Place of the literature review in research, bringing clarity and focus to research problem, improving research methodology, broadening knowledge base in research area,enabling contextual findings, Review of the literature, searching the existing literature, reviewing the selected literature, developing a theoretical framework, developing a conceptual framework, writing about the literature reviewed.

Refer the soft copy.

Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs.

Text Book 1 - Chapter 3. **08 Hours**

Module – III

Design of Sample Surveys: Design of Sampling: Introduction, Sample Design, Sampling and Non Sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs.

Measurement and Scaling: Qualitative and Quantitative Data, Classifications of Measurement Scales, Goodness of Measurement Scales, Sources of Error in Measurement, Techniques of Developing Measurement Tools, Scaling, Scale Classification Bases, Scaling Techniques, Multidimensional Scaling, Deciding the Scale.

Data Collection: Introduction, Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method.

Text Book 1 - Chapter 4, 5, 6. **08 Hours**

Module – IV

Ethics in Engineering Research- Ethics in Engineering Research Practice, Types of Research Misconduct, Ethical Issues Related to Authorship.

Text Book 2 - Chapter 5.

Interpretation and Report Writing- Meaning of Interpretation, Techniques of Interpretation, Precautions in Interpretation, Significance of Report writing, Different steps in writing report, Layout of the research report, Types of reports, Oral presentation, Mechanics of writing a research report, Precautions for writing research reports, Conclusion.

Text Book 1 - Chapter 19.

Technical Writing and Publishing - Free Writing and Mining for Ideas, Attributes and Reasons of Technical Writing, Patent or Technical Paper?—The Choice,Writing Strategies, Journal Paper: Structure and Approach, Language Skills, Writing Style, and Editing, Rules of Mathematical Writing, Publish Articles to Get Cited, or Perish.

Text Book 2 - Chapter 6. **08 Hours**

Module – V

Intellectual property: an introduction - Intellectual property types, More patent basics.

Text Book 3 - Module 1 - 1, 2.

Patents- Detailed overview of patents-What is a patent?, What can be the subject of a patent?, Why are patents important?. Legal requirements for patentability - Novelty, Inventive step/non obviousness, Industrial application/utility, Patentable subject matter, Disclosure requirement.

Text Book 3 - Module 2 - 1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 2.4, 2.5

Patent application preparation - Preparing patent applications - Obtaining invention disclosures from Inventors, Identifying patentable inventions, Understanding the invention (core inventive concept), Inventorship. Typical parts of the patent Application - Request, Description, Claims, Drawings, Abstract, Application format.

Text Book 3 - Module 3 - 1.1, 1.2, 1.3, 1.4, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6. **8 Hours**

Teaching-Learning Process for allmodules	**Chalk and board, Active Learning, PPT Based presentation, Video**

Course Outcomes (Course Skill Set)

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

1. Explain the meaning of engineering research.
2. Explore the procedure of Literature Review and Technical Reading.
3. Explain the fundamentals of patent laws and drafting procedure.
4. Explore the copyright laws and subject matters of copyrights and designs
5. Comprehend the basic principles of design rights.

Assessment Details (both CIE and SEE)

Component		**Weightage (%)**	
CIE's	CIE 1- At the end of 5th week	20	60
	CIE 2 - At the end of 10th week	20	
	CIE 3 - At the end of 15th week	20	
AAT's	AAT-1- At the end of 4th week	10	40
	AAT-2- At the end of 9th week	10	
	AAT-3- At the end of 13th week	20	
Continuous Internal Evaluation Total Marks: 100. Reduced to 50 Marks			
Semester End Examination (SEE) Total Marks: 100. Reduced to 50 Marks			

Textbooks

1	Research Methodology:Methods and Techniques	C. R. Kothari, GauravGarg	New Age International	4th Edition, 2019
2	Engineering Research Methodology: A PracticalInsight for Researchers	Dipankar Deb,Rajeeb Dey, Valentina E. Balas	Intelligent Systems Reference Library	1st Edition, 2019
3	WIPO (2022), WIPO Patent Drafting Manual, 2nd edition. Geneva: WIPO.	DOI: 10.34667/tind.44657 ISBN: 978-92-805-3264-7	World Intellectual Property Organization	Second edition

Reference Books

1	"Research Methods for Engineers"	David V. Thiel	Cambridge University Press	2020

Online Resources

1. https://onlinecourses.nptel.ac.in/noc22_ge08/preview
2. https://archive.nptel.ac.in/courses/127/106/127106227/
3. https://onlinecourses.swayam2.ac.in/cec20_hs17/preview

https://archive.nptel.ac.in/courses/110/105/110105139/

SEMESTER V

ENVIRONMENTAL STUDIES			
Course Code	**21ENV57**	**CIE Marks**	**50**
Teaching Hours/Week (L: T:P: S) (0:0:2:0)	**Credits (0:0:1:0)**	**SEE Marks**	**50**
Credits	**01**	**Exam Hours**	**03**

Course Objectives: To recognize major concepts in environmental sciences and demonstrate in-depth understanding of the environment. The industrial revolution and development have led to the stress on environment in the form of pollution. Checking of the pollution in all fronts at local and global level encompassing the issues of carbon credit, ozone level depletion, global warming, desertification and polar ice cap melting. The main objectives of the course is to expose to students to the problems and mitigation measures concerned to the environmental components like resources, air, water and land.

Module 1

Ecosystems (Structure and Function): Forest, Desert, Wetlands, Riverine, Oceanic and Lake.
Biodiversity: Types, Value; Hot-spots; Threats and Conservation of biodiversity, Forest Wealth, and Deforestation.

3 Hours

Module 2

Advances in Energy Systems (Merits, Demerits, Global Status and Applications)**:** Hydrogen, Solar,OTEC, Tidal and Wind.
Natural Resource Management (Concept and case-studies): Disaster Management, Sustainable Mining, Cloud Seeding, and Carbon Trading.

4 Hours

Module 3

Environmental Pollution (Sources, Impacts, Corrective and Preventive measures, Relevant Environmental Acts, Case-studies)**:** Surface and Ground Water Pollution; Noise pollution; Soil Pollution and Air Pollution.
Waste Management & Public Health Aspects: Bio-medical Wastes; Solid waste; Hazardous wastes; E-wastes; Industrial and Municipal Sludge.

4 Hours

Module 4

Global Environmental Concerns (Concept, policies and case-studies): Ground water depletion/ recharging, Climate Change; Acid Rain; Ozone Depletion; Radon and Fluoride problem in drinkingwater; Resettlement and rehabilitation of people, Environmental Toxicology.

3 Hours

Module 5

Latest Developments in Environmental Pollution Mitigation Tools (Concept and Applications):
G.I.S. & Remote Sensing, Environment Impact Assessment, Environmental Management Systems, ISO14001; Environmental Stewardship- NGOs.

Field work: Visit to an Environmental Engineering Laboratory or Green Building; Visit to a local area to document environment assets river / forest / grassland / hill / mountain. Visit to a local polluted site-urban/rural/industrial/agricultural/Water Treatment Plant/ Waste water treatment Plant. Study of common plants, insects, birds. Study of simple ecosystems-pond, river, hills lopes; etc (field workequal to 2 lecture works) ought to be Followed by understanding of process and its brief documentation.

4 Hours

Course outcomes (Course Skill Set):

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

1. Understand the principles of ecology and environmental issues that apply to air, land, and waterissues on a global scale,
2. Develop critical thinking and/or observation skills, and apply them to the analysis of a problem orquestion related to the environment.
3. Demonstrate ecology knowledge of a complex relationship between biotic and a bioticcomponents.
4. Apply their ecological knowledge to illustrate and graph a problem and describe the realities that managers face when dealing with complex issues.

Assessment Details (both CIE and SEE)

Component		weightage (%)	
CIE's	CIE 1- At the end of t h e week	20	60
	CIE 2 - At the end of the 10th week	20	
	CIE 3 - At the end of the 15th week	20	
AAT's	AAT-1- At the end of the 4th week	10	40
	AAT-2- At the end of t h e 9th week	10	
	AAT-3- At the end of t h e 13th week	20	
Continuous Internal Evaluation Total Marks: 100. Reduced to 50 Marks			
Semester End Examination (SEE) Total Marks: 100. Reduced to 50 Marks			

Text Books:

1. Benny Joseph: "Environmental Studies". Tata Mc Graw – Hill, 2nd Edition,2012.
2. S M Prakash: "Environmental Studies", Pristine PublishingHouse, Mangalore, 3rd Edition,2018.
3. R Rajagopalan: "Environmental Studies – From Crisis to Cure: Oxford Publisher, 2005.
4. R. Geetha Balakrishna, and K. G. LakshminarayanaBhatta: "Environmental Studies", SM Publications, 2016.

Reference Books:

1. Raman Sivakumar: "Principals of Environmental Science and Engineering", Cengage learning, Singapur, 2nd Edition, 2005.
2. M.Ayi Reddy Textbook of environmental science and Technology, BS publications 2007.
3. Dr. B.S Chauhan, Environmental studies, university of science press 1st edition.

CO- PO Mapping :

COs	POs											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C307.1						3		1				2
C307.2						2		1				2
C307.3						3		1				2
C307.4						3		1				2

SEMESTER V

IoT (Internet of Things) Lab			
Course Code	**21EC581**	**CIE Marks**	**50**
Teaching Hours/Week (L: T:P: S) (0:0:2:0)	**Credits (0:0:1:0)**	**SEE Marks**	**50**
Credits	**01**	**Exam Hours**	**03**

Course objectives:

- Understand the concept of the Internet of Things
- Implement interfacing of various sensors with Arduino/Raspberry Pi.
- Demonstrate the ability to transmit data wirelessly between different devices.
- Show an ability to upload/download sensor data on the cloud and server and examine various SQL queries from MySQL database.
- Develop skills required to build real-life IoT-based projects.

Sl.No	Experiments
1	i) Study the fundamentals of IOT software and components. ii) Familiarization with Arduino/Raspberry Pi and performing necessary software installation.
2	i) To interface LED/Buzzer with Arduino/Raspberry Pi and write a program to 'turn ON' LED for1 sec after every 2 seconds. ii) To interface the 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.
3	i) To interface the DHT11 sensor with Arduino/Raspberry Pi and write a program to printtemperature and humidity readings. ii) To interface OLED with Arduino/Raspberry Pi and write a program to print temperature and humidity readings on it.
4	To interface the motor using a relay with Arduino/Raspberry Pi and write a program to 'turn ON motor when the push button is pressed.
5	To interface Bluetooth with Arduino/Raspberry Pi and write a program to send sensor data to smartphone using Bluetooth.
6	To interface Bluetooth with Arduino/Raspberry Pi and write a program to turn LED ON/OFF when '1'/'0' is received from a smartphone using Bluetooth.
7	Write a program on Arduino/Raspberry Pi to upload temperature and humidity data to Things speak cloud.
8	Write a program on Arduino/Raspberry Pi to retrieve temperature and humidity data from Things speak cloud.
9	To install MySQL database on Raspberry Pi and perform basic SQL queries.
10	Write a program on Arduino/Raspberry Pi to publish temperature data to the MQTT broker.
11	i) Write a program to create a UDP server on Arduino/Raspberry Pi and respond with humidity data to the UDP client when requested. ii) Write a program to create a TCP server on Arduino/Raspberry Pi and respond with humidity data to TCP Client when requested
12	Write a program on Arduino/Raspberry Pi to subscribe to the MQTT broker for temperature data and print it.

Course outcomes (Course Skill Set):

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

1. Understand the Internet of Things and its hardware and software components
2. Interface I/O devices, sensors & communication modules.
3. Remotely monitor data and control devices.
4. Demonstrate the concept of upload/download sensor data & various SQL queries from MySQL database.
5. Develop real-life IoT-based projects.

Assessment Details (both CIE and SEE)

Continuous Internal Assessment of Laboratory/Practical Courses		
Lab Test 1	Lab Test 2	Lab Records
15 marks	15 marks	20 marks
Semester End Examination **(**SEE)		50 marks

Suggested Learning Resources:

1. Vijay Madisetti, Arshdeep Bahga, Internet of Things. "A Hands-on Approach", University Press
2. Dr. SRN Reddy, Rachit Thukral, and Manasi Mishra, "Introduction to Internet of Things: A Practical Approach", ETI Labs
3. Pethuru Raj and Anupama C Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press
4. Jeeva Jose, "Internet of Things", Khanna Publishing House, Delhi
5. Adrian McEwen, "Designing the Internet of Things", Wiley
6. Raj Kamal, "Internet of Things: Architecture and Design", McGraw Hill

CO- PO Mapping :

POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C308.A.1	3	3	3	3	1	-	-	-	3	1	1	1	3	2	1
C308.A.2	3	3	3	3	1	-	-	-	3	1	1	1	3	2	1
C308.A.3	3	2	3	3	1	-	-	-	3	1	1	1	3	2	1
C308.A.4	3	2	3	3	1	-	-	-	3	1	1	1	3	1	1
C308.A.5	3	2	3	3	1	-	-	-	3	1	1	1	3	1	1

SEMESTER – V

Communication Simulink Toolbox			
Course Code	**21EC582**	**CIE Marks**	**50**
Teaching Hours/Week (L: T:P: S) (0:0:2:0)	**Credits (0:0:1:0)**	**SEE Marks**	**50**
Credits	**01**	**Exam Hours**	**03**

Course objectives:

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

Sl.No	Experiments
1	Modulation & demodulation of a random binary data stream using 16 – QAM.
2	Bit error rate (BER) improvement using Pulse Shaping on 16 – QAM signal. (Use forward error correction (FEC) coding.)
3	Perform OFDM modulation and obtain time domain and frequency domain plots to show a low-rate signal, a high-rate signal, and a frequency selective multipath channel response.
4	(a) Simulate basic OFDM with no cyclic prefix. Perform Equalization, Convolution, and Cyclic Prefix Addition on basic OFDM.
5	OFDM with FFT Based Oversampling - Modify an OFDM+ Cyclic Prefix signal to efficiently output an oversampled waveform from the OFDM modulator.
6	Simulate a basic communication system in which the signal is first QPSK modulated and then subjected to Orthogonal Frequency Division Multiplexing (OFDM).
7	Obtain the scatter plots & eye diagrams of a QPSK signal to visualize the signal behaviour in presence of AWGN.
8	(a) Generate a multiband signal using the Communications Toolbox. Random noise generation using Simulink & display histogram plots of Gaussian, Rayleigh,Rician, and Uniform noise.
9	QPSK Transmitter and Receiver in Simulink.
10	Multipath Fading Channel in Simulink – For example: Simulate QPSK transmission over a • multipath Rayleigh fading channel and a multipath Rician fading channel.

Course outcomes (Course Skill Set):

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

1. Perform sampling, aliasing, filtering, and quadrature modulation through simulation.
2. Plot signal space representation of digital modulation techniques.
3. Design and implement a pulse shape and matched filter to avoid inter-symbol interference and maximize receiver SNR.
4. Demonstrate advanced wireless communication techniques like Multipath fading, CCI etc. and model the same using MATLAB / Simulink.

Assessment Details (both CIE and SEE)

Continuous Internal Assessment of Laboratory/Practical Courses		
Lab Test 1	Lab Test 2	Lab Records
15 marks	15 marks	20 marks
Semester End Examination **(**SEE)		50 marks

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.

CO- PO Mapping :

POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C308.A.1	3	3	3	3	1	-	-	-	3	1	1	1	3	2	1
C308.A.2	3	3	3	3	1	-	-	-	3	1	1	1	3	2	1
C308.A.3	3	2	3	3	1	-	-	-	3	1	1	1	3	2	1
C308.A.4	3	2	3	3	1	-	-	-	3	1	1	1	3	1	1
C308.A.5	3	2	3	3	1	-	-	-	3	1	1	1	3	1	1

SEMESTER V

VLSI Design Lab			
Course Code	**21EC583**	**CIE Marks**	**50**
Teaching Hours/Week (L: T:P: S) (0:0:2:0)	**Credits (0:0:1:0)**	**SEE Marks**	**50**
Credits	**01**	**Exam Hours**	**03**

Course objectives:

This laboratory course enables students to

1. Design, model, simulate and verify digital circuits.
2. Design layouts and perform physical verification of CMOS digital circuits.
3. Perform ASIC design flow and understand the process of synthesis, synthesis constraints and evaluating the synthesis reports to obtain optimum gate level netlist.
4. Perform RTL-GDSII flow and understand the stages in ASIC.

Sl.No	Experiments
1	Combinational Circuits Multiplexer, D Multiplexer • Write Verilog Code • Verify the Functionality using Test-bench • Synthesize the design and compare the synthesis report
2	Flip-Flop (D, SR, JK) • Write Verilog Code • Verify the Functionality using Test-bench • Synthesize the design and compare the synthesis report
3	Counter (4 Bit) • Write Verilog Code • Verify the Functionality using Test-bench • Synthesize the design and compare the synthesis report
4	Full Adder • Write Verilog Code • Verify the Functionality using Test-bench • Synthesize the design by setting proper constraints and obtain the netlist. From the report generated identify Critical path, Maximum delay, Total number of cells, Power requirement and Total area required
5	4-Bit Adder • Write Verilog Code • Verify the Functionality using Test-bench • Synthesize the design by setting proper constraints and obtain the netlist. From the report generated identify Critical path, Maximum delay, Total number of cells, Power requirement and Total area required
6	4-Bit Booth Multiplier • Write Verilog Code • Verify the Functionality using Test-bench • Synthesize the design by setting proper constraints and obtain the netlist. From the report generated identify Critical path, Maximum delay, Total number of cells, Power requirement and Total area required
	Analog Design
7	a) Capture the schematic of CMOS inverter with load capacitance of 0.1pF and set the widths of Inverter with Wn = Wp, Wn = 2Wp, Wn = Wp/2 and length at selected technology. Carry out the following: i. Set the input signal to a pulse with rise time, fall time of 1ns and pulse width of 10ns and the time period of 20ns and plot the input voltage and output voltage of designed inverter? ii. From the simulation result compute tpHL, tpLH and td for all three geometrical settings of width iii. Tabulate the results of delay and find the best geometry for minimum delay for CMOS inverter? b) Draw layout of inverter with Wp/Wn = 180nm/2u, use optimum layout methods. Verify for DRC and LVS, extract parasitic and perform post layout simulations. Record the observations.

8	a) Capture the schematic of 2-input CMOS NAND gate having similar delay as that of CMOS inverter computed in experiment above. Verify the functionality of NAND gate and also find out the delay td for all four possible combinations of input vectors. Table the results. b) Draw the layout of NAND with Wp/Wn = 40/20, use optimum layout methods. Verify for DRC and LVS, extract parasitic and perform post layout simulations, compare the results with pre-layout simulations. Record the observations.
9	a) Capture schematic of Common Source Amplifier with PMOS Current Mirror Load and find its transient response and AC response? b) Measure the Unit Gain Bandwidth (UGB), amplification factor by varying transistor geometries, study the impact of variation in width to UGB. c) Draw the layout of Common Source Amplifier with Wp/Wn = 40/20, use optimum layout methods. Verify for DRC and LVS
	Demonstration Experiments (For Advance learning)
10	UART • Write Verilog Code • Verify the Functionality using Test-bench • Synthesize the design targeting suitable library and by setting area and timing constraints • Tabulate the Area, Power and Delay for the Synthesized netlist, Identify Critical path
11	For synthesized netlist carry out the following: • Floor planning • Placement and Routing • Record the parameters such as no. of metal layers used for routing, flip method for placement of standard cells • Physical Verification and record the DRC and LVS reports • Generate GDSII
12	Design and characterize 6T binary SRAM cell and measure the following: • Read Time, Write Time, SNM, Power • Draw Layout of 6T SRAM, use optimum layout methods. Verify for DRC & LVS, extract parasitic and perform post layout simulations, compare the results with pre-layout simulations. Record the observations.

Course outcomes (Course Skill Set):

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

1. Design and simulate combinational and sequential digital circuits using Verilog HDL.
2. Understand the synthesis process of digital circuits using EDA tool.
3. Perform ASIC design flow and understand the process of synthesis, synthesis constraints and evaluating the synthesis reports to obtain optimum gate level netlist.
4. Design and simulate basic CMOS circuits like inverter, common source amplifier.
5. Perform RTL_GDSII flow and understand the stages in ASIC design.

Assessment Details (both CIE and SEE)

Continuous Internal Assessment of Laboratory/Practical Courses		
Lab Test 1	Lab Test 2	Lab Records
15 marks	15 marks	20 marks
Semester End Examination **(**SEE)		50 marks

CO- PO Mapping :

POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C308.B.1	3	3	2	3	1	-	-	-	-	-	1	-	3	2	1
C308.B.2	2	2	2	3	1	-	-	-	-	1	1	1	2	3	2
C308.B.3	2	2	2	2	1	-	-	-	-	1	1	1	2	2	1
C308.B.4	2	2	3	3	1	-	-	-	-	-	-	1	2	1	2
C308.B.5	3	2	3	3	1	-	-	-	-	-	1	1	2	1	1

SEMESTER-VI

DATA COMMUNICATION			
Course Code	**21ECT61**	**CIE Marks**	**50**
Teaching Hours/Week (L: T: P: S) (3:0:0:0)	**Credits (3:0:0:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40 hours**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course objectives:

This course will enable students to:

1. Understand the layering architecture of OSI reference model and TCP/IP protocol suite.
2. Study the Media access control protocols associated with Data link layer.
3. Learn the Wireless LANs and fundamentals of Network layer.
4. Define the Network layer protocols and network management system.
5. Assess the services and applications of Transport layer and application layer.

Teaching-Learning Process (General Instructions)

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

1. Lecture method (L): the traditional lecture method, or a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various concepts in networking.
3. Encourage collaborative (Group) Learning in the class.
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
6. Demonstrate implementation of various protocols to help better understand the functioning of various concepts in networking.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the sstudent'sunderstanding.

Module-1

Introduction: Data communication: Components, Data representation.

Network Models: Layered tasks, OSI Model, Layers in OSI model, TCP/IP Suite, OSI Versus TCP/IP, Addressing. (T1-2.12.2,2.3,2.4,2.5)

Data link layer: Framing, Flow and error control, Data-Link layer protocols: Simple protocol, Stop and Wait protocol, Piggy backing.

(T1-11.1,11.2,11.4,11.5)

8 Hours

Module-2

Media Access Control: Random Access: ALOHA, CSMA, CSMA/CD, CSMA/CA. Controlled Access: Reservation, Polling and Token passing. (T1-12.1,12.2)

Wired LANs: Ethernet protocol: IEEE 802, Ethernet Evolution, Standard Ethernet, changes in the standards. Fast Ethernet, Gigabit Ethernet, 1Gigabit Ethernet (T1-13.1 to 13.5)

8 Hours

Module-3

Wireless LANs and Network Layer: Architectural Comparison, Characteristics, (T1-14.1)

Connecting Devices: Hubs, Switches. (T1-15.1)

Virtual LANs: Membership, Configuration, Communication between Switches and Routers, Advantages. (T1-15.3)

Network Layer: Introduction, Network Layer services: Packetizing, Routing and Forwarding. DHCP, Network Address Resolution (T1-22.1,22.2)

8Hours

Module-4

Network Layer Protocols and Network Management:

Internet Protocol (IP): Datagram Format, Fragmentation, Logical addressing, IPv4 addresses, IPv6 addresses, Transition from IPv4 to IPv6.

Network Management System: Configuration Management, Fault management, Performance management. Simple Network Management Protocol (SNMP): Concept, Management Components, Structure of Management Information (Ch-28, 28.1, 28.2)

8Hours

Module-5

Transport Layer: Introduction: Transport Layer Services, Connectionless and Connection oriented Protocols, Transport Layer Protocols: Simple protocol, Stop and wait protocol, Go-Back N Protocol,
Selective repeat protocol. User Datagram Protocol: User Datagram, UDP Services,
UDP Applications, Transmission Control Protocol: TCP Services, TCP Features, State Transition diagram, TCP applications.
Application Layer: Introduction: Providing services, Domain Name System (DNS), Applications.

08 Hours

Teaching-Learning Process for all modules	**Chalk and Talk/PowerPoint presentation/YouTube videos.**

Course Outcomes:

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

1. Understand the concepts of OSI model and TCP/IP protocol suite thoroughly.
2. Identify the protocols and services associated with Data link layer.
3. Distinguish the basic network configurations and standards associated with each network.
4. Discuss and analyze the Network layer protocols and network management system.
5. Apply various algorithms and services to implement various applications.

Assessment Details (both CIE and SEE)

Component		**Weightage (%)**	
CIE's	CIE 1- At the end of 5th week	20	60
	CIE 2 - At the end of 10th week	20	
	CIE 3 - At the end of 15th week	20	
AAT's	AAT-1- At the end of 4th week	10	40
	AAT-2- At the end of 9th week	10	
	AAT-3- At the end of 13th week	20	
Continuous Internal Evaluation Total Marks: 100. Reduced to 50 Marks			
Semester End Examination (SEE) Total Marks: 100. Reduced to 50 Marks			

Suggested Learning Resources:

Text Books:

1. Behrouz A Forouzan, "Data Communications and Networking" 4th edition, McGraw Hill publication, 2017, ISBN: 978-0070634145.
2. Nader F Mir, "Computer and Communication Network" 2nd edition, Prentice Hall publication, 2014, ISBN-10: 0-13-381474-2

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- **Quizzes**
- Assignments
- Seminars

CO- PO Mapping:

POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C309.1	3	2	2	2	-	-	-	-	-	-	1	1
C309.2	3	3	3	2	2	-	-	-	-	-	1	1
C309.3	3	3	2	2	2	-	-	-	-	-	1	1
C309.4	2	3	3	2	3	-	-	-	-	-	1	1
C309.5	3	3	3	2	3	-	-	-	-	-	1	1

SEMESTER-VI

Object Oriented Programming with Java & Data Structures			
Course Code	**21ECI62**	**CIE Marks**	**50**
Teaching Hours/Week (L: T: P: S) (3:0:2:0)	**Credits (3:0:1:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40 hours Theory + 13 Lab slots**	**Total Marks**	**100**
Credits	**04**	**Exam Hours**	**03**

Course objectives:

This course will enable students to:

1. To make students learn fundamentals features of object-oriented language and JAVA
2. To impart the knowledge of classes and objects.
3. To illustrate concept of inheritance and exception handling
4. To describe the Stack, Queues, Linked data structures
5. To evaluate Lists, Trees, Binary Tree

Teaching-Learning Process (General Instructions)

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

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

Module-1

Introduction to JAVA An Overview of Java: Object-Oriented Programming, A First Simple program, Data types, Variables and arrays: Primitive types, Booleans, A Closer Look at Literals, Variables, Reference variables, Operators, Control statements, Type conversion and casting, Arrays, Simple java programs.

08 Hours

Module-2

OOP in JAVA Classes: Class fundamentals, Declaring objects, Assigning Object Reference Variables, Introducing Methods, Constructors The this keyword, Garbage collection, The finalize() method, A stack class, Overloading methods, Using objects as parameters, Returning objects, Access control, static members, final members, Command LIne Arguments, String Class.

08 Hours

Module-3

Inheritance and Exception Handling: Inheritance Basics: Member access and Inheritance, A Superclass Variable can reference a subclass object, Using Super, Creating a Multilevel Hierarchy, When Constructors are called. Method overriding, using abstract classes, using final

08 Hours

Module-4

Stack, Queues, Linked data structures: Stack operations, JCF Stack class, A stack interface, An indexed implementation, A linked implementation, Abstracting the common code, Queues: Queue operations, JCF Queue Interface, A simple queue interface, An indexed implementation

08 Hours

Module-5

Lists, Trees, Binary Tree: JCF list interface, Range-view operation sublist( ), List iterators, Other List types. Tree: Tree definitions, Decision trees, Ordered trees, Traversal algorithms Binary Tree: Definitions, Full binary trees, Complete Binary trees, Binary tree traversal algorithms, Expression tree

08 Hours

PRACTICAL COMPONENT OF IPCC

Sl.No	Experiments
1	Use Eclipse or NetBeans IDE and acquaint with the various menus. Create a test project, add a testclass, and run it. Try debug step by step with a small program of about 10 to 15 lines which contains at least one if else condition and a for loop. To include suitable Small Java programs.
2	Design a class to represent a Student (details include the Student ID, Name of the Student, Branch, year, location and college). Assign initial values using constructor. Design a sub-class with methods to accept the marks & attendance and hence calculate average of marks of 6 subjects and attendance percentage.
3	Write a recursive and non recursive Java program to implement i) Linear search ii) Binary search
4	Write a Java program to implement i) Bubble sort ii) Selection sort iii) quick sort iv) insertion sort
5	Write a Java program to generate 'N' Fibonacci numbers using recursive and non-recursive methods.
6	Write a menu-driven Java program to implement the following data structures using an array: a)Stack ADT (b) Queue ADT
7	Write a menu-driven Java program to implement the following operations on Singly Linked List(SLL): a) Create a SLL of integers. b) Insert a given integer from SLL. c) Delete a given integer into SLL. d) Display the contents of SLL.
8	Write a Java program to perform the following operations: a) Insert an element into a Binary Search Tree (BST). b) Delete an element from a BST. c) Search for a key element in a BST d) Traverse the BST in pre-order, in-order & post-order.
9	Write a java program to demonstrate method overloading and constructors overloading.
10	Write a Java programs to implement the following using a singly linked list and perform the givenoperations. a) Stack ADT i) push an element into stack ii) pop an element from the stack iii) display the contents of the stack
11	Write a Java programs to implement the following using a singly linked list and perform the givenoperations. b) Queue ADT i) insert an element into queue ii) delete an element from the queue iii) display the contents of the queue
12	Write a java program that works as a simple calculator. Use a Grid Layout to arrange Buttons for digits and for the + - * % operations. Add a text field to display the result. Handle any possible exceptions like divide by zero.

Course Outcomes

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

1. Use OOP concepts effectively to build simple application programs.
2. Use inheritance and constructor concepts to write programs
3. Explain and implement the object-oriented core-concepts such as class, object, inheritance and exception handling using JAVA.
4. Implement the data structures such as Arrays, Lists, Stack, Queue and Trees using Java
5. Make a decision on choosing a suitable data structure for a specific application program.

Assessment Details (both CIE and SEE)

Component		Weightage (%)		
CIE's	CIE 1 5th week	20	60	Average of 3 tests for 20 marks
	CIE 2 10th week	20		
	CIE 3 15th week	20		
AAT's	AAT-1 10th week			10
	Lab Test	30		Reduced to 10
	Lab Record	20		10
Continuous Internal Evaluation Total Marks :100. Reduced to 50 Marks				
Semester End Examination (SEE) Total Marks :100. Reduced to 50 Marks				

Suggested Learning Resources:

Text Books

1. "JAVA The Complete Reference", Herbert Schildt, 7th Edition, Tata McGraw Hill, 2007.
2. "Data Structures with Java", John R Hubbard, 2nd edition, Schaum's Outlines.

Reference Books

1. "Fundamentals of OOP and Data Structures in Java", Richard Wiener, Lewis J Pinson, CambridgeUniversity Press, 2000.
2. "Object Oriented Programming and Java", Danny Poo, Derek Kion, Swarnalatha Ashok, Springer, 2nd edition, 2007.
3. "Java Fundamentals", Herbert Schildt, Dale Skrien, McGraw Hill Education, 2017.
4. "Data Structures and Algorithms Made Easy in JAVA: Data Structure and Algorithmic Puzzles",Narasimha Karumanchi, CareerMonk Publications, Second edition, 2011.
5. "Data Structures & Algorithms in Java", Goodrich, Tamassia, Goldwasser, Universities Press; Secondedition, 2005.

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program
- https://www.youtube.com/watch?v=CFD9EFcNZTQ
- https://www.youtube.com/watch?v=grEKMHGYyns

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Quizzes, Assignments, Seminars

CO- PO Mapping:

POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C310.1	3	3	3	3	3	-	-	-	2	2	1	1	3	3	3
C310.2	2	3	3	2	2	-	-	-	3	1	1	1	2	3	3
C310.3	1	2	3	3	2	-	-	-	3	1	1	1	1	2	3
C310.4	3	3	3	3	1	-	-	-	3	1	1	1	3	3	3
C310.5	3	3	3	3	3	-	-	-	2	2	2	2	3	3	3

SEMESTER-VI

Microwave Theory & Antennas			
Course Code	**21ECT63**	**CIE Marks**	**50**
Teaching Hours/Week (L: T: P: S) (3:0:0:0)	**Credits (3:0:0:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40 hours**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course objectives:

This course will enable students to:

1. Describe the microwave properties and its transmission media.
2. Describe the microwave devices for several applications.
3. Understand the fundamental concepts of antenna parameters.
4. Learn the basic principles of antenna arrays.
5. Illustrate the characteristics of different types of antennas and gain the knowledge on antenna measurements.

Teaching-Learning Process (General Instructions)

Teaching-Learning Process (General Instructions) The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the evolution of communication technologies.
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
7. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Microwave Sources: Introduction, Gunn Diode (**Text 2**: 7.1,7.1.1,7.1.2)

Microwave transmission lines: Microwave frequencies, Microwave devices, Microwave systems. Transmission line equations and solutions, Reflection Coefficient and Transmission Coefficient. Standing wave and standing wave ratio. Smith chart, Single stub matching. (**Text 2**: 0.1, 0.2, 0.3, 3.1, 3.2, 3.3, 3.5, 3.6)

08 Hours

Module-2

Microwave Network Theory: Introduction, S matrix representation of multi-port networks (**Text 1**: 6.1, 6.3, 6.3.1, 6.3.2)
Microwave passive devices: Coaxial connectors and Adapters, Attenuators, Phase shifters, waveguide Tees, Magic Tee, Circulator, Isolator. (**Text 1**: 6.4.2, 6.4.14, 6.4.15, 6.4.16, 6.4.17 A, B)

08 Hours

Module-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, wave polarization, illustrative examples. (**Text 3**: 2.1 – 2.31, 2.34)

08 Hours

Module-4

Point source: Introduction, Power theorem, Radiation Intensity, Source with unidirectional Cosine and Cosine squared power pattern, Source with Bidirectional Cosine power pattern, Source with Sine (Doughnut) power pattern, Source with Sine (Doughnut) squared power pattern. (**Text 3**: 3.1 – 3.11)

Antenna arrays: Introduction, Array of Two Isotropic Point Sources, Pattern Multiplication, Linear array of n Isotropic Point Sources of equal amplitude and spacing, Broadside array, End fire array. (**Text 3**: 4.1 – 4.7)

08 Hours

Module-5

Loop and Horn antenna: Introduction: Small loop, Comparison of far fields of small loop and short dipole. Radiation resistance of small loop, Horn Antennas, (Text 3: 6.1 – 6.3, 7.6, 7.7, 7.19)

Antenna Types: Slot Antenna, Babinet's Principle and complementary antennas, Patch or Microstrip antennas, MIMO Antenna, Dielectric Resonator Antenna, Yagi-Uda antenna, Helical antenna, Antenna Measurements: Radiation pattern, Gain & Direct measurement (**Text 3**: 7.13 – 7.15, **Text R3**: 1 – 1.2, **Text R4**: 1 – 1.2, **Text 3**: 7.6, 7.7, 7.19, 8.1,8.8, 21.2b, 21.5a – 21.5b,)

08 Hours

Teaching-Learning Process for all modules	**Chalk and Talk/PowerPoint presentation/YouTube videos.**

Course Outcomes (Course Skill Set):

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

6. Describe the use and advantages of microwave transmission.
7. Analyze various parameters related to transmission lines.
8. List and explain various antenna parameters.
9. Illustrate the different types of arrays and their radiation pattern.
10. Analyze the various antenna designing techniques for a given antenna parameters.

Assessment Details (both CIE and SEE)

Component		**Weightage (%)**	
CIE's	CIE 1- At the end of 5th week	20	60
	CIE 2 - At the end of 10th week	20	
	CIE 3 - At the end of 15th week	20	
AAT's	AAT-1- At the end of 4th week	10	40
	AAT-2- At the end of 9th week	10	
	AAT-3- At the end of 13th week	20	
Continuous Internal Evaluation Total Marks: 100. Reduced to 50 Marks			
Semester End Examination (SEE) Total Marks: 100. Reduced to 50 Marks			

Suggested Learning Resources:

Text Books:

1. Microwave Engineering -Annapurna Das, Sisir K Das, TMH Publication, 2nd Edition, 2010.
2. Microwave Devices and Circuits – Samuel Y 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:

1. Microwave Engineering -David M Pozar, John Wiley India Pvt Ltd., Pvt Ltd., 3rd edition, 2008. 2. Microwave Engineering-Sushrut Das, Oxford Higher Education, 2nd Edn, 2015.
2. C.A Balanis: "Antenna Theory-Analysis and Design", Third Edition, John Wiley & Sons,2010,
3. ISBN:0-471-66782-X
4. Leeladhar Malviya, M. V. Kartikeyan, and Rajib Kumar Panigrahi: MIMO Antennas for Wireless Communication: Theory and Design, CRC Press, 2020, ISBN: 9781003080275
5. K. M. Luk, K. W. Leung, K. M. Luk, K. W. Leung: Dielectric Resonator Antenna, Research Studies Press, 2002, ISBN: 9780863802638

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

a. Quizzes
b. Assignments
c. Seminars/Expert Lectures

CO- PO Mapping:

POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C311.1	3	3	2	1	1	--	--	--	--	--	1	--
C311.2	3	2	2	1	1	--	--	--	--	--	1	--
C311.3	3	3	2	1	1	--	--	--	--	--	1	1
C311.4	3	3	2	1	--	--	--	--	--	--	--	--
C311.5	3	3	2	1	1	--	--	--	--	1	1	1

SEMESTER-VI

Nano Electronics			
Course Code	**21EC641**	**CIE Marks**	**50**
Teaching Hours/Week (L: T: P: S) (3:0:0:0)	**Credits (3:0:0:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40 hours**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course objectives:

This course will enable students to:

1. Understand the basics of top-down and bottom-up fabrication process, devices and Systems
2. Enhance basic engineering science and technical knowledge of nano electronics.
3. Describe technologies involved in modern day electronic devices.
4. Know various nanostructures of carbon and the nature of the carbon bond itself.
5. Learn the photo physical properties of sensor used in generating a signal.

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various techniques.
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
7. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
8. Incorporate programming examples given under Activity based learning.

Module-1

Introduction to nanotechnology: Impacts, Limitations of conventional microelectronics, Trends in microelectronics and optoelectronics, MOSFET basics and operation characteristic lengths in mesoscopic systems, Classification of Nano structures, Low dimensional structures Quantum wells, wires and dots, Density of states and dimensionality Basic properties of two dimensional semiconductor nanostructures, square quantum wells of finite depth, parabolic and triangular quantum wells Quantum wires and quantum dots, carbon nano tube, graphene

08 Hours

Module-2

Fabrication of nano-layers: Different approaches, physical vapour deposition, chemical vapour deposition Molecular Beam Epitaxy, Ion Implantation, Formation of Silicon Dioxide- dry and wet oxidation methods Fabrication of nano particle- grinding with iron balls, laser ablation, reduction methods, sol gel, self assembly, precipitation of quantum dots.

08 Hours

Module-3

Characterization of nanostructures: Tools used for of nano materials characterization, microscope-optical, electron, and electron microscope. Principle of operation of Scanning Tunnelling Microscope, Atomic Force Microscope, Scanning Electron microscope, Specimen interaction. Transmission Electron Microscope X-Ray Diffraction analysis, PL & UV Spectroscopy, Particle size analyzer.

08 Hours

Module-4

Carbon Nanostructures: Carbon molecules, Carbon Clusters, Carbon Nanotubes, application of Carbon Nanotubes.

08 Hours

Module-5

Nano electronic devices: MODFETS, hetero junction bipolar transistors Resonant tunnel effect, RTD, RTT, Hot electron transistors Coulomb blockade effect and single electron transistor, CNT transistors Hetero structure semiconductor laser Quantum well laser, quantum dot LED, quantum dot laser, Quantum well optical modulator, quantum well sub band photo detectors, principle of NEMS.

08 Hours

Course Outcomes:

On completion of this course, students should be able to:

1. Illustrate the principles behind Nano science engineering and Nano electronics.
2. Explain the effect of particles size on mechanical, thermal, optical and electrical properties of nano materials.
3. Describe the properties of carbon and carbon nanotubes and its applications.
4. Apply the knowledge to prepare and characterize nano materials.
5. Analyze the process flow required to fabricate state-of-the-art transistor technology.

Assessment Details (both CIE and SEE)

Component		Weightage (%)	
CIE's	CIE 1- At the end of 5th week	20	60
	CIE 2 - At the end of 10th week	20	
	CIE 3 - At the end of 15th week	20	
AAT's	AAT-1- At the end of 4th week	10	40
	AAT-2- At the end of 9th week	10	
	AAT-3- At the end of 13th week	20	
Continuous Internal Evaluation Total Marks: 100. Reduced to 50 Marks			
Semester End Examination (SEE) Total Marks: 100. Reduced to 50 Marks			

Text Books:

1. J.M. Martinez-Duart, R.J. Martin Palma, F. Agulle Rueda Nanotechnology for Microelectronics and optoelectronics, Elsevier, 2006, ISBN 9780080445533.
2. W.R. Fahrner, Nanotechnology and Nanoelctronics, Springer, 2005, ISBN 9783540266211.

Reference Books:

1. Chattopadhyay, Banerjee, Introduction to Nano science & Technology, PHI, 2012, ISBN-13: 978-8120336087.
2. George W. Hanson, Fundamentals of Nano electronics, Pearson Education, 2009, ISBN-13: 9780.1B.
3. K. Goser, P. Glosekotter, J. Dienstuhl, Nano electronics and nano systems, Springer 2004, ISBN 978-3-662-05421-5.

E-Resources:

1. https://www.sciencedirect.com/topics/materials-science/nanoelectronics
2. https://www.circuitstoday.com/nanoelectronics

CO-PO Mapping:

POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C312.A.1	3	1	1	-	1	-	-	-	-	-	1	1
C312.A.2	2	2	3	-	1	-	-	-	-	-	1	1
C312.A.3	3	2	1	1	1	-	-	-	-	-	1	1
C312.A.4	2	3	3	1	1	-	-	-	-	-	1	1
C312.A.5	3	1	3	1	1	-	-	-	-	-	1	1

SEMESTER-VI

Cryptography			
Course Code	**21EC642**	**CIE Marks**	**50**
Teaching Hours/Week(L:T:P:S)(2:2:0:0)	**Credits (2:1:0:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40 hours**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course objectives:

The goal of the course Cryptography and Network Security is:

1.Understand the basic concepts of Network security and Classical encryption techniques.
2.Gain the Knowledge of stream ciphers and block ciphers cryptographic algorithms.
3.Apply the classical encryption techniques to stream and block ciphers.
4.Analyze the Stream ciphers and block ciphers and their applications in Network security.
5.Design and develop the block ciphers and stream ciphers for Applications in Network security.

Module-1

Introduction:
Services, mechanisms and attacks, OSI security architecture, Model for network security.
Symmetric ciphers:

Introduction , Symmetric Cipher Model, Substitution Techniques: Caesar Cipher. Mono Alphabetic Cipher. Playfair Cipher, Hill Cipher, poly alphabetic Cipher and One-Time Pad(OTP),Transposition Technique, Rotor Machines, Steganography.

08 Hours

Module-2

Basic Concepts of Number Theory and Finite Fields:
Divisibility and The Division Algorithm Euclidean algorithm, Modular arithmetic, Groups, Rings and Fields, Finite fields of the form GF(p), Polynomial Arithmetic, Finite Fields of the Form GF(2^n), Prime Numbers, Fermat's and Euler's theorem, discrete logarithm.

08 Hours

Module-3

Block Ciphers:
Simplified DES, Block Cipher Principles. Data encryption standard (DES), Strength of DES Block Cipher Design Principles and

Block Cipher Modes of Operation, Evaluation Criteria for Advanced Encryption Standard, The AES Cipher.

08 Hours

Module-4

Asymmetric Ciphers:
Principles of Public-Key Cryptosystems, The RSA algorithm. Key Management, Diffie - Hellman Key Exchange, Overview of Elliptic curve Cryptography.
Authentication functions and Hash Functions: Authentication functions, message authentication codes, hash functions.

08 Hours

Module-5

Pseudo-Random-Sequence Generators and Stream Ciphers:
Linear Congruential Generators, Linear Feedback Shift Registers, Design and analysis of stream

ciphers, Stream ciphers using LFSRs, A5, RC4, Hughes XPD/KPD, Nanoteq, Rambutan, Additive generators, Gifford, Algorithm M, PKZIP

08 Hours

Teaching-Learning Process for all modules	**Chalk and Talk/Power Point presentation/YouTube videos.**

Course Outcomes:

After successfully completing the course, the students will be able

1.Explain the basic concept of classical encryption used for network security.

2. Illustrate the structure of cryptographic algorithm and their applications.

3. Apply the concepts of classical encryption techniques to existing standard algorithms.

4. Evaluate the significance of cryptographic algorithms and their applications in network security.

5. Design and develop the private key and public key, authentication functions for applications in network security.

Assessment Details (both CIE and SEE)

Component		Weightage(%)	
CIE's	CIE 1-At the end of 5th week	20	60
	CIE2 -At the end of 10th week	20	
	CIE3 -At the end of 15th week	20	
AAT's	AAT-1-At the end of 4th week	10	40
	AAT-2-At the end of 9th week	10	
	AAT-3-At the end of 13th week	20	
Continuous Internal Evaluation Total Marks: 100. Reduced to 50Marks			
Semester End Examination (SEE) Total Marks: 100. Reduced to 50Marks			

Suggested Learning Resources:

Text Books:

1.William Stallings , "Cryptography and Network Security Principles and Practice", Pearson Education Inc., 6th Edition, 2014, ISBN: 978-93-325-1877-3

2. Bruce Schneier, "Applied Cryptography Protocols, Algorithms, and Source code in C", Wiley Publications, 2nd Edition, ISBN: 9971-51-348-X.

Reference Books:

1.Cryptography and Network Security, Behrouz A Forouzan, TMH, 2007.
2. Cryptography and Network Security, Atul Kahate, TMH, 2003.

E-Resources:

1.http://www.nptel.ac.in/courses/106105031
2. http://faculty.mu.edu.sa/public/uploads/1360993259.0858Cryptography and Network Security Principles and Practice, 5th Edition.pdf

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- **Quizzes**
- Assignments
- Seminars

CO-POMapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C312.B.1	3	3	3	2	2	1	1			2	1		2	3	2
C312.B.2	3	3	3	3	2	1				2	2		3	3	3
C312.B.3	3	3	3	2	2	1				2	2		3	3	2
C312.B.4	3	3	2	2	2	1				2	2	1	3	2	2
C312.B.5	3	3	2	3	2	1	1			2	2	1	2	2	2

SEMESTER-VI

Python Programming			
Course Code	**21EC643**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P:S) (2:0:2:0)	**Credits (2:0:1:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**26 hours Theory + 10 Lab slots**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course objectives:

1. To learn programming using Python
2. Develop application using functions in Python
3. To understand the Pattern Matching with Regular Expressions
4. To learn the concepts of reading writing with files
5. Develop the programs using classes and objects concepts

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

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

Module-1

Python Basics, Python language features, History , Entering Expressions into the Interactive Shell, The Integer, Floating-Point, and String Data Types, String Concatenation and Replication, Storing Values in Variables, Your First Program, Dissecting Your Program, Flow control, Boolean Values, Comparison Operators, Boolean Operators, Mixing Boolean and Comparison Operators, Elements of Flow Control, Program Execution, Flow Control Statements, Importing Modules, Ending a Program Early with sys. exit.

08 Hours

Module-2

Functions, def Statements with Parameters, Return Values and return Statements, The None Value, Keyword Arguments and print (), Local and Global Scope, The global Statement, Exception Handling.

Data Structures: Lists: The List Data Type, Working with Lists Strings: Manipulating Strings, Working with Strings, Useful String Methods Tuples and Dictionaries, basics Using Data Structures to Model Real-World Things.

08 Hours

Module-3

Pattern Matching with Regular Expressions, Finding Patterns of Text Without Regular Expressions, Finding Patterns of Text with Regular Expressions, More Pattern Matching with Regular Expressions, The findall() Method, Character Classes, Making Your Own Character Classes, The Caret and Dollar Sign Characters, The Wildcard Character, Review of Regex Symbols

08 Hours

Module-4

Reading and Writing Files, Files and File Paths, The os path Module, The File Reading/Writing Process, Saving Variables with the shelve Module, Saving Variables with the print. format() Function

INPUT VALIDATION

The Input Plus Module, The min, max, greater than, and less Than Keyword Arguments, Passing a Custom Validation Function to input Custom().

08 Hours

Module-5

Classes and objects: Programmer-defined types, Attributes, Rectangles, Instances as return values, Objects are mutable, Copying, Classes and functions: Time, Pure functions, Modifiers, Prototyping versus planning, Classes and methods: Object-oriented features, Printing objects, Another example, The input method, method, Operator overloading, Type-based dispatch, Polymorphism.

08 Hours

Course outcomes (Course Skill Set)

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

1. To acquire programming skills in Python
2. To demonstrate data structure representation using Python
3. To develop the skill of pattern matching and files in Python
4. To acquire Object Oriented Skills in Python
5. To develop the ability to write database applications in Python

Text Books:

1. Al Sweigart, "Automate the Boring Stuff with Python",1st Edition, No Starch Press, 2015. (Available under CC-BY-NC-SA license at https://automatetheboringstuff.com/) (Chapters 1 to 8)
2. Allen B Downey, "Think Python: How to Think Like a Computer Scientist", 2nd Edition, Green TeaPress, 2015. (Available under CC-BY-NC license at http://greenteapress.com/thinkpython2/thinkpython2.pdf) (Chapters 15 - 18)
   (Download pdf/html files from the above links)
3. Charles R. Severance, "Python for Everybody: Exploring Data Using Python 3", 1st, Create SpaceIndependent Publishing Platform, 2016

Web links and Video Lectures (e-Resources)

- https://www.youtube.com/watch?v= xQNeOTRyig
- https://www.youtube.com/watch?v=kqtD5dpn9C8

Assessment Details (both CIE and SEE)

Component		Weightage (%)		
CIE's	CIE 1 5th week	20	60	Average of 3 tests for 20 marks
	CIE 2 10th week	20		
	CIE 3 15th week	20		
AAT's	AAT-1 10th week			10
	Lab Test	30		Reduced to 10
	Lab Record	20		10
Continuous Internal Evaluation Total Marks :100. Reduced to 50 Marks				
Semester End Examination (SEE) Total Marks :100. Reduced to 50 Marks				

CO-PO Mapping:

POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C312.C.1	3	3	3	3	3	-	-	-	2	2	1	1	3	3	3
C312.C.2	2	3	3	2	2	-	-	-	3	1	1	1	2	3	3
C312.C.3	1	2	3	3	2	-	-	-	3	1	1	1	1	2	3
C312.C.4	3	3	3	3	1	-	-	-	3	1	1	1	3	3	3
C312.C.5	3	3	3	3	3	-	-	-	2	2	2	2	3	3	3

SEMESTER-VI

Micro Electro Mechanical Systems			
Course Code	**21EC644**	**CIE Marks**	**50**
Teaching Hours/Week (L: T: P: S) (3:0:0:0)	**Credits (3:0:0:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40 hours**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course objectives:

1. To provide overview of MEMS devices and its application.
2. To introduce various sensors and actuators
3. To introduce different materials used for MEMS
4. To educate on the applications of MEMS to disciplines beyond Electrical and Mechanical engineering.

Teaching-Learning Process (General Instructions)

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

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes
2. Show Video/animation films to explain the functioning of various
3. Encourage collaborative (Group) Learning in the class to promote critical thinking
4. Topics for seminars on several MEMS related topics and their applications
5. Encourage the students to take up mini projects and main projects
6. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding

Module-1

Overview of MEMS and Microsystems: MEMS and Microsystem, Typical MEMS and Microsystems Products, Evolution of Microfabrication, Microsystems and Microelectronics, Multidisciplinary Nature of Microsystems, Miniaturization. Applications and Markets.

Text1: 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9

08 Hours

Module-2

Working Principles of Microsystems: Introduction to MEMS sensors and actuators, Microsensors: Electrostatic sensors, Parallel plate capacitors, Applications, Interdigitated Finger capacitor, Piezoresistive sensors, Piezoresistive sensor materials, Stress analysis of mechanical elements Micro actuators: Comb drive devices, Micro Grippers, Piezoelectric and actuators

Text 2: 4.1, 4.2, 4.3, 4.4, 4.7, 6.1,6.3,7.1

08 Hours

Module-3

MICRO-OPTO-ELECTRO MECHANICAL SYSTEMS: Principle of MOEMS technology, properties of light, light modulators, beam splitter, micro lens, micro mirrors, digital micro mirror device (DMD), light detectors, grating light valve (GLV), optical switch, wave guide and tuning, shear stress measurement.

Text1: 4.1,4.2,4.3,4.4,4.5,4.6,4.7

08 Hours

Module-4

Scaling Laws in Miniaturization: Introduction, Scaling in Geometry, Scaling in Rigid-Body Dynamics, Scaling in Electrostatic Forces, Scaling in Electromagnetic Forces, Scaling in Electricity, Scaling in Fluid Mechanics, Scaling in Heat Transfer. Text1: 6.1, 6.2,6.3,6.4,6.5,6.6,6.7,6.8

08 Hours

Module-5

Overview of Micromanufacturing: Introduction, Bulk Micromanufacturing, Surface Micromachining, The LIGA Process, Summary on Micromanufacturing.

Text1: 9.1,9.2,9.3,9.4,9.5

Microsystem Packaging: Introduction, Overview of Mechanical Packaging of Microelectronics, Microsystem Packaging.

Text1: 11.1,11.2, 11.3

08 Hours

Teaching-Learning Process for all modules	**Chalk and Talk/PowerPoint presentation/YouTube videos.**

Course Outcomes:

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

1. Appreciate the technologies related to Micro Electro Mechanical Systems.
2. Understand design and fabrication processes involved with MEMS devices.
3. Analyse the MEMS devices and develop suitable mathematical models
4. Know various application areas for MEMS device.

Assessment Details (both CIE and SEE)

Component		Weightage (%)	
CIE's	CIE 1- At the end of 5th week	20	60
	CIE 2 - At the end of 10th week	20	
	CIE 3 - At the end of 15th week	20	
AAT's	AAT-1- At the end of 4th week	10	40
	AAT-2- At the end of 9th week	10	
	AAT-3- At the end of 13th week	20	
Continuous Internal Evaluation Total Marks: 100. Reduced to 50 Marks			
Semester End Examination (SEE) Total Marks: 100. Reduced to 50 Marks			

Suggested Learning Resources:

Text Book:

8. Tai-Ran Hsu, MEMS and Micro systems: Design and Manufacture, 1st Ed, Tata Mc Graw Hill.
9. Chang Liu, "Foundations of MEMS", Pearson Education Inc., 2006.

Reference Books:

10. Hans H Gatzen, Volker Saile, JurgLeuthold, Micro and Nano Fabrication: Tools and Processes, Springer, 2015.
11. Dilip Kumar Bhattacharya, Brajesh Kumar Kaushik, Microelectromechanical Systems (MEMS), Cengage Learning. 3. Chang Liu, Foundations of MEMS, Pearson Ed.
12. Foundation of MEMS, Chang Liu, Prentice Hall Ltd.
13. MEMS and NEMS, Sergey Edwrd Lyshevski, CRC Press, Indian Edition.

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Seminars

CO- PO Mapping:

POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C312.D.1	3	2	1	1	--	--	--	--	--	--	--	--
C312.D.2	3	3	2	1	--	--	--	--	--	--	--	--
C312.D.3	2	3	1		--	--	--	--	--	--	--	--
C312.D.4	3	2	2	2	--	--	--	--	--	--	--	--

SEMESTER-VI

Communication Engineering			
Course Code	**21EC651**	**CIE Marks**	**50**
Teaching Hours/Week (L: T: P: S) (3:0:0:0)	**Credits (3:0:0:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40 hours**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course objectives:

This course will enable students to:

1. Describe essential elements of an electronic communication system.
2. Understand Amplitude, Frequency & Phase modulations, and Amplitude demodulation.
3. Define the sampling theorem and methods to generate pulse modulations.
4. Understand the concept of Multiplexing and learn the various methods of digital modulation techniques and compare the different schemes.
5. Understand the basic concepts of wireless and cellular communications.

Teaching-Learning Process (General Instructions)

Teaching-Learning Process (General Instructions) The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the evolution of communication technologies.
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
7. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction to Electronic Communications: Historical perspective, Electromagnetic frequency spectrum, Signal and its representation, Elements of electronic communications system, primary communication resources, signal transmission concepts, Analog and digital transmission, Modulation, Concept of frequency translation, Signal radiation and propagation (Text 1: 1.1 to 1.10) **08 Hours**

Module-2

Amplitude Modulation Techniques: Types of analog modulation, Principle of amplitude modulation, AM power distribution, Limitations of AM, (TEXT 1: 4.1, 4.2, 4.4, 4.6)

Angle Modulation Techniques: Principles of Angle modulation, Theory of FM-basic Concepts, Theory of phase modulation (TEXT1: 5.1, 5.2, 5.5) **08 Hours**

Module-3

Sampling Theorem and Pulse Modulation Techniques: Digital Versus Analog Transmissions, Sampling Theorem, Classification of pulse modulation techniques, PAM, PWM, PPM, PCM, Quantization of signals (TEXT 1: 7.2 to 7.8)

08 Hours

Module-4

Digital Modulation Techniques: differential pulse code modulation. Delta modulation, Adaptive Delta Modulation, noise considerations in PCM, (TEXT 1: 7.9 to 7.13).

Time division multiplexing, Frequency division multiplexing, (TEXT 1: 8.8-8.9).

Types of digital Modulation, ASK, FSK, PSK (TEXT 1: 9.1 to 9.5).

08 Hours

Module-5

Evolution of wireless communication systems: Brief History of wireless communications, Advantages of wireless communication, disadvantages of wireless communications, wireless network generations, Comparison of wireless systems, Evolution of next generation networks, Applications of wireless communication (TEXT 2: 1.1 to 1.7)

Principles of Cellular Communications: Cellular terminology, Cell structure and Cluster, Frequency reuse concept, Cluster

size and system capacity, Method of locating cochannel cells, Frequency reuse distance (TEXT 2: 4.1 to 4.7) **08 Hours**

Teaching-Learning Process for all modules	**Chalk and Talk/PowerPoint presentation/YouTube videos.**

Course Outcomes(Course Skill Set):

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

1. Describe the scheme and concepts of radiation and propagation of communication signals.
2. Understand the AM and FM modulation techniques and represent the signal in time and frequency domain relations.
3. Understand the process of sampling and quantization of signals and describe different methods to generate digital signals.
4. Describe the basic digital modulation techniques, performance comparison between digital modulation techniques and uses of multiplexing in communication domain
5. Compare the different wireless communication systems and describe the structure of cellular communication.

Assessment Details (both CIE and SEE)

Component		**Weightage (%)**	
CIE's	CIE 1- At the end of 5th week	20	60
	CIE 2 - At the end of 10th week	20	
	CIE 3 - At the end of 15th week	20	
AAT's	AAT-1- At the end of 4th week	10	40
	AAT-2- At the end of 9th week	10	
	AAT-3- At the end of 13th week	20	
Continuous Internal Evaluation Total Marks: 100. Reduced to 50 Marks			
Semester End Examination (SEE) Total Marks: 100. Reduced to 50 Marks			

Suggested Learning Resources:

Text Books:

1. T L Singal, Analog and Digital Communications, McGraw Hill Education (India) Private Limited, 2012, 0-07-107269-1

2. T L Singal, Wireless Communications, McGraw Hill Education (India) Private Limited, 2016, ISBN:0-07-068178-3.

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- **Quizzes**
- Assignments
- Seminars

CO- PO Mapping:

POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C313.A.1	3	2	1	--	--	--	--	--	--	--	--	2
C313.A.2	3	2	2	--	1	--	--	--	--	--	--	--
C313.A.3	3	2	1	--	--	--	--	--	--	--	--	--
C313.A.4	3	2	1	--	--	--	--	--	--	--	--	--
C313.A.5	2	2	--	--	--	--	--	--	--	--	--	2

SEMESTER-VI

MICROCONTROLLERS			
Course Code	**21EC652**	**CIE Marks**	**50**
Teaching Hours / Week (L:T:P:S) (3:0:0:0)	**Credits (3:0:0:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40 hours**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course Objectives:

This course will enable students to:

1. Understand the difference between a Microprocessor and a Microcontroller and embedded microcontrollers.
2. Familiarize the basic architecture of 8051 microcontroller.
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 Serial port of 8051.
6. Interface 8051 to external memory and I/O devices using its I/O ports.

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various techniques.
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
7. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
8. Give Programming Assignments.

Module-1

8051 Microcontroller: Microprocessor Vs Microcontroller, Embedded Systems, Embedded Microcontrollers, 8051 Architecture- Registers, Pin diagram, I/O ports functions, Internal Memory organization. External Memory (ROM & RAM) interfacing.

Text 2: Chapter 1 section 1.1 to 1.3, chapter 3 sections 3.1 to 3.3.

08 Hours

Module-2

8051 Instruction Set: Addressing Modes, Data Transfer instructions, Arithmetic instructions, Logical instructions, and Bit manipulation instructions. Examples for instructions with memory allocations. Simple Assembly language program examples (without loops) to use these instructions.

Text 2 : Chapter 5 , chapter 6, chapter 7, chapter 8

08 Hours

Module-3

8051 Jump and Call instructions & Embedded C Jump and Call Instructions, Calls & Subroutine instructions. Assembly language program examples on subroutine and involving loops.

Macros and Procedures.**8051 Programming in C**: Data Types and Time delay in 8051 C.

Text 1 : chapter 7 section 7.1 to 7.3

08 Hours

Module-4

8051 Timers and Serial Port 8051 Timers and Counters – Operation and Assembly language programming to generate a pulse using Mode-1 and a square wave using Mode- 2 on a port pin.

8051 Serial Communication- Basics of Serial Data Communication, RS- 232 standard, 9 pin RS232 signals, Simple Serial Port programming in Assembly and C to transmit a message and to receive data serially.

Text 1 : Chapter 9 section 9.1 Chapter 10 section 10.1 to 10.5

08 Hours

Module-5

8051 Interrupts and Interfacing Applications 8051 Interrupts. 8051 Assembly language programming to generate an external interrupts using a switch, 8051 C programming to generate a square waveform on a port pin using a Timer interrupt.

Interfacing 8051 to ADC-0804, DAC, LCD and Stepper motor and their 8051 Assembly and C language interfacing programming.

Text 1: Chapter 11 section 11.1 and 11.2 Chapter 13 section 13.1 to 13.2, chapter 12 section 12.1, chapter 17 section 17.2

08 Hours

Teaching-Learning Process for all modules	**Chalk and Talk/Power Point presentation/YouTube videos.**

Course outcome (Course Skill Set)

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

1. Explain the difference between Microprocessors & Microcontrollers, Architecture of 8051 Microcontroller, and Interfacing of 8051 to external memory and Instruction set of 8051.
2. Develop 8051 Assembly level programs using 8051 instruction set.
3. Develop 8051 Assembly / C language program to generate timings and waveforms using 8051 timers, to send & receive serial data using 8051 serial port.
4. Develop 8051 Assembly / C language programs to generate square wave on 8051 I/O port pin using interrupt and C Programme to send & receive serial data using 8051 serial port.
5. Interface various peripheral devices to 8051 using I/O ports.

Assessment Details (both CIE and SEE)

Component		**Weightage (%)**	
CIE's	CIE 1-At the end of 5thweek	20	60
	CIE2 –At the end of 10th week	20	
	CIE3 –At the end of 15th week	20	
AAT's	AAT-1-At the end of 4thweek	10	40
	AAT-2-At the end of 9thweek	10	
	AAT-3-At the end of 13thweek	20	
Continuous Internal Evaluation Total Marks: 100. Reduced to 50 Marks			
Semester End Examination (SEE) Total Marks: 100. Reduced to 50 Marks			

Suggested Learning Resources: Text Books:

1. "The 8051 Microcontroller and Embedded Systems – using assembly and C", Muhammad Ali Mazidi, Janice Gillespie Mazidi and Rollin D McKinlay; PHI, 2006 / Pearson, 2006. 2. "The 8051 Microcontroller", Kenneth J Ayala, 3rd Edition, Thomson/Cengage Learning. **Reference Books:**
2. "The 8051 Microcontroller Based Embedded Systems", Manish K Patel, McGraw Hill, 2014, ISBN: 978-93-329-0125-4.
3. "Microcontrollers: Architecture, Programming, Interfacing and System Design", Raj Kamal, Pearson Education, 2005.

CO-PO Mapping:

POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C313.B.1	3	1	2	2	2	2	1				1	1
C313.B.2	2	2	3	3	1	1	2				1	1
C313.B.3	3	2	3	3	2	3	2				2	2

C313.B.4	3	2	3	3	2	3	2				2	2	
C313.B.5	3	3	3	3	3	3	3		1		2	3	

SEMESTER-VI

Electronic Circuits with Verilog			
Course Code	**21EC654**	**CIE Marks**	**50**
Teaching Hours/Week (L: T: P: S) (2:0:2:0)	**Credits (2:0:1:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**26 hours Theory + 13 Lab slots**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course objectives:

1. To understand the basic Verilog HDL design flow.
2. To understand the basic Verilog programming concepts.
3. To describe the simple logic circuits using dataflow, gate-level, and behavioural level modelling.
4. To model digital systems using advanced concepts of Verilog HDL.

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various techniques.
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
6. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
7. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
8. Give programming assignments.

Module-1

Overview of Digital Design with Verilog HDL: Evolution of CAD, emergence of HDLs, typical HDL- flow, why Verilog HDL?, trends in HDLs. (Text 1) **Hierarchical Modelling Concepts**: Top-down and bottom-up design methodology, differences between modules and module instances, parts of a simulation, design block, stimulus block. (Text 1)

08 Hours

Module-2

Basic Concepts: Operators- Arithmetic, Logical and Relationals, datatypes, system tasks, compiler directives. (Text 1)
Modules and Ports: Module definition, port declaration, connecting ports, hierarchical name referencing. (Text 1)

08 Hours

Module-3

Gate-Level Modelling: Modelling using basic Verilog gate primitives, description of and/or and buf/not type gates, rise, fall and turn-off delays, min, max, and typical delays. (Text1) **Dataflow Modelling**: Continuous assignments, delay specification, expressions, operators, operands, operator types. (Text 1)

08 Hours

Module-4

Behavioral Description: Behavioral Description Highlights, Structure of the HDL Behavioral Description, Sequential Statements, IF Statement, The case Statement, Verilog casex and casez The wait-for Statement. The Loop Statement, For-Loop, While-Loop, Verilog repeat, Verilog forever (content with respect to Verilog only)

(Text 2)

08 Hours

Module-5

Structural Description: Highlights of Structural Description, Organization of Structural Description Binding **Tasks and**

Functions: Differences between tasks and functions, declaration, invocation, automatic tasks and functions. (4.1, 4.2, 4.3 till example 4.9) (Text 2)

(Text 1)

08 Hours

Teaching-Learning Process for all modules	**Chalk and Talk/PowerPoint presentation/YouTube videos.**

Course Outcomes:

After successfully completing the course, the students will be able to

1. Under the Verilog HDL design flow.
2. Describe the basic concepts of Verilog HDL programming.
3. Design of digital electronics circuits using dataflow, behavioural, gate-level, and structural modelling.
4. Design complex digital circuits using advanced Verilog concepts.

Assessment Details (both CIE and SEE)

Component		**Weightage (%)**		
CIE's	CIE 1 5th week	20	60	Average of 3 tests for 20 marks
	CIE 2 10th week	20		
	CIE 3 15th week	20		
AAT's	AAT-1 10th week			10
	Lab Test	30		Reduced to 10
	Lab Record	20		10
Continuous Internal Evaluation Total Marks :100. Reduced to 50 Marks				
Semester End Examination (SEE) Total Marks :100. Reduced to 50 Marks				

Suggested Learning Resources:

Text Books:

1. "Verilog HDL: A Guide to Digital Design and Synthesis", Samir Palnitkar, Pearson education, Second edition.
2. "HDL programming (VHDL and Verilog)", Nazeih M Botros, John Wiley India Pvt. Ltd., 2008.

Reference Books:

1. **B.V. Ramana:** "Higher Engineering Mathematics" McGraw-Hill Education, 11th Ed.
2. **Srimanta Pal & Subodh C.** Bhunia: "Engineering Mathematics" Oxford University Press,3rd Reprint, 2016.
3. **N.P Bali and Manish Goyal**: "A textbook of Engineering Mathematics" Laxmi Publications, Latest edition.
4. **C. Ray Wylie, Louis C. Barrett:** "Advanced Engineering Mathematics" McGraw – HillBook Co.Newyork, Latest ed.
5. **Gupta C.B, Sing S.R and Mukesh Kumar:** "Engineering Mathematic for Semester I andII", Mc-Graw Hill Education(India) Pvt. Ltd 2015.
6. **H.K.Dass and Er. Rajnish Verma:** "Higher Engineering Mathematics" S.Chand Publication(2014).
7. **James Stewart: "**Calculus" Cengage publications, 7th edition, 4th Reprint 2019.

E-Resources:

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

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- **Quizzes**
- Assignments
- Seminars

CO- PO Mapping:

POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C313.D.1	3	1	--	--	--	--	--	--	--	--	--	--
C313.D.2	3	3	--	--	--	--	--	--	--	--	--	--
C313.D.3	3	2	--	--	--	--	--	--	--	--	--	--
C313.D.4	3	3	--	--	--	--	--	--	--	--	--	--
C313.D.5	2	2	--	--	--	--	--	--	--	--	--	--

SEMESTER-VI

Sensors & Actuators			
Course Code	**21EC655**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P:S) (3:0:0:0)	**Credits (3:0:0:0)**	**SEE Marks**	**50**
Total Hours of Theory	**40 hours**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course objectives:

1. To understand the fundamental knowledge about sensors and measurement system.
2. To impart the knowledge of analog and digital transducer with actuators.
3. To Analyze the principle, design and working of transducers for the measurement of physical timevarying quantities.
4. To design sensors for various real time applications.
5. To develop different actuators suitable in industrial process control systems.

Teaching-Learning Process (General Instructions)

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

1. Explain the fundamental concepts required for the module in the introduction phase for themodule.
2. Conducting quiz after completion of every module in class and evaluate.
3. Asking questions about completed previous topic, will aid to assess the student understanding.
4. Evaluate the internals answer booklet by correcting the mistakes if any.
5. Modules revision at the end as well use practical lab sessions and demonstrate the concepts if applicable and feasible.

Module-1

Sensors and measurement system: Introduction to Sensors, Classification, Block Diagram, Smart sensors. Recent trends in sensors technology: Fibre Optic Sensors, Film Sensors, Semiconductor IC Technology, Microelectromechanical System (MEMS), Nano Sensors, Application of Sensors.

Measurement: Definition, significance of measurement, Elements of generalized measurement system with example. Input-output configuration of measuring instruments and measurement systems, methods of correction for interfering and modifying inputs.

08 Hours

Module-2

Transducers: Introduction to transducers, Classifications of transducers-primary & secondary, active & passive, analog and digital transducers. Electrostatic and Piezoelectric Transducers, Ultrasonic Sensors, Hall effect and Inductance and Eddy current sensors. Angular/Rotary movement Transducer, Electromagnetic Flowmeter, Acoustic Temp Sensor, Nuclear Thermometer, Magnetic Thermometer, Thermoelectric, case study.

08 Hours

Module-3

Measurement of Temperature: RTD, Thermistor, Thermocouple, laws of thermocouple, Thermopile, AD590.
Measurement of Displacement: Introduction, Principles of Transduction, Variable resistance devices, variable Inductance Transducer, Variable Capacitance Transducer, Hall Effect Devices, Proximity Devices, Digital Transducer.

08 Hours

Module-4

Electroanalytical Sensors: Introduction, Electro-chemical Cell, Cell potential, Sd. Hydrogen Electrode (SHE), Liquid Junction and Other potentials, Polarization, Reference Electrodes, Sensor Electrodes, Radiation Sensors: Basic Characteristics, Photo-emissive Cell and Photomultiplier, Photovoltaic Cell, X-ray and Nuclear Radiation Sensors.

08 Hours

Module-5

Actuators: Introduction to actuators, transducer, Types of actuators, Signal conversions analog, digital, pneumatic signal. Actuators, Control elements.

Electrical actuating systems: Pneumatic Actuators, Hydraulic Actuators: Principle and working of actuators, case study.

08 Hours

Course outcome (Course Skill Set)

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

1. To understand the fundamental concepts related to sensors and measurement, functional elements of measurement system, I/O Characteristics of measurement system.
2. To analyze the comparison of analog and digital transducer with actuators
3. Elucidate the working principle and usage of different transducers for temperature, displacement and level measurement.
4. To develop sensor electrode for electrochemical application.
5. To design the principle and working of different types of actuators used in industrial application.

Assessment Details (both CIE and SEE)

Component		Weightage (%)	
CIE's	CIE 1- At the end of 5th week	20	60
	CIE 2 - At the end of 10th week	20	
	CIE 3 - At the end of 15th week	20	
AAT's	AAT-1- At the end of 4th week	10	40
	AAT-2- At the end of 9th week	10	
	AAT-3- At the end of 13th week	20	
Continuous Internal Evaluation Total Marks: 100. Reduced to 50 Marks			
Semester End Examination (SEE) Total Marks: 100. Reduced to 50 Marks			

Text Books:

1. Electrical and Electronic Measurements and Instrumentation, A K Sawhney, 17th Edition, (Reprint 2004), Dhanpat Rai & Co. Pvt. Ltd., 2004.
2. Instrumentation: Devices and Systems, C S Rangan, G R Sarma, V S V Mani, 2nd Edition (32 Reprint), McGraw Hill Education (India), 2014.
3. Process Control Instrumentation Technology by C D Johnson, 7th Edition, Pearson Education Private Limited, New Delhi 2002.

CO PO Mapping:

POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C313.E.1	2	2	2	3	2	2	-	-	-	-	-	1	2	3	2
C313.E.2	3	2	3	2	2	2	-	-	-	-	-	1	2	3	2
C313.E.3	3	3	2	2	3	2	-	-	1	1	1	1	2	3	2
C313.E.4	3	3	2	3	2	3	-	-	-	-	-	2	2	3	2
C313.E.5	3	2	3	3	2	3	-	-	-	-	-	2	2	3	2

SEMESTER-VII

Advanced VLSI			
Course Code	**21ECT71**	**CIE Marks**	**50**
Teaching Hours/Week (L: T: P: S) (3:0:0:0)	**Credits (3:0:0:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40 Hours**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course objectives:

1. Learn an overview the of VLSI design flow of ASIC.
2. Emphasize Back-end VLSI design of Floor planning and Routing
3. Demonstrate the verification concepts with reference to System Verilog.
4. Impart knowledge on procedural statements and test bench designs.
5. Understand Randomization and Functional Coverage concepts.

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various techniques.
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem-Based Learning (PBL), which fosters students' Analytical skills, and develops thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Topics will be introduced in multiple representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the student's understanding.

Module-1

Introduction to ASICs: Full custom, Semi-custom, and Programmable ASICs, ASIC Design flow, ASIC cell libraries.
CMOS Logic: Data path Logic Cells: Data Path Elements, Adders: Carry skip, Carry bypass, Carry save, Carry select, Conditional sum, Multiplier (Booth encoding), Data path Operators, I/O cells, Cell Compilers.
Text Book 1

08 Hours

Module-2

Floor planning and placement: Goals and objectives, Measurement of delay in Floor planning, Floor planning tools
Routing: Global Routing: Goals and objectives, Global Routing Methods, Global routing between blocks, Back-annotation.
Detailed Routing: Goals and objectives, Measurement of Channel Density, Left-Edge Algorithm, Area-Routing Algorithms, Multilevel routing, Timing –Driven detailed routing, Final routing steps.
Text Book 1

08 Hours

Module-3

Verification Guidelines: The verification process, basic test bench functionality, directed testing, methodology basics, constrained random stimulus, randomization, functional coverage, test bench components, layered testbench.
Data Types: Built-in Data types, fixed and dynamic arrays, Queues, associative arrays, linked lists, array methods, choosing a type, creating new types with type def, creating user-defined structures, type conversion, Enumerated types, constants and strings, Expression width.
Text Book 2

08 Hours

Module-4

Chip Input and Output (I/O) Circuits: Introduction, ESD Protection, Input Circuits, Output Circuits and L(di/dt) Noise, On-Chip Clock Generation and Distribution, Latch-Up and Its Prevention.

Connecting the test bench and design: Separating the test bench and design, the interface construct, Stimulus timing, Interface driving and sampling, and System Verilog assertions.

Text Book 2

08 Hours

Module-5

Randomization: Introduction, what to randomize? Randomization in System Verilog, Random number functions, Common randomization problems, Random Number Generators.

Functional Coverage: Coverage types, Coverage strategies, Simple coverage example, Anatomy of Cover group and Triggering a Cover group, Data sampling.

Text Book 2

08 Hours

Teaching-Learning Process for all modules	**Chalk and Talk/PowerPoint presentation/YouTube videos.**

Course Outcomes:

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

1. Demonstrate the understanding of VLSI design flow used for ASIC.
2. Analyze the concepts of floor plan, partition and routing with the use of CAD tools.
3. Describe the concepts of ASIC design verification methodology.
4. Impart the use of test bench design for Verification of Digital system design
5. Analyze the concepts of Randomization and Functional Coverage using System Verilog.

Assessment Details (both CIE and SEE)

Component		**weightage (%)**	
CIE's	CIE 1- At the end of t h e week	20	60
	CIE 2 - At the end of the 10th week	20	
	CIE 3 - At the end of the 15th week	20	
AAT's	AAT-1- At the end of the 4th week	10	40
	AAT-2- At the end of t h e 9th week	10	
	AAT-3- At the end of t h e 13th week	20	
Continuous Internal Evaluation Total Marks: 100. Reduced to 50 Marks			
Semester End Examination (SEE) Total Marks: 100. Reduced to 50 Marks			

Suggested Learning Resources: Text Books:

1. Michael John Sebastian Smith, Application - Specific Integrated Circuits, Addison-Wesley Professional, 2005.
2. Chris Spear, System Verilog for Verification – A guide to learning the Test bench language features, Springer Publications, Second Edition, 2010.

CO- PO Mapping:

POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C401.1	2	2	3	--	--	--	--	--	--	--	2	2
C401.2	3	1	2	1	2	--	--	--	--	--	3	3
C401.3	2	2	3	1	2	--	--	--	--	--	2	3
C401.4	3	2	2	1	2	--	--	--	--	--	1	3
C401.5	3	3	3	--	1	--	--	--	--	--	2	3

SEMESTER-VII

Wireless Communication			
Course Code	**21ECT72**	**CIE Marks**	**50**
Teaching Hours/Week (L: T: P: S) (2:0:0:0)	**Credits (2:0:0:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**30 hours**	**Total Marks**	**100**
Credits	**02**	**Exam Hours**	**03**

Course objectives:

1. Understand different modes of light propagation, transmission characteristics and losses in optical fiber.
2. Understand working principle of optical sources and detectors and transmission techniques using WDM concepts.
3. Study the evolution of mobile communication.
4. Understand the propagation of mechanisms in mobile communication and cell concepts to improve capacity of the system.
5. Understand different multiple access schemes for resource allocation in cellular communication standards.

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various techniques.
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem-Based Learning (PBL), which fosters students' Analytical skills, and develops thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Topics will be introduced in multiple representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the student's understanding.

Module-1

Optical Fiber Structures: Key elements of Optical Fibre systems, Basic Optical laws and Definitions, Fiber Modes and Configurations, Mode theory for circular waveguides, Single mode fibers. (T1 1.6, 2.2,2.3,2.4,2.5)

Attenuation and Dispersion: Attenuation, Absorption, Scattering Losses, Bending loss, Signal Dispersion: Modal delay, Material dispersion (T1 3.1,3.2)

06 Hours

Module-2

Optical Sources and detectors: Light Emitting Diode: LED Structures, Light source materials,
Quantum efficiency and LED power, Laser Diodes: Modes and threshold conditions, Photodetectors: The pin Photodetector, Avalanche Photodiodes. (T1 4.2, 4.3,6.1)

WDM Concepts: Overview of WDM, Isolators and Circulators, Fiber grating filters, Dielectric thin-film filters, Active Optical Components: MEMS Technology variable Optical Attenuators (T1 10.1,10.3,10.4,10.5,10.8)

06 Hours

Module-3

Introduction to wireless Communication systems: Evolution of mobile radio commutation, mobile radio telephonic, Mobile radio systems around the world, Examples of wireless communication systems, paging systems, cordless telephone systems, cellular telephone systems, comparisons of common wireless communication systems, trends in cellular radio and personal communication systems (T2 1.1 to 1.6)

06 Hours

Module-4

Mobile Communication Engineering: Wireless Network generations, Basic propagation Mechanisms, Mobile radio Channel **Principles of Cellular Communications:** Cellular terminology, Cell structure and Cluster, Frequency reuse concept, Cluster size and system capacity, Frequency Reuse Distance, Cochannel Interference and signal quality [T2: 1.4, 2.4, 2.5, 4.1 to 4.4, 4.6, 4.7]

06 Hours

Module-5

Multiple Access Techniques: FDMA, TDMA, CDMA, SDMA, Hybrid Multiple Access Techniques, Multicarrier Multiple Access Schemes. [T2: 8.2, 8.3, 8.4.5, 8.5, 8.6, 8.10, 9.2.2, 9.2.3, 9.3]

GSM Network Architecture, Identifiers used in GSM system, GSM Channels, Frame structure for GSM, GSM Call procedures, GSM hand-off Procedures, GSM Services and features [T2: 11.1, 11.2,11.3,11.4, 11.5, 11.8, 11.9. 11.10]

06 Hours

Teaching-Learning Process for all modules	**Chalk and Talk/PowerPoint presentation/YouTube videos.**

Course Outcomes:

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

1. Describe different modes of signal propagation and transmission losses in optical fiber
2. Classification of different types of optical sources and detectors with WDM concepts used in transmission techniques
3. Understand the concepts of mobile and wireless communication
4. Demonstrate knowledge on propagation mechanism and cellular concepts in wireless communication
5. Compare different multiple access techniques in mobile communication and the concept of GSM

Assessment Details (both CIE and SEE)

Component		**weightage (%)**	
CIE's	CIE 1- At the end of the week	20	60
	CIE 2 - At the end of the 10th week	20	
	CIE 3 - At the end of the 15th week	20	
AAT's	AAT-1- At the end of the 4th week	10	40
	AAT-2- At the end of the 9th week	10	
	AAT-3- At the end of the 13th week	20	
Continuous Internal Evaluation Total Marks: 100. Reduced to 50 Marks			
Semester End Examination (SEE) Total Marks: 100. Reduced to 50 Marks			

Suggested Learning Resources: Text Books:

1. Gerd Keiser, Optical Fiber Communication, 5th Edition, McGraw Hill Education (India) Private Limited, 2016. ISBN:1-25-900687-5.
2. T L Singal, Wireless Communications, McGraw Hill Education (India) Private Limited, 2016, ISBN:0-07-068178-3.

CO- PO Mapping:

POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C402.1	3	1	2	2	-	-	-	-	-	1	1	-
C402.2	3	3	2	2	-	-	-	-	-	1	1	-
C402.3	3	3	2	1	-	-	-	-	-	2	2	-
C402.4	3	3	2	1	-	-	-	-	-	1	1	-
C402.5	3	2	2	2	-	-	-	-	-	1	2	-

SEMESTER-VII

Power Electronics			
Course Code	**21EC721**	**CIE Marks**	**50**
Teaching Hours/Week (L: T: P: S) (2:0:2:0)	**Credits (2:0:1:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**30 hours Theory + 13 Lab slots**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course objectives:

This course will enable students to:

6. Understand the main switching topologies used in power electronics circuits and the principle of operation of a thyristor.
7. Gain knowledge of different configurations of control rectifiers.
8. Analyze the operation of different commutation techniques.
9. Apply concepts of the AC voltage controllers and conceptualize DC-DC converters.
10. Design, analyze the principles and performance of inverters.

Teaching-Learning Process (General Instructions)

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

1. Lecture method (L) does not mean only traditional lecture method, but a different type of teaching methods may be adopted to develop the outcomes.
2. Show Video/animation films to explain the different concepts of Power Electronics.
3. Encourage collaborative (Group) Learning in the class.
4. Ask at least three HOTS (Higher Order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Topics will be introduced in a multiple representation.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
9. Adopt Flipped class technique by sharing the materials / Sample Videos prior to the class and have discussions on the that topic in the succeeding classes.

Module-1

Power Devices: Application of power electronics, Power BJT's, Switching characteristics, Switching units, Power MOSFETs, Switching characteristics, Gate drives, IGBTs, Construction of thyristor, Principle of operation, Different states/Modes of operation, Static anode VI characteristics, Two transistor model, Gate characteristics, Gate triggering, di/dt and dv/dt protection, Thyristor firing circuits.

(Section 1.1 ,4.1 to 7.1 of Text 1)

06 Hours

Module-2

Controlled Rectifiers: Introduction, Principle of Phase controlled converter operation, Single phase half controlled converter, Single phase fully controlled converter, Dual converter, Three phase half controlled converter, Three phase fully controlled converter.

(Section 10.2 to 10.5 of Text 1)

06 Hours

Module-3

Commutation Techniques: Introduction to commutation, Natural commutation and forced commutation, Class A, Class B, Class C, Class D commutation, Self-commutation, Complementary commutation, Auxiliary thyristor commutation (Section 2.5 of Text 2)

06 Hours

Module-4

AC Voltage Controllers and Choppers: Introduction to choppers, Principles of step down and step up choppers, Step down chopper with RL load, Classification of chopper, Analysis of impulse commutated thyristor chopper, Introduction

to AC voltage controllers, Principle of ON-OFF control, Principle of phase control, Single-phase AC controllers with R load and RL load. (Section 5.2 ,5.4 to 11.5 of Text 1)

06 Hours

Module-5

Inverters: Introduction, Principle of operation, Performance parameters, Single-phase bridge inverter, Voltage control of single-phase inverters, Current source inverters.

(Section 6.1 to 6.10 of Text 1)

06 Hours

Teaching-Learning Process for all modules	**Chalk and Talk, Power point presentation, flip teaching, YouTube videos**

Course Outcomes

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

6. Design drive controls for power semiconductor devices.

7. Analyze the operation of single phase and three phase rectifiers with various loads.

8. Design commutation circuits.

9. Design AC-voltage controllers for different configurations.

10. Analyze the operation of choppers and inverters.

Assessment Details (both CIE and SEE)

Component		**Weightage (%)**		
CIE's	CIE 1 5th week	20	60	Average of 3 tests for 20 marks
	CIE 2 10th week	20		
	CIE 3 15th week	20		
AAT's	AAT-1 10th week			10
	Lab Test	30		Reduced to 10
	Lab Record	20		10
Continuous Internal Evaluation Total Marks :100. Reduced to 50 Marks				
Semester End Examination (SEE) Total Marks :100. Reduced to 50 Marks				

Suggested Learning Resources:

Text Books:

4. M. H. Rashid: "Power Electronics Circuits, Devices and Applications", 3rd Edition, Pearson India, New Delhi, 2014, ISBN: 978-9332518445.

5. G. K. Dubey, S. R. Doradla, A. Joshi, R. M. K. Sinha: "Thyristorized Power Controllers", 6th Edition, New Age International Pvt. Ltd., 1986, ISBN: 9788122434224

Reference Books:

4. P. S. Bhimbra: "Power Electronics", Khanna Publication, 1995, ISBN: 9788174092 -793

5. Daniel W Hart, "Power Electronics", Tata McGraw Hill, 2011, ISBN 0071321209, 9780071321204

E-Resources:

7. https://nptel.ac.in/courses/108105066

8. https://www.tutorialspoint.com/power_electronics/index.htm

9. https://ocw.mit.edu/courses/6-334-power-electronics-spring-2007/

10. https://resourcecenter.ieee-pels.org/

11. https://www.electronics-tutorials.ws/power/thyristor.html

CO- PO Mapping :

POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C402.A.1	2	2	2	1	1	-	1	-	1	-	2	-	2	3	1
C402.A.2	2	3	2	2	1	1	-	-	-	-	2	-	3	3	1
C402.A.3	2	2	3	2	1	1	-	-	-	-	2	-	2	3	2
C402.A.4	2	2	2	3	2	1	-	-	-	-	2	-	2	2	1
C402.A.5	3	2	1	1	2	1	1	-	-	-	2	-	2	2	1

SEMESTER-VII

Digital Image Processing			
Course Code	**21EC722**	**CIE Marks**	**50**
Teaching Hours/Week(L:T:P:S)(2:0:2:0)	**Credits (2:0:1:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**30 hours Theory + 13 Lab slots**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course Objectives:

This course will enable the students to :

1. Understand the fundamentals of digital image processing.
2. Study the concepts of image enhancement using transformation techniques.
3. Illustrate image analysis techniques in the form of image segmentation and to evaluate the methodologies for segmentation.
4. Examine the image restoration techniques and methods used in digital image processing.
5. Explain the Morphological operations used in digital image processing.

Teaching-Learning Process(General Instructions)

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

1. Show Video/animation films to explain the functioning of various image processing concepts.
2. Encourage cooperative (Group) Learning through puzzles, diagrams, coding etc., in the class.
3. Encourage students to ask questions and investigate their own ideas helps improve their problem-solving skills as well as gain a deeper understanding of academic concepts.
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Students are encouraged to do coding based projects to gain knowledge in image processing.
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in multiple representations.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding
9. Arrange visits to nearby PSUs such as CAIR (DRDO), NAL, BEL, ISRO, etc., and small-scale software industries to give industry exposure.

Module-1

Digital Image Fundamentals: Introduction, Brief history, Image Representation, Fundamental Steps in Image Processing, Components in Image Processing, Applications of Image Processing ,Image Sensing and Acquisition, Image sampling and quantization, Basic Relationship between pixels, Linear and Nonlinear Operations.

[Text 1 : 1.1,1.3,1.4,1.5,2.3,2.4,2.5,2.6]

06 Hours

Module-2

Spatial Domain: Some Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters
Frequency Domain: The Discrete Fourier Transform (DFT) of Two Variables, Properties of the 2-D DFT, Filtering in the Frequency Domain, Image Smoothing and Image Sharpening Using Frequency Domain Filters, Selective Filter.

[Text 1: 3.1,3.2,3.3,3.4,3.5,3.6,4.6,4.8,4.9,4.10]

06 Hours

Module-3

Image Segmentation: Point, Line, and Edge Detection, Thresholding, Region Based Segmentation, Segmentation using Morphological Watersheds, Representation, Boundary descriptors**.**

[Text 1: 10.2,10.3,10.4,10.5,11.1,11.2]

06 Hours

Module-4

Image Restoration: Reasons for image degradation, Model of image degradation/ restoration process, Noise probability density functions, Image restoration using spatial filtering (Mean filters), Inverse Filtering, MMSE (Wiener) Filtering, Geometric Mean Fliter.

[Text 1: 5.1,5.2,5.3,5.7,5.8,5.10]

06 Hours

Module-5

Morphological Image Processing: Preliminaries, Dilation and erosion, opening and closing, Basic morphological operations: Boundary extraction, Region filling, extraction of connected components, convex hull, thinning, thickening, Hit-or-Miss transform, Color image processing.

[Text 1: 9.1,9.2,9.3,9.4,9.5]

06 Hours

Teaching-Learning Process for all modules	**Chalk and Talk/Power Point presentation/You Tube videos.**

Course Outcomes:

After successfully completing the course the students will be able to

1. Explain the historical background, concepts of image processing and its application.
2. Apply image processing techniques in both the spatial and frequency (Fourier) domains.
3. Design image analysis techniques in the form of image segmentation and to evaluate the Methodologies for segmentation
4. Analyze the image restoration technique to remove degradation from given image.
5. Design Morphological operation dilation and erosion on a given image.

Assessment Details (both CIE and SEE)

Component		**Weightage (%)**		
CIE's	CIE 1 5th week	20	60	Average of 3 tests for 20 marks
	CIE 2 10th week	20		
	CIE 3 15th week	20		
AAT's	AAT-1 10th week			10
	Lab Test	30		Reduced to 10
	Lab Record	20		10
Continuous Internal Evaluation Total Marks :100. Reduced to 50 Marks				
Semester End Examination (SEE) Total Marks :100. Reduced to 50 Marks				

Suggested Learning Resources:

Text Books:

1. Rafael C Gonzalez and Richard E Woods ,Digital Image Processing,ISBN 978-0-13-335672-4 PHI, 3rd Edition 2010.
2. A K Jain ,Fundamentals of Digital Image Processing, ISBN: 978-8-12-030929-6 PHI Learning Private Limited 2014.

Reference Book:

1. S Jayaraman, S Esakkirajan, T Veerakumar ,Digital Image Processing, ISBN 978-0-07-014479-8, Tata McGraw Hill, 2014.

E-Resources:

- Image databases, https://imageprocessingplace.com/root_files_V3/image_databases.htm
- Student support materials
- https://imageprocessingplace.com/root_files_V3/students/students.htm
- NPTEL Course, Introduction to Digital Image Processing, https://nptel.ac.in/courses/117105079
- Computer Vision and Image Processing, https://nptel.ac.in/courses/108103174
- Image Processing and Computer Vision – Matlab and Simulink,
- https://in.mathworks.com/solutions/image-video-processing.html

Activity-BasedLearning(SuggestedActivitiesinClass)/Practical-Based Learning

- **Quizzes**
- Assignments
- Seminars

CO-PO Mapping:

POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C402.B.1	2	2	2	1	2	-	-	-	-	1	1	1
C402.B.2	3	3	3	1	2	-	-	-	-	2	2	1
C402.B.3	3	3	3	3	**3**	-	-	-	-	1	-	1
C402.B.4	3	3	3	2	2	-	-	-	-	2	-	1
C402.B.5	3	2	3	2	3	-	-	-	-	1	-	1

SEMESTER-VII

DSP Algorithms & Architecture			
Course Code	**21ECT723**	**CIE Marks**	**50**
Teaching Hours/Week (L: T: P: S) (3:0:0:0)	**Credits (3:0:0:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40 hours**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course objectives:

The goal of the course DSP Algorithms & Architecture is:

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

Teaching-Learning Process (General Instructions)

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

1. In addition to the traditional lecture method, different types of innovative teaching methods maybe adopted so that the delivered lessons shall develop students theoretical and applied skills.
2. Discuss how every concept of DSP Algorithms can be applied to the real world and when that's possible.
3. Support and guide the students for self–study.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students for group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways:
7. As an introduction to new topics (pre-lecture activity).
8. As a revision of topics (post-lecture activity). As additional examples (post-lecture activity).
9. As an additional material of challenging topics (pre-and post-lecture activity).
10. As a model solution of some exercises (post-lecture activity).

Module-1

Introduction to Digital Signal Processing: Introduction, A Digital Signal – Processing system, Major features of programmable Digital signal processors, The Sampling Process, Discrete Time Sequences, Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear Time-Invariant Systems, Digital Filters, Decimation and Interpolation. Number formats for signals and coefficients in DSP systems- Fixed point and floating point format.
Section 1.3, 2.1 to 2.8 and 3.2 of Text 1

08 Hours

Module-2

Architectures for Programmable Digital Signal Processing Devices: Introduction, Basic Architectural Features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Speed Issues, Features for External Interfacing.
Section 4.1 to 4.9 of Text 1

08 Hours

Module-3

Programmable Digital Signal Processors: Introduction, Commercial Digital Signal-processing Devices, Data Addressing Modes of TMS32OC54XX, Memory Space of TMS32OC54xx Processors, Program Control. TMS320C54xx Instructions and Programming, On – Chip Peripherals, Interrupts of TMS32OC54XX Processors, Pipeline Operation of TMS32OC54xx Processor.
Section 5.1 to 5.10 of Text 1

08 Hours

Module-4

Implementation of Basic DSP Algorithms: Introduction, The Q – notation, FIR Filters, IIR Filters, Interpolation and Decimation Filters (one example in each case).

Implementation of FFT Algorithms: Introduction, An FFT Algorithm for DFT Computation, Overflow and Scaling, Bit – Reversed Index. Generation & Implementation on the TMS32OC54xx.

Section 7.1 to 7.6 and 8.1 to 8.6 of Text 1

08 Hours

Module-5

Interfacing Memory and Parallel I/O Peripherals to Programmable DSP Devices: Introduction, Memory Space Organization, External Bus Interfacing Signals. Memory Interface, Parallel I/O Interface, Programmed I/O, Interrupts and I/O Direct Memory Access (DMA).

Interfacing and Applications of DSP Processors: Introduction, Synchronous Serial Interface, A CODEC Interface Circuit, DSP Based Bio-telemetry Receiver, A Speech Processing System, An Image Processing System.

Section 9.1 to 9.8, 10.1 to 10.5 and 11.1 to 11.5 of Text 1

08 Hours

Teaching-Learning Process for all modules	**Chalk and Talk/PowerPoint presentation/YouTube videos.**

Course Outcomes:

After successfully completing the course, the students will be able

1. Comprehend the knowledge & concepts of digital signal processing techniques.
2. Understand the basic architectural features and computational building blocks of DSP devices.
3. Apply knowledge of various types of addressing modes, interrupts, peripherals and pipelining structure of TMS320C54xx processor.
4. Develop assembly language programs to implement FIR, IIR filters and FFT algorithms.
5. Build the Applications on Programmable DSP devices.

Assessment Details (both CIE and SEE)

Component		**Weightage (%)**	
CIE's	CIE 1- At the end of 5th week	20	60
	CIE 2 - At the end of 10th week	20	
	CIE 3 - At the end of 15th week	20	
AAT's	AAT-1- At the end of 4th week	10	40
	AAT-2- At the end of 9th week	10	
	AAT-3- At the end of 13th week	20	
Continuous Internal Evaluation Total Marks: 100. Reduced to 50 Marks			
Semester End Examination (SEE) Total Marks: 100. Reduced to 50 Marks			

Suggested Learning Resources:

Text Book:

"Digital Signal Processing", Avatar Singh and S Srinivasan, Thomson Learning, 2004

Reference Books:

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

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- **Quizzes**
- Assignments
- Seminars

CO- PO Mapping:

POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C402.C.1	3	2	2	--	--	--	--	--	--	-	--	--
C402.C.2	3	2	2	--	--	--	--	--	--	-	--	--
C402.C.3	3	2	2	--	--	--	--	--	--	-	--	--
C402.C.4	3	2	3		3	--	--	--	--	-	2	--
C402.C.5	3	2	3	--	3	--	--	--	--	-	2	--

SEMESTER-VII

Biomedical Signal Processing			
Course Code	**21EC724**	**CIE Marks**	**50**
Teaching Hours/Week (L: T:P:S)(3:0:0:0)	**3:0:0:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40 hours**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course objectives:

The goal of the course Transform Calculus, Fourier series and Numerical techniques is:

1. Possess the basic mathematical, scientific and computational skills necessary to analyse ECG and EEG signals.
2. Apply classical and modern filtering and compression techniques for ECG and EEG signals.
3. Develop a thorough understanding on basics of ECG and EEG feature extraction.
4. To have an insight into Biomedical signals.
5. To enable the students to understand various data reduction techniques

Teaching-Learning Process (General Instructions)

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

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various techniques.
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding. Show short related video lectures in the following ways:

a) As an introduction to new topics (pre-lecture activity).

b) As a revision of topics (post-lecture activity).

c) As additional examples (post-lecture activity).

d) As an additional material of challenging topics (pre-and post-lecture activity).

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

Module-1

Introduction to Biomedical Signals: The nature of Biomedical Signals, Examples of Biomedical Signals, Objectives of Biomedical Signal analysis, Difficulties in Biomedical Signal analysis.
(Text-1: 1.1, 1.2, 1.3, 1.4)

Electrocardiography: Techniques used in electrocardiography, ECG Electrodes, the cardiac equivalent generator, genesis of the ECG, the standard and augmented limb leads, 12 lead ECG, the vectorcardiogram, ECG signal characteristics. (Text-2: 2.1, 2.1.1, 2.1.2, 2.1.3, 2.1.4, 2.1.5, 2.2.1, 2.2.2, 2.3)

Signal Conversion: Simple signal conversion systems, Conversion requirements for biomedical signals, Signal converter characteristics, D to A converters, A to D converters, Sample and Hold circuit, Analog Multiplexer, Amplifiers. (Text-2: 3.2, 3.3, 3.4.1, 3.4.2, 3.4.3, 3.4.4, 3.4.5, 3.4.6).

08 Hours

Module-2

Signal Averaging: Basics of signal averaging, Signal averaging as a digital filter, a typical averager, Software for signal averaging, Limitations of signal averaging.
(Text-2: 9.1, 9.2, 9.3, 9.4, 9.5).

Adaptive Filters: Principal noise canceller model, 60-Hz adaptive cancelling using a sine wave model, Applications: Maternal ECG in fetal ECG, Cardiogenic artifact, detection of ventricular fibrillation and tachycardia. (Text-2: 8.1, 8.2, 8.3.1, 8.3.2, 8.3.3).

08 Hours

Module-3

Data Reduction Techniques: Introduction, Turning point algorithm, AZTEC algorithm, Fano algorithm, Huffman coding: Static coding, Modified coding, Adaptive coding, Residual differencing, Runlength coding.
(Text-2: 10.1, 10.2, 10.3, 10.4.1, 10.4.2, 10.4.3, 10.4.4, 10.4.5).
Time and Frequency domain techniques: The Fourier transform for a discrete nonperiodic and periodic signals, the Fast Fourier transform, Correlation in time domain and in frequency domain, Convolution in time domain and in frequency domain, Power spectrum estimation: Parseval's theorem
(Text-2: 11.1.1, 11.1.2, 11.1.3, 11.2.1, 11.2.2, 11.2.3, 11.3.1, 11.3.2, 11.3.3, 11.4.1)

08 Hours

Module-4

ECG QRS detection: Power spectrum of the ECG, Bandpass filtering techniques, Differentiation techniques, Template matching techniques: Template cross correlation, template subtraction, automata based template matching, a QRS detection algorithm.

ECG Analysis Systems: Interpretation of the 12 lead ECG, ST segment analyzer, Portable arrhythmia monitor: Holter recording, software and hardware design, arrhythmia analysis (Text -2)

08 Hours

Module-5

Neurological signal processing: The brain and its potentials, origin of brain waves, the EEG signal andits characteristics, EEG analysis, Linear prediction theory, The Autoregressive method, Recursive estimation of AR parameters, Spectral error measure.
(Text-3: 4.1, 4.2, 4.3 4.4, 4.5, 4.6, 4.7, 4.8)

Event detection and waveform analysis: EEG rhythms, waves and transients, Detection of EEGrhythms, Template matching for EEG spike and wave detection, the matched filter

(Text-1: 4.2.4, 4.4.1, 4.4.2, 4.6)

08 Hours

Teaching-Learning Process for all modules	**Chalk and Talk/PowerPoint presentation/YouTube videos.**

Course Outcomes:

After successfully completing the course, the students will be able

1. Describe the origin, properties and suitable models of important biological signals such as ECGand EEG.
2. Know the basic signal processing techniques in analysing biological signals.
3. Acquire mathematical and computational skills relevant to the field of biomedical signalprocessing.
4. Describe the basics of ECG signal compression algorithms.
5. Know the complexity of various biological phenomena.

Assessment Details (both CIE and SEE)

Component		**Weightage (%)**	
CIE's	CIE 1- At the end of 5th week	20	60
	CIE 2 - At the end of 10th week	20	
	CIE 3 - At the end of 15th week	20	
AAT's	AAT-1- At the end of 4th week	10	40
	AAT-2- At the end of 9th week	10	
	AAT-3- At the end of 13th week	20	
Continuous Internal Evaluation Total Marks: 100. Reduced to 50 Marks			
Semester End Examination (SEE) Total Marks: 100. Reduced to 50 Marks			

Suggested Learning Resources:

Suggested Learning Resources:

1. Biomedical Signal Analysis-Rangaraj M Rangayyan, John Wiley & Sons 2002
2. Biomedical Digital Signal Processing- Willis J Tompkins, PHI2001.
3. Biomedical Signal Processing Principles and Techniques-D C Reddy, McGraw-Hill publications, 2005.

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

a. **Quizzes**
b. Assignments
c. Seminars

CO- PO Mapping:

POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C402.D.1	3	1	3	2	2	3	1	0	1	1	1	1
C402.D.2	3	3	2	2	2	3	2	0	1	1	1	1
C402.D.3	3	2	2	2	2	--	-	--	--	--	--	--
C402.D.4	3	3	3	2	2	--	--	--	--	--	--	--
C402.D.5	3	2	2	--	--	--	--	--	--	--	--	--

SEMESTER-VII

Speech Signal Processing			
Course Code	**21EC725**	**CIE Marks**	**50**
Teaching Hours/Week(L:T:P:S) (3:0:0:0)	**Credits (3:0:0:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40 hours**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course objectives:

This course will enable the students to :

1. Explain the models for speech production
2. Describe the Time domain and frequency domain speech processing techniques
3. Interpret a predictive technique for speech compression
4. Understand the concepts of Homomorphic Speech Processing
5. Provide fundamental knowledge required to understand and analyze speech recognition, synthesis and speaker identification systems

Teaching-Learning Process(General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various techniques.
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Fundamentals of Human Speech Production: Introduction, The Process of Speech Production, The Acoustic Theory of Speech production, Lossless Tube Models, Digital Models for Sampled Speech Signals.

[Text 1:3.0,3.1,3.2,3.3,3.4]

08Hours

Module-2

Time-Domain Methods for Speech Processing: Introduction, Time-Dependent Processing of speech, Short-Time Energy and Average Magnitude, Short-Time Average Zero-Crossing Rate, Speech vs Silence Discrimination using Energy and Zero-Crossings, The Short-Time Autocorrelation Function.

[Text 1:4.0,4.1,4.2,4.3,4.4,4.6]

08 Hours

Module-3

Frequency Domain Representations: Discrete-Time Fourier Analysis, Short-Time Fourier Analysis, Overlap Addition (OLA),Digital Representations of Speech Waveform

[Text 1:5.0,5.1,5.3,5.4,5.6,5.7,6.0,6.1]

08Hours

Module-4

Homomorphic Speech Processing: Introduction, Homomorphic Systems for Convolution, Complex Cepstrum of Speech, Pitch Detection,Formant Estimation,Homomorphic vocoder.

[Text 1:7.0,7.1,7.2,7.3,7.4,7.5]

08Hours

Module-5

Linear Predictive Analysis of Speech Signals: Introduction, Basic Principles of Linear Predictive Analysis, Computation of the Gain for the Model, Solution of the LPC Equations, The Prediction Error Signal, Frequency Domain Interpretations of Linear Predictive Analysis.
[Text 1:8.0,8.1,8.2,8.3,8.5,,8.6]

08Hours

Teaching-Learning Process for all modules	**Chalk and Talk/Power Point presentation/YouTube videos.**

Course outcomes (Course Skill Set)

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

1. Model speech production system and describe the fundamentals of speech.
2. Apply time domain and frequency domain algorithms, on speech to find, enhance and modify speech parameters.
3. Describe an appropriate processing technique for a given application.
4. Apply the concepts of Homomorphic Speech Processing.
5. Analyze speech recognition, synthesis and speaker identification systems.

Assessment Details(both CIE and SEE)

Component		**Weightage(%)**	
CIE's	CIE 1-At the end of 5th week	20	60
	CIE2 –At the end of 10th week	20	
	CIE3 -Attheendof 15th week	20	
AAT's	AAT-1-At the end of 4th week	10	40
	AAT-2-A the end of 9th week	10	
	AAT-3-Attheendof13th week	20	
Continuous Internal Evaluation Total Marks:100.Reduced to 50Marks			
Semester End Examination(SEE)Total Marks:100.Reduced to 50Marks			

Suggested Learning Resources:

Text Books:

1. L R Rabiner and R W Schafer ,"Digital Processing of Speech Signals" , ISBN 978-81-317-0513-1 Pearson Education Asia, 2004
2. Rabiner and Schafer, "Theory and Applications of Digital Speech Processing", ISBN 81-203-0501-9 Pearson Education 2011.

ReferenceBooks:

1. Lawrence Rabiner and Biing-Hwang Juang ,"Fundamentals of Speech Recognition", ISBN 81-297-0138-3 Pearson Education, 2003.
2. Daniel Jurafsky and James H Martin," Speech and Language Processing–An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", ISBN 01-350-4196-1 Pearson Prentice Hall, 2009.

E-Resources:

1.https://nptel.ac.in/courses/117105145
2. https://ocw.mit.edu/courses/6-345-automatic-speech-recognition-spring-2003/
3. https://www.classcentral.com/course/youtube-digital-speech-processing-47859

Activity-Based Learning(Suggested Activities in Class)/Practical-Based Learning

- **Quizzes**
- Assignments
- Seminars

CO-PO Mapping:

POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C402.E.1	3	2	2	2	2	--	--	--	--	2	--	--
C402.E.2	3	3	3	2	2	--	--	--	--	2	--	1
C402.E.3	3	3	3	2	2	--	--	--	--	2	1	1
C402.E.4	3	3	3	2	2	--	--	--	--	2	--	1
C402.E.5	3	3	3	3	3	--	--	--	--	2	--	1

SEMESTER-VII

IoT & Wireless Sensor Networks			
Course Code	**21EC731**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P:S) (3:0:0:0)	**Credits (3:0:0:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40 hours**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course objectives:

The goal of the course **IoT & Wireless Sensor Networks** is:

1. To Understand the concepts and characteristics of IoT devices.
2. To Interpret the use of different IoT devices and their prototyping.
3. To Evaluate the Wireless sensor networks characteristics and applications.
4. To Analyze the sensor, transmission technology and systems associated with WSN.
5. To Apply the concepts of middleware, performance evaluation and traffic management in WSN.

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the various concepts.
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes criticalthinking
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Topics will be introduced in multiple representations.
7. Show the different ways to solve the same problem and encourage the students to come up withtheir own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Internet of Things: Introduction, Physical design, Logical design, Enabling technologies, IoT Communication models & APIs, IoT Levels &deployment templates,
Text 1: Chapter 1

08 Hours

Module-2

Domain Specific IoTs: Home automation, cities, environment, energy, retail, logistics, agriculture, industry, health & lifestyle, manufacturing, Education, Automotive
IoT Protocols : 6LowPAN, RPL, CoAP, MQTT
Text 1: Chapter 2

08 Hours

Module-3

Wireless Sensor Networks: Introduction, applications of sensor networks, basic overview of the technology, basic sensor network architectural elements, present day sensor network research, challenges and hurdles, WSN vs Adhoc & other alternative Networks. examples of Category 1 and 2 WSN applications
Text 2: Chapter 1 – 1.1, 1.1.2, 1.2, 1.2.1, 1.2.2 (phase 4), 1.2.3 Chapter 2: 2.4, 2.5

08 Hours

Module-4

Wireless sensor technology: Introduction, sensor node technology – overview, hardware andsoftware, sensor taxonomy, WN operating environment, WN trends.
Wireless Transmission technology and systems: Introduction, Campus applications, MAN/WANapplications.
Text 2: Chapter 3: 3.1, 3.2 – 3.2.1, 3.2.2, 3.3, 3.4, 3.5 Chapter 4: 4.1, 4.3.1, 4.3.2

08 Hours

Module-5	
Middleware for WSNs: Introduction, principles, architecture, data related functions **Performance and traffic management:** background, WSN Design issues, performance modelling ofWSNs. Text 2: Chapter 8: 8.1, 8.2, 8.3, 8.3.1 Chapter 11: 11.2, 11.3, 11.4 **08 Hours**	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Course outcome (Course Skill Set)

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

1. Understand the characteristics, building blocks, enabling technologies of the IoT systems
2. Describe the characteristics and applications of domain specific IoTs.
3. Discuss the overview of the Wireless sensor networks characteristics and applications.
4. Present the sensor, transmission technology and systems associated with WSN.
5. Develop the concepts of middleware, performance evaluation and traffic management in WSN.

Assessment Details (both CIE and SEE)

Component		Weightage (%)	
CIE's	CIE 1- At the end of 5th week	20	60
	CIE 2 - At the end of 10th week	20	
	CIE 3 - At the end of 15th week	20	
AAT's	AAT-1- At the end of 4th week	10	40
	AAT-2- At the end of 9th week	10	
	AAT-3- At the end of 13th week	20	
Continuous Internal Evaluation Total Marks: 100. Reduced to 50 Marks			
Semester End Examination (SEE) Total Marks: 100. Reduced to 50 Marks			

Suggested Learning Resources:

Text Books:

1. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014. (ISBN: 9788173719547)
2. Kazem Sohraby, Daniel Minoli and Taieb Znati, "Wireless Sensor Networks", Wiley, 2015. (ISBN : 8126527307)

E-resources

1. www.coursera.org/specializations/iot
2. https://nptel.ac.in/courses/106/105/106105166/
3. http://www.tfb.edu.mk/amarkoski/WSN/Kniga-w02
4. https://web.cse.ohio-state.edu/~arora.9/788-12.html

Activity-Based Learning (Suggested Activities in Class)

Quizzes

Surprise Tests

Assignments Seminars

Case Studies

CO- PO Mapping:

POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C403a.1	2	2	3	3	1	-	-	-	-	2	-	1
C403a.2	3	3	3	3	3	-	-	-	-	2	-	2
C403a.3	1	2	2	2	1	-	-	-	-	2	-	1
C403a.4	1	2	2	2	1	-	-	-	-	2	-	1
C403a.5	1	3	3	3	2	-	-	-	-	2	-	1

SEMESTER-VII

Network Security			
Course Code	**21EC732**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P:S) (3:0:0:0)	**Credits (3:0:0:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40 hours**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course objectives:

1. To Learn the Network Models for Security.
2. To understand the Routing in Network layer.
3. To explore methods of communication and congestion control by the transport layer.
4. To study the Network Security Mechanisms.
5. To learn various security attacks and their counter measures.

Module-1

Attacks on Computers and Computer Security: Need for Security, Security Approaches, Principles of Security Types of Attacks. Security Mechanisms, Services and Attacks, A model for Network security, Network Access Control, Extensible Authentication Protocol.

08 Hours

Module-2

Transport Level Security: Web Security Considerations, Secure Sockets Layer, Transport Layer Security, TCP/IP ,HTTPS, Secure Shell (SSH).

08 Hours

Module-3

IP Security: Overview of IP Security (IPSec), IP Security Architecture, Modes of Operation, Security Associations (SA), Authentication Header (AH), Encapsulating Security Payload (ESP), Internet Key Exchange, Cryptographic suites.

08 Hours

Module-4

Intruders: Secure Electronic Transaction (SET).Intruders, Intrusion Detection. Malicious Softwares: Virus and related threats, Virus counter measures.

08 Hours

Module-5

Firewalls: The need for firewalls, Firewall characteristics, Types of Firewalls, Firewall biasing, Firewall location and configuration.

08 Hours

Teaching-Learning Process for all modules	**Chalk and Talk/Power Point presentation/YouTube videos.**

Course Outcomes:

After successfully completing the course, the students will be able

1. Explain network security services and mechanisms and explain security concepts
2. Understand the concept of Transport Level Security and Secure Socket Layer.
3. Explain Security concerns in Internet Protocol security
4. Explain Intruders, Intrusion detection and Malicious Software
5. Describe Firewalls, Firewall Characteristics, Biasing and Configuration.

Assessment Details (both CIE and SEE)

Component		Weightage(%)	
CIE's	CIE 1-At the end of 5th week	20	60
	CIE2 -At the end of 10th week	20	
	CIE3 -At the end of 15th week	20	
AAT's	AAT-1-At the end of4th week	10	40
	AAT-2-At the end of 9th week	10	
	AAT-3-At the end of 13th week	20	
Continuous Internal Evaluation Total Marks: 100. Reduced to 50Marks			
SemesterEndExamination(SEE)TotalMarks:100.Reducedto50Marks			

Suggested Learning Resources:

TextBooks:

7. William Stallings "Cryptography and Network Security: Principles and Practice", Fifth Edition, Pearson education,2011.ISBN : 9780136097044.

2..Atul Kahate, "Cryptography and Network Security", TMH, 2003.

Reference Books:

1. Cryptography and Network Security, Behrouz A Forouzan, TMH, 2007.
2. Introduction to Computer Security, Matt Bishop, Sathyanarayana S V, Pearson Education, 2006,ISBN 81-7758-425/1.

E-Resources:

1.http://www.nptel.ac.in/courses/106105031

2. http://faculty.mu.edu.sa/public/uploads/1360993259.0858Cryptography%20and%20Network%20Security%20Principles%20and%20Practice,%205th%20Edition.pdf

Activity-Based Learning(SuggestedActivitiesinClass)/Practical-Based Learning

- **Quizzes**
- Assignments
- Seminars.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C403.B.1	3	3	3	2	2	1	1	-		2	1		2	3	2
C403.B.2	3	3	3	3	2	1				2	2		3	3	3
C403.B.3	3	3	3	2	2	1				2	2		3	3	2
C403.B.4	3	3	2	2	2	1				2	2	1	3	2	2
C403.B.5	3	3	2	3	2	1	1			2	2	1	2	2	2

SEMESTER-VII

Fabrication Technology			
Course Code	**21EC733**	**CIE Marks**	**50**
Teaching Hours/Week (L: T: P: S) (3:0:0:0)	**Credits (3:0:0:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40 hours**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course objectives:

This course will enable students to:

1. Familiarize with the concepts of different processes involved in fabrication process and also with packaging issues.
2. Apply principles to identify and analyse the various steps for the fabrication of various components.
3. Introduce the fundamental concepts relevant to VLSI fabrication.
4. Enable the students to understand the various VLSI fabrication techniques

Teaching-Learning Process (General Instructions)

Teaching-Learning Process (General Instructions) The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the evolution of communication technologies.
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
7. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Crystal Growth and Wafer Preparation: Introduction, Electronic grade Silicon, Czochralski Crystal Growing, Silicon Shaping Epitaxy: Introduction, Vapor-Phase Epitaxy

Text Book 1.1 to 1.4, 2.1 to 2.2

08 Hours

Module-2

Epitaxy: Molecular beam epitaxy, Epitaxial evaluation Oxidation: Introduction, Growth mechanism and kinetics, Thin oxides, oxidation techniques, oxide properties, redistribution of dopants, oxidation of polysilicon, oxidation-induced defects

Text Book 2.3 and 2.5, 3.1 to 3.8

08 Hours

Module-3

Lithography: Introduction, Optical Lithography, Electron Lithography, X-ray lithography, Ion Lithography

Text Book 4.1 to 4.5

08 Hours

Module-4

Diffusion: Introduction, Models of diffusion in solids, fick's 1D diffusion equation, atomic diffusion mechanism, Diffusivities, Measurement techniques, fast diffusants in silicon, diffusion in polycrystalline silicon, diffusion in SiO_2 Ion Implantation: Introduction, Implantation equipment Text Book 7.1 to 7.9, 8.1 and 8.3

08 Hours

Module-5

Ion Implantation: Annealing, Shallow Junctions, High energy implantation Metallization: Introduction, Metallization applications, metallization choices, Metallization problems, New role of metallization.

Text Book 8.4 to 8.6, 9.1 to 9.7 (except 9.4 and 9.5)

08 Hours

Teaching-Learning Process for all modules	**Chalk and Talk/PowerPoint presentation/YouTube videos.**

Course Outcomes (Course Skill Set):

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

1. Understanding the process in the field of Fabrication technology.
2. Understand the properties and growth mechanism of oxidation.
3. Relate to the competing methods of various lithographic techniques and their limitations.
4. Analyse the diffusion profiles and models in various materials.
5. Describe the Metallization choices, properties and selection of optimum deposition process.

Assessment Details (both CIE and SEE)

Component		**Weightage (%)**	
CIE's	CIE 1- At the end of 5th week	20	60
	CIE 2 - At the end of 10th week	20	
	CIE 3 - At the end of 15th week	20	
AAT's	AAT-1- At the end of 4th week	10	40
	AAT-2- At the end of 9th week	10	
	AAT-3- At the end of 13th week	20	
Continuous Internal Evaluation Total Marks: 100. Reduced to 50 Marks			
Semester End Examination (SEE) Total Marks: 100. Reduced to 50 Marks			

Suggested Learning Resources:

Text Book:

1. VLSI Technology, S M Sze, 2nd edition, Mc Graw Hill.

Reference Books:

1. VLSI Fabrication Principles, S K Gandhi, John Willey & Sons.
2. Micromachined transducer, G T A Kovacs, McGraw Hill.

CO- PO Mapping:

POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C403.C.1	3	3	2	1	1	--	--	--	--	--	1	--
C403.C.2	3	2	2	1	1	--	--	--	--	--	1	--
C403.C.3	3	3	2	1	1	--	--	--	--	--	1	1
C403.C.4	3	3	2	1	--	--	--	--	--	--	--	--
C403.C.5	3	3	2	1	1	--	--	--	--	1	1	1

SEMESTER-VII

Machine Learning with Python			
Course Code	**21EC734**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P:S)(2:0:2:0)	**2:0:1:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**30 hours Theory + 10 Lab slots**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course objectives:

1. To understand the basic theory underlying machine learning.
2. To be able to formulate machine learning problems corresponding to different applications.
3. To understand a range of machine learning algorithms along with their strengths and weaknesses.
4. To be able to apply machine learning algorithms to solve problems of moderate complexity.
5. To apply the algorithms to a real-world problem, optimize the models learned and report on theexpected accuracy that can be achieved by applying the models.

Teaching-Learning Process (General Instructions)

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

1. In addition to the traditional lecture method, different types of innovative teaching methods may beadopted so that the delivered lessons shall develop student's theoretical and programming skills.
2. State the need for learning Machine Learning with real-life examples.
3. Support and guide the students for self–study.
4. You will also be responsible for assigning homework, grading assignments and quizzes, anddocumenting students & progress
5. Encourage the students for group learning to improve their creative and analytical skills.
6. Show short, related video lectures in the following ways:
    - As an introduction to new topics (pre-lecture activity).
    - As a revision of topics (post-lecture activity).
    - As additional examples (post-lecture activity).
    - As an additional material of challenging topics (pre-and post-lecture activity).
    - As a model solution of some real world problems. (post-lecture activity).

Module-1

Introduction: Introduction to Machine Learning, Building intelligent machines to transform data into knowledge, The three different types of machine learning, An introduction to the basic terminology and notations, A roadmap for building machine learning systems, Using Python for machine learning. **Machine Learning Algorithms for Classification** Artificial neurons – a brief glimpse into the early history of machine learning, Implementing a perceptron learning algorithm in Python, Adaptive linear neurons and the convergence of learning Training. Textbook 1: Chapters 1,2

06 Hours

Module-2

A Tour of Machine Learning Classifiers Using Scikit-Learn Choosing a classification algorithm, First steps with scikit-learn, Modeling class probabilities via logistic regression, Maximum margin classification with support vector machines, Solving nonlinear problems using a kernel SVM, Decision tree learning, Maximizing information gain – getting the most bang for the buck

Building Good Training Sets – Data Preprocessing Dealing with missing data, Handling categorical data, Partitioning a dataset in training and test sets, Bringing features onto the same scale, Selecting meaningful features, Assessing feature importance with random forests. Textbook 1: Chapters 3 ,4

06 Hours

Module-3

Compressing Data via Dimensionality Reduction Unsupervised dimensionality reduction via principal component Analysis, Supervised data compression via linear discriminant analysis, Using kernel principal component analysis for nonlinear mappings **Learning Best Practices for Model Evaluation and Hyperparameter Tuning** Streamlining workflows with pipelines, Loading the Breast Cancer Wisconsin dataset, Combining transformers and estimators in a Pipeline,Using k-fold cross-validation to assess model performance,

Applying Machine Learning to Sentiment Analysis Obtaining the IMDb movie review dataset, Introducing the bag-of-words model, training a logistic regression model for document classification , Working with bigger data – online algorithms and out-of-core learning

06 Hours

Module-4

Embedding a Machine Learning Model into a Web Application Serializing fitted scikit-learn estimators, Setting up a SQLite database for data storage, Developing a web application with Flask, Form validation and rendering, Turning the movie classifier into a web application, Deploying the web application to a public server **Predicting Continuous Target Variables with Regression Analysis** Introducing a simple linear regression model, Exploring the Housing Dataset, Implementing an ordinary least squares linear regression model, Textbook 1: Chapters 9,10

06 Hours

Module-5

Working with Unlabeled Data – Clustering Analysis Grouping objects by similarity using k-means, Organizing clusters as a hierarchical tree, **Training Artificial Neural Networks for Image Recognition** Modeling complex functions with artificial neural networks, Classifying handwritten digits, Training an artificial neural network, Convergence in neural networks

06 Hours

Practical Based learning

1. Using IRIS data set implement Adaline rule Classification Algorithm.
2. Implement Logistic Regression algorithm and generate corresponding graphs for overfitting and under fitting.
3. Implement linear SVM algorithm with maximum margin intuition.
4. Implement a kernel SVM to solve nonlinear problems.
5. Implement KNN Algorithm.
6. Implement decision tree algorithm.
7. Implement s rbf_kernel_pca for separating half-moon shapes.
8. Develop web application using flask.

Assessment Details (both CIE and SEE)

Component		Weightage (%)		
CIE's	CIE 1 5th week	20	60	Average of 3 tests for 20 marks
	CIE 2 10th week	20		
	CIE 3 15th week	20		
AAT's	AAT-1 10th week			10
	Lab Test	30		Reduced to 10
	Lab Record	20		10
Continuous Internal Evaluation Total Marks :100. Reduced to 50 Marks				
Semester End Examination (SEE) Total Marks :100. Reduced to 50 Marks				

Course outcomes (Course Skill Set)

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

1. Appreciate the importance of visualization in the data analytics solution
2. Apply structured thinking to unstructured problems
3. Understand a very broad collection of machine learning algorithms and problems

4. Learn algorithmic topics of machine learning and mathematically deep enough to introduce therequired theory.
5. Develop an appreciation for what is involved in learning from data.

Suggested Learning Resources:

Text Books:

1. Python Machine Learning by Sebastian Raschka, Published by Packt Publishing Ltd.
2. Machine Learning with Python for Everyone by Mark E Fenner
3. Machine Learning using Python by Manaranjan Pradhan & U Dinesh Kumar
4. Practical Machine Learning with Python by Dipanjan Sarkar, Raghav Bali &Tushar Sharma

Web links and Video Lectures (e-Resources)

- https://www.youtube.com/watch?v=RnFGwxJwx-0
- https://www.youtube.com/watch?v=eq7KF7JTinU

CO-PO Mapping

POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C404.D.1	3	3	3	3	3	-	-	-	2	2	1	1	3	3	3
C404.D.2	2	3	3	2	2	-	-	-	3	1	1	1	2	3	3
C404.D.3	1	2	3	3	2	-	-	-	3	1	1	1	1	2	3
C404.D.4	3	3	3	3	1	-	-	-	3	1	1	1	3	3	3
C404.D.5	3	3	3	3	3	-	-	-	2	2	2	2	3	3	3

SEMESTER-VII

MULTIMEDIA COMMUNICATION			
Course Code	**21EC735**	**CIE Marks**	**50**
Teaching Hours/Week (L: T: P: S) (2:0:2:0)	**Credits (2:0:1:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**30 hours Theory + 10 Lab slots**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course objectives:

This course will enable students to:

1. Understand the importance of multimedia in today's online and offline information sources and repositories.
2. Distinguish how Text, Audio, Image, and Video information can be represented digitally in a computer so that it can be processed, transmitted and stored efficiently.
3. Describe the Multimedia Transport in Wireless Networks
4. Infer Real-time multimedia network applications.
5. Explain the Different network layer-based applications.

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various techniques.
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Topics will be introduced in multiple representations.
6. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the student's understanding.

Module-1

Multimedia Communications: Introduction, Components of Multimedia, Multimedia Networks, Multimedia software tools, Multimedia applications.

[Text 1:1.1,1.3,1.4][Text 2:1.1.1,1.3]

06 Hours

Module-2

Information Representation: Introduction, Text, Images, Audio, and Video, Popular File formats.

[Text 1: 2.1,2.3.1,2.3.2,2.4.1,2.4.3,2.5.1,2.5.2,2.6.1,2.6.2][Text 2: 3.2]

06 Hours

Module-3

Text and Image Compression: Introduction, Compression principles, text compression, image Compression.

[Text 1:3.1,3.2,3.3.1,3.3.2,3.3.5,3.4.1,3.4.2,3.4.3,3.4.5]

06 Hours

Module-4

Audio and video compression: Introduction, Audio compression, Video compression, Video compression principles

[Text 1:4.1,4.2.1,4.2.2,4.2.3,4.2.4,4.2.7,4.3,4.3.1,4.3.2, 4.3.4,4.3.5,4.3.6]

06 Hours

Module-5

Multimedia Information Networks: Introduction, LANs, Ethernet, Internet: introduction, IP datagrams, IP Address

[Text 1: 8.1,8.2,8.3,8.7,9.1,9.2,9.4]

06 Hours

Teaching-Learning Process for all modules	**Chalk and Talk/PowerPoint presentation/YouTube videos.**

Practical Based learning

1. Develop a Matlab/python code for encoding and decoding a message.
2. Write a Matlab/python code for the quantization of a signal.
3. Implement text file compression using Lempel-Ziv-Welch Algorithm.
4. Implement image compression using JPEG Algorithm.
5. Implement audio compression using Free Lossless Audio Codec algorithm.
6. Implement video compression using H.264/AVC algorithm.

Course Outcomes:

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

1. Understand the basics of different multimedia networks and applications.
2. Analyse different media types to represent them in digital form.
3. Illustrate the different types of text and images using different compression techniques.
4. Apply the different compression techniques to compress audio and video.
5. Describe multimedia Communication across Networks.

Assessment Details (both CIE and SEE)

Assessment Details (both CIE and SEE)

Component		Weightage (%)		
CIE's	CIE 1 5th week	20	60	Average of 3 tests for 20 marks
	CIE 2 10th week	20		
	CIE 3 15th week	20		
AAT's	AAT-1 10th week			10
	Lab Test	30		Reduced to 10
	Lab Record	20		10
Continuous Internal Evaluation Total Marks :100. Reduced to 50 Marks				
Semester End Examination (SEE) Total Marks :100. Reduced to 50 Marks				

Suggested Learning Resources:

Text Books:

1. Fred Halsall, Pearson Education "Multimedia Communications" Pearson 2001, ISBN -978813170994
2. Ze-Nian Li, Mark S. Drew, Jiangchuan Liu, "Fundamentals of Multimedia" Springer Third Edition 2021, ISBN-9783030621230.

Reference Books:

1. Steinmetz, Klara Nahrstedt, "Multimedia: Computing, Communications and Applications- Raif" Pearson Education, 2002, ISBN-978817758.
2. K. R. Rao, Zoran S. Bojkovic, Dragorad A. Milovanovic, "Multimedia Communication Systems", Pearson Education, 2004

E-Resources:

https://nptel.ac.in/courses/117105083

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- **Quizzes**
- Assignments
- Seminars

CO- PO Mapping:

POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C404.E.1	2	2	2	--	--	--	1	--	--	--	--	--
C404.E.2	2	2	3	--	--	--	2	--	--	--	--	--
C404.E.3	2	2	1	--	--	--	--	--	--	--	--	--
C404.E.4	2	2	2	--	--	--	--	--	--	--	--	--
C404.E.5	2	3	2	--	--	--	--	--	--	--	--	--

SEMESTER-VII

ARM EMBEDDED SYSTEMS			
Course Code	**21EC742**	**CIE Marks**	**50**
Teaching Hours/Week (L: T: P: S) (3:0:0:0)	**Credits (3:0:0:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40 hours**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course objectives:

This course will enable students to:

1. Explain the architectural features and instructions of 32-bit ARM microcontroller
2. Develop Programs using the various instructions of ARM for different Applications.
3. Understand the basic hardware components and their selection method based on the characteristics and Attributes of an embedded system.
4. Develop the hardware-software co-design and firmware design approaches.
5. Explain the need for real-time operating systems for embedded system applications.

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various techniques.
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Adopt Problem-Based Learning (PBL), which fosters students' Analytical skills, and develops thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
7. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the student's understanding.
8. Give programming assignments.

Module-1

ARM Embedded System: RISC Design Philosophy, ARM design Philosophy, Embedded System hardware and Embedded System software.

ARM Processor Fundamentals: Registers, Current Program Status Registers, Pipeline, Exceptions, Interrupts and the Vector table, Core Extensions, Architecture Revisions, ARM processor families

[Text1: Chapter 1 and Chapter 2]

8 Hours

Module-2

ARM Instructions: Introduction, Data Processing Instructions, Branch Instructions, Load–Store Instructions Software Instructions, Program Status Register Instructions, Conditional Execution.

Thumb Instructions: Thumb register usage, ARM – Thumb Interworking, Other branch Instructions, Data Processing instructions, Single and Multiple Register Load Store Instructions, Stack Instructions, and Software Interrupt Instructions.

[Text1: Chapter 3 and Chapter 4,]

08 Hours

Module-3

Embedded System Components: Introduction, Embedded Vs General computing system, Classification of Embedded systems, Major applications and purpose of ES.

Elements of an Embedded System (Block diagram and explanation), Differences between RISC and CISC, Harvard and Princeton, Big- and Little-Endian formats, ASICS, Programmable Logic devices, Memory (ROM and RAM types), Sensors, Actuators, Optocoupler, Communication Interfaces (I2C, SPI, USB, RS-232, Wi-Fi, only)

[Text 2: Chapter 1.1,1.2, .4,1.5.1.6,2.1.1.6,2.1.1.7]
[Chapter 2: 2.1.1.8,2.1.2,2.1,3,2.2,2.3.1,2.3.2,2.3.3.3,2.4]

08 Hours

Module-4

Embedded System Design Concepts: Characteristics and Quality Attributes of Embedded Systems, Operational and non-operational quality attributes,
Hardware Software Co-Design and Program Modelling (excluding UML), Embedded firmware design and development (excluding C language). IDE, Types of files generated on cross-compilation.
[Text 2: Chapters 3,7, and 9.1,9.2,13.1,13.2]

08 Hours

Module-5

RTOS and IDE for Embedded System Design: Operating System basics, Types of operating systems, Tasks, process and threads (Only POSIX Threads with an example program), Thread pre-emption,
Pre-emptive Task scheduling techniques, Task Communication, Task synchronization issues- Racing and Deadlock, Programs related to semaphores, message queue, shared buffer applications involving inter-task/thread communication
[Text 2: Chapter 10.1,10.2,10.3,10.5,10.6,10.7]

08 Hours

Teaching-Learning Process for all modules	**Chalk and talk/PowerPoint presentation/YouTube videos.**

Course Outcomes:

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

1. Depict the organization, architecture, bus technology, memory and operation of the ARM processors.
2. Employ the knowledge of the Instruction set of ARM processors to develop basic Assembly Language Programs
3. Understand the concepts of Embedded systems, applications, and different input-output components.
4. Develop the hardware /software co-design and firmware design approaches.
5. Design, analyze and write programs using RTOS for inter-task communication.

Assessment Details (both CIE and SEE)

Component		**Weightage (%)**	
CIE's	CIE 1- At the end of 5th week	20	60
	CIE 2 - At the end of the 10th week	20	
	CIE 3 - At the end of the 15th week	20	
AAT's	AAT-1- At the end of 4th week	10	40
	AAT-2- At the end of 9th week	10	
	AAT-3- At the end of 13th week	20	
Continuous Internal Evaluation Total Marks: 100. Reduced to 50 Marks			
Semester End Examination (SEE) Total Marks: 100. Reduced to 50 Marks			

Suggested Learning Resources:

Text Books:

1. Andrew N Sloss, Dominic System and Chris Wright, "ARM System Developers Guide", Elsevier, Morgan Kaufmann publisher, 1st Edition, 2008, ISBN:1758608745.
2. K. V. Shibu, "Introduction to embedded systems", TMH Education Pvt. Ltd. 2009. ISBN: 9780070145894.

Reference Books:

1. Sam Siewert, "Real-Time Embedded Systems and Components", Cengage Learning India Edition, 2007. ISBN:1584504684
2. Dr. K.V.K.K Prasad, Embedded/Real-Time Systems, Concepts, Design and Programming, Black Book, Dream Tech Press, New edition, 2010. ISBN: 9788177224610.

3. Joseph Yiu, ''TheDefinitiveGuidetotheARMCortex-M3", 211d Edition, Newnes, (Elsevier), 2010.

E-Resources:
https://archive.nptel.ac.in/courses/106/105/106105193/

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- **Quizzes**
- Assignments
- Seminars

CO- PO Mapping:

POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C405.B.1	2	2	2	--	--	--	--	--	--	--	--	--
C405.B.2	3	3	3	2	1	--	--	--	--	--	--	--
C405.B.3	3	2	2	--	--	--	--	--	--	--	--	--
C405.B.4	3	3	3	2	3	--	--	--	--	--	--	--
C405.B.5	3	3	3	2	2	--	--	--	--	--	--	--

SEMESTER-VII

Basic Digital Image Processing			
Course Code	**21EC743**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P:S) (2:0:2:0)	**Credits (2:0:1:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**30 hours Theory + 10 Lab slots**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course objectives:

1. Understand the fundamentals of digital image processing
2. Understand the image enhancement techniques in spatial domain used in digital image processing
3. Understand the frequency domain enhancement techniques in digital image processing
4. Understand the Color Image Processing in digital image processing
5. Understand the image restoration techniques and methods used in digital image processing

Teaching-Learning Process (General Instructions)

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

1. Show Video/animation films to explain the functioning of various image processing concepts.
2. Encourage cooperative (Group) Learning through puzzles, diagrams, coding etc., in the class.
3. Encourage students to ask questions and investigate their own ideas helps improve theirproblem-solving skills as well as gain a deeper understanding of academic concepts.
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes criticalthinking
5. Students are encouraged to do coding based projects to gain knowledge in image processing.
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in multiple representations.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
9. Arrange visits to nearby PSUs such as CAIR(DRDO), NAL, BEL, ISRO, etc., and small-scale software industries to give industry exposure.

Module-1

Digital Image Fundamentals: What is Digital Image Processing?, Origins of Digital Image Processing, Examples of fields that use DIP, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception, Image Sensing and Acquisition.

[Text 1: Chapter 1, Chapter 2: Sections 2.1 to 2.3]

06 hours

Module-2

Spatial Domain: Image Sampling and Quantization, Some Basic Relationships Between Pixels. Some Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters.

[Text1: Chapter2: Sections 2.4 to 2.5, Chapter3 : Sections 3.2 to 3.6]

06 hours

Module-3

Frequency Domain: Preliminary Concepts, The Discrete Fourier Transform (DFT) of Two Variables, Properties of the 2-DDFT Basics of Filtering in the Frequency Domain, Image Smoothing and ImageSharpening Using Frequency Domain Filters. [Text 1: Chapter 4: Sections 4.4 to 4.9]

06 hours

Module-4

Color Image Processing: Color Fundamentals, Color Models, Pseudo-color Image Processing, Basics of Full-Color image processing [Text 1: Chapter 6: Sections 6.1 to 6.4]

06 hours

Module-5

Restoration: Noise models, Restoration in the Presence of Noise Only using Spatial Filtering and Frequency Domain Filtering, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Constrained Least Squares Filtering.

[Text 1: Chapter 5: Sections 5.2, to 5.4.3, 5.7, 5.8,5.9]

06 hours

Teaching-Learning Process for all modules	**Chalk and Talk/Power Point presentation/YouTube videos.**

Practical Based learning

Simulink models for Image processing

Course Outcomes:

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

1. Understand image formation and the role of human visual system plays in perception of gray andcolor image data.
2. Apply image processing techniques in spatial domains.
3. Apply image processing techniques in frequency (Fourier) domains.
4. Conduct independent study and analysis of Image Enhancement techniques.
5. Summarize Image Restoration using Degradation Models.

Assessment Details (both CIE and SEE)

Component		**Weightage (%)**		
CIE's	CIE 1 5th week	20	60	Average of 3 tests for 20 marks
	CIE 2 10th week	20		
	CIE 3 15th week	20		
AAT's	AAT-1 10th week			10
	Lab Test	30		Reduced to 10
	Lab Record	20		10
Continuous Internal Evaluation Total Marks :100. Reduced to 50 Marks				
Semester End Examination (SEE) Total Marks :100. Reduced to 50 Marks				

Suggested Learning Resources:

Text Book:

Digital Image Processing- Rafael C Gonzalez and Richard E Woods, PHI, 3rd Edition, 2010.

Reference Books:

1. Digital Image Processing- S Jayaraman, S Esakkirajan, T Veerakumar, Tata McGraw Hill, 2014.
2. **Fundamentals of Digital Image Processing- A K Jain, PHI Learning Private Limited 2014.**

E-Resources:

Web links and Video Lectures (e-Resources)

- Image databases, https://imageprocessingplace.com/root_files_V3/image_databases.htm
- Student support materials, https://imageprocessingplace.com/root_files_V3/students/students.htm
- NPTEL Course, Introduction to Digital Image Processing, https://nptel.ac.in/courses/117105079
- Computer Vision and Image Processing, https://nptel.ac.in/courses/108103174
- Image Processing and Computer Vision – Matlab and Simulink, https://in.mathworks.com/solutions/image-video-processing.html

Activity-BasedLearning(SuggestedActivitiesinClass)/Practical-Based Learning

- Simulink models for Image processing

CO-PO Mapping:

POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C405.1	1	1	2		--	--	--	--	--	--	--	--
C405C.2	1		2	1	--	--	--	--	--	--	--	--
C405C.3	3	2	1	--	--	--	--	--	--	--	--	--
C405C.4	3	2	2	--	--	--	--	--	--	--	--	--
C405C.5	3	2	2	--	--	--	--	--	--	--	--	--

SEMESTER-VII

Nanotechnology			
Course Code	**21EC744**	**CIE Marks**	**50**
Teaching Hours/Week (L: T: P: S) (3:0:0:0)	**Credits (3:0:0:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40 Hours**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course objectives:

This course will enable students to

1. Understand the basics of top-down and bottom-up fabrication process, devices and Systems
2. Enhance basic engineering science and technical knowledge of nano electronics.
3. Describe technologies involved in modern day electronic devices.
4. Illustrate nano scale effects in electronic devices & quantum level computing
5. Learn the photo physical properties of sensor used in generating a signal.

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various techniques.
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem-Based Learning (PBL), which fosters students' Analytical skills, and develops thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Topics will be introduced in multiple representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the student's understanding.

Module-1

Introduction to nanotechnology: Impacts, Limitations of conventional microelectronics, Trends in microelectronics and optoelectronics, mosfet basics and operation characteristic lengths in mesoscopic systems, Classification of Nano structures, Low dimensional structures Quantum wells, wires and dots, Density of states and dimensionality Basic properties of two dimensional semiconductor nanostructures, square quantum wells of finite depth, parabolic and triangular quantum wells Quantum wires and quantum dots, carbon nano tube, graphene

08 Hours

Module-2

Fabrication techniques: Different approaches, physical vapour deposition, chemical vapour deposition Molecular Beam Epitaxy, Ion Implantation, Formation of Silicon Dioxide- dry and wet oxidation methods Fabrication of nano particle- grinding with iron balls, laser ablation , reduction methods, sol gel, self-assembly, precipitation of quantum dots.

08 Hours

Module-3

Characterization of Nanomaterials: Tools used for of nano materials characterization, microscope-optical, electron, and electron microscope. Principle of operation of Scanning Tunnelling Microscope, Atomic Force Microscope, Scanning Electron microscope, Specimen interaction. Transmission Electron Microscope X-Ray Diffraction analysis, PL & UV Spectroscopy, Particle size analyzer.

08 Hours

Module-4

Free and confined electrons: Free electrons, Periodic boundary conditions, Electrons Confined to a Bounded Region of Space, and Quantum Numbers, Fermi level and Chemical potential, Partially Confined Electrons- Finite Potential Wells, Quantum Dots, Wires, and Wells, Simulation examples. (Ref 1: Chapter 4)

08 Hours

Module-5

Nano electronic devices: MODFETS, hetero junction bipolar transistors Resonant tunnel effect, RTD, RTT, Hot electron transistors Coulomb blockade effect and single electron transistor, CNT transistor's Hetero structure semiconductor laser Quantum well laser, quantum dot LED, quantum dot laser Quantum well optical modulator, quantum well sub band photo detectors, principle of NEMS

08 Hours

Teaching-Learning Process for all modules	**Chalk and Talk/PowerPoint presentation/YouTube videos.**

Course Outcomes:

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

1. Illustrate the principles behind Nano science engineering and Nano electronics.
2. Explain the effect of particles size on mechanical, thermal, optical and electrical properties of nano materials.
3. Apply the knowledge to prepare and characterize nano materials.
4. Evaluate nano scale effects in futuristic electron devices & quantum level computing
5. Analyze the process flow required to fabricate state-of-the-art transistor technology

Assessment Details (both CIE and SEE)

Component		**weightage (%)**	
CIE's	CIE 1- At the end of t h e week	20	60
	CIE 2 - At the end of the 10th week	20	
	CIE 3 - At the end of the 15th week	20	
AAT's	AAT-1- At the end of the 4th week	10	40
	AAT-2- At the end of t h e 9th week	10	
	AAT-3- At the end of t h e 13th week	20	
Continuous Internal Evaluation Total Marks: 100. Reduced to 50 Marks			
Semester End Examination (SEE) Total Marks: 100. Reduced to 50 Marks			

Suggested Learning Resources:

Text Books:

1. J.M. Martinez-Duart, R.J. Martin Palma, F. Agulle Rueda Nanotechnology for Microelectronics and optoelectronics, Elsevier, 2006, ISBN 9780080445533.
2. W.R. Fahrner, Nanotechnology and Nanoelctronics, Springer, 2005, ISBN 9783540266211.
3. Nanoelectronics and Information Technology, Rainer Waser, Wiley VCH; 3rdRevised edition (2012), ISBN: 978-3527409273

Reference Books:

4. Chattopadhyay, Banerjee, Introduction to Nano science & Technology, PHI, 2012, ISBN-13: 978- 8120336087.
5. George W. Hanson, Fundamentals of Nano electronics, Pearson Education, 2009, ISBN-13: 9780.1B.
6. K. Goser, P. Glosekotter, J. Dienstuhl, Nano electronics and nano systems, Springer 2004, ISBN 978- 3-662-05421-5.

E-Resources:

1. https://www.sciencedirect.com/topics/materials-science/nanoelectronics

2. https://www.circuitstoday.com/nanoelectronics

CO- PO Mapping:

POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C405. D.1	3	3	2	1	1	--	--	--	--	--	1	--
C405. D.2	3	2	2	1	1	--	--	--	--	--	1	--
C405. D.3	3	3	2	1	1	--	--	--	--	--	1	1
C405. D.4	3	3	2	1	--	--	--	--	--	--	--	--
C405. D.5	3	3	2	1	1	--	--	--	--	1	1	1

SEMESTER-VII

E-Waste Management			
Course Code	**21EC745**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P:S) (3:0:0:0)	**Credits (3:0:0:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40 hours**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course objectives:

This course will enable students to:

1. Know the current status about a large quantity of e-waste being generated each year, the future of e-waste recycling in India. The E-waste (Management) Rules, 2016, enacted on October 1, 2017, added over 21 products (Schedule-I) under the purview of the rule.
2. Review of e-waste management in India, with a focus on the evolution of legal frame works in India and the world, it presents impacts and outcomes; challenges and opportunities; and management strategies and practices to deal with e-waste.
3. It also includes a survey of pan-India initiatives and trajectories of law-driven initiatives for effective e-waste management along with responses from industries and producers.
4. Understand considerable scope for e-waste recycling in India. It is not only a solution to help mitigate e-waste management issues, but it also helps to generate employment.
5. With the rise in e-waste recycling plants, the demand for employees with all levels of qualification and skills also increases.

Teaching-Learning Process (General Instructions)

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

- Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
- Show Video/animation films to explain the functioning of various techniques.
- Encourage collaborative(Group)Learning in the class
- Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
- Adopt Problem Based Learning (PBL), which fosters students Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze in formation rather than simply recall it.
- Topics will be introduced in multiple representations.
- Discusshoweveryconceptcanbeappliedtotherealworld-andwhenthat'spossible,ithelpstoimprovethe students' understanding.
- Arrange visits to nearby industries to give industry exposure.

Module-1

Sustainable development and e-waste management: Importance of electrical and electronic equipment in a nation's development, and e-waste as toxic companion of digital era, Let's understand e-waste, E-waste statistics: quantities, collection and recycling, E-waste categories and harmonizing statistics, Indian scenario: e-waste generation, collection and recycling.

Text Book 1 – Chapter 1

08 Hours

Module-2

Extended producer responsibility: a main stay for e-waste management: Evolution of concept of extended producer responsibility, EPR applied for waste management and extended fore-waste management, EPR: goals, implementation, and challenges for e-waste management, Challenges in implementation of EPR fore-waste management, Impact of EPR, EPR and e-waste management in India. **Toxicity and impacts on environment and human health**: Toxicity, recycling, and regulations, I: Environmental concerns, II: Human health concerns.

Text Book 1- Chapter 2 and 3

08 Hours

Module-3

Treating e-waste, resource efficiency, and circular economy: Safe environment, resource use, and circular economy,

Circular economy: recycling, resource recovery, and resource efficiency, Potentials of urban mining in circular economy, Recycling and resource efficiency related challenges to the circular economy, Urban mining, recycling, resource use, resource efficiency, and circular economy in India.

E-waste management through legislations in India: I: Historical backdrop of regulatory regime fore-waste in India, II: E-waste (management) Rules, 2016 and E-waste (management) Amendment Rules, 2018.

Text Book 1: Chapter 4 and 5

08 Hours

Module-4

Strategies and initiatives for dealing with e-waste in India: I: Overview of pan-India initiatives for dealing with e-waste during 2000 and 2012, II: Law-driven e-waste management – initiatives by the government, non-government agencies, and judiciary.

Text Book 1: Chapter 4 and 5

08 Hours

Module-5

Moving towards horizons: I: Legal and judicial domain, II: Economic concerns III: Environment concerns, IV: Recycling culture/recycling society.

Text Book 1: Chapter 4 and 5

08 Hours

Teaching-Learning Process for all modules	**Chalk and Talk/Power Point presentation/YouTube videos.**

Course Outcomes

1.Understand the existing discourse on e-waste and its management, statistics, opportunities, and challenges w.r.t. regulatory framework, SDGs, CE, and LCIA (Life Cycle Impact Assessment) and MFA (Material Flow Analysis), Indian scenario.

2. Describe EPR, a regulatory framework for achieving specified goals and impacts on environment and human health.

3. Explain Urban mining, financial support for recycling infrastructure building, e-waste management which have been incorporated in the existing regulatory framework in comparison with India & international legislatures.

4. Identify and infer pan-Indian initiatives dealing with E-waste management & Analyse roadmap for the Agenda 2030.

5.Use opportunities and challenges around legal and judicial domain; economic concerns; recycling culture/society; and environment concerns.

Assessment Details (both CIE and SEE)

Component		**Weightage (%)**	
CIE's	CIE 1-At the end of5thweek	20	60
	CIE2 –At the end of 10th week	20	
	CIE3 –At the end of 15th week	20	
AAT's	AAT-1-At the end of 4thweek	10	40
	AAT-2-At the end of 9thweek	10	
	AAT-3-At the end of 13thweek	20	
Continuous Internal Evaluation Total Marks: 100 Reduced to 50 Marks			
Semester End Examination (SEE) Total Marks: 100 Reduced to 50 Marks			

Suggested Learning Resources:

Text Books:

Varsha Bhagat Gangulay, 'E-Waste Management', Taylor and Francis, 2022.

E-Resources:

- https://link.springer.com/book/10.1007/978-3-030-14184-4
- https://rajyasabha.nic.in/rsnew/publication_electronic/E-Waste_in_india.pdf
- https://greene.gov.in/wp-content/uploads/2018/01/E-waste-Vol-II-E-waste-Management-Manual.pdf
- https://nptel.ac.in/courses/105105169

Activity Based Learning (Suggested Activities in Class)/Practical Based learning

• Groups can be made to conduct a survey on the present scenario of India and top 5 countries facing e- waste management challenges.

• Industry visits to give an exposure of the e-waste management process and also business.

• Case studies to develop e-waste management models.

• Survey of few e-waste management companies can be carried out and submit report.

CO-PO Mapping:

POS / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C405.E.1	-	-	-	-	-	2	3	3	2	1	-	2
C405.E.2	-	-	-	-	-	1	3	2	1	1	1	1
C405.E.3	-	-	-	-	-	3	3	2	1	1	1	1
C405.E.4	-	-	-	-	-	3	3	1	1	1	-	3
C405.E.5	-	-	-	-	-	-	3	3	1	1	2	2