Sri Krishna College of Engineering and Technology

An Autonomous Institution, Affiliated to Anna University

Coimbatore – 641 008

CURRICULUM AND SYLLABI

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING

Regulation 2022

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

VISION AND MISSION OF THE INSTITUTION

Vision

To Produce Globally Competitive Engineers with High Ethical Values and Social Responsibilities.

Mission

- To impart the highest quality state-of-the-art technical education by providing impetus to innovation, research, and development and empowering students with entrepreneurship skills.
- To instill ethical values, imbibe a sense of social responsibility, and strive for societal well-being.
- To identify the needs of society and offer sustainable solutions through outreach programs.

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

VISION AND MISSION OF THE DEPARTMENT

VISION

To equip future engineers with high academic knowledge, ethical values, leadership skills and a passion to contribute to the society.

MISSION

- ➢ **To provide quality and contemporary education in Electronics and Communication Engineering through continuous upgradation of Curriculum and laboratory facilities, industrial collaboration and effective teaching learning process.**
- ➢ **To facilitate research activities and entrepreneurship skills to cope up with the changes in industrial demand and meet the global and societal needs.**
- ➢ **To inculcate professional attitude and ethical values.**

PROGRAMME OBJECTIVES (POs)

At the time of their graduation students of Electronics and Communication Engineering Programme should be in possession of the following Programme Outcomes

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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

PO4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

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

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

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

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

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

PO12. Life-long learning: 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.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

The following Programme Educational Objectives are designed based on the department mission

PEO1: Exhibit technical competence in Electronics and Communication Engineering by providing innovative engineering solutions and excel in professional career.

PEO2: Indulge in problem identification, analysis and formulation to provide technically superior, economically feasible, environmentally compatible and socially acceptable design solutions.

PEO3: Contribute towards entrepreneurship and research, and exercise leadership through effective communication, teamwork and knowledge upgradation through lifelong learning.

PROGRAMME SPECIFIC OUTCOMES (PSO)

On successful completion of Bachelor of Engineering in Electronics and Communication Engineering Programme from Sri Krishna College of Engineering and Technology, the graduate will demonstrate:

PSO1: Potential to analyse, design, synthesize and provide technical solutions in the field of VLSI, Embedded Systems and Communication Networks.

PSO2: Emerge as ethical leaders, excel in research, engage in lifelong learning, pursue entrepreneurship and contribute towards the field of Electronics and Communication Engineering.

Mapping of PO's to PEO's

Programme Educational Objectives	Programme Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
PEO 1	3	3	3	3	2	2	2	1	1	1	1	2
PEO 2	3	3	3	3	3	3	3	1	1	1	1	2
PEO 3	1	1	1	1	1	2	1	3	3	3	3	1

1	Reasonably agreed	2	Moderately agreed	3	Strongly agreed

REGULATION 2022

YEAR	SEM	COURSES	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PS0 2
I	I	ENGINEERING BIOLOGY	2	2	2	2	1	-	-	-	-	-	-	2	2	1
		CALCULUS AND TRANSFORMS I	2	2	2	-	-	-	-	-	-	-	-	-	2	-
		CIRCUIT THEORY	3	3	3	2	2	-	-	-	-	-	-	2	2	1
		TECHNICAL COMMUNICATION SKILLS	-	-	-	-	-	-	-	2	-	3	2	3	-	2
		PHYSICS FOR ELECTRONICS	3	2	1	1	-	-	-	-	-	-	-	2	2	1
		PROBLEM SOLVING USING C++	3	3	3	3	3	-	-	-	3	2	-	3	3	2
		MANDATORY COURSE I (INDUCTION PROGRAM)	-	-	-	-	-	-	-	3	3	-	-	-	1	-
	II	UNIVERSAL HUMAN VALUES	-	-	-	-	-	3	3	3	3	-	2	-	-	3
		HERITAGE OF TAMILS	-	-	-	-	-	-	-	1	1	-	-	1	-	-
		CALCULUS AND TRANSFORMS II	2	2	2	-	-	-	-	-	-	-	-	-	2	-
		ELECTRON DEVICES	2	2	2	1	-	-	-	-	-	-	-	1	3	1
		ENGINEERING CHEMISTRY	3	3	2	1	1	-	-	-	-	-	-	1	-	1
		JAVA PROGRAMMING	3	3	3	-	2	-	-	2	2	2	-	3	2	2
		DATABASE MANAGEMENT SYSTEMS	3	3	3	2	2	-	-	-	2	2	2	3	3	2
		CIRCUITS AND DEVICES LABORATORY	3	2	2	3	2	-	-	-	2	2	3	2	3	1
		MANDATORY COURSE II (ENVIRONMENTAL SCIENCES)	-	-	-	-	-	3	3	-	-	-	-	-	2	2
II	III	TAMILS AND TECHNOLOGY	-	-	-	-	-	-	-	-	-	1	-	1	-	1
		ELECTRONIC CIRCUITS	3	3	2	2	2	-	-	-	1	1	-	-	2	-
		DIGITAL ELECTRONICS	3	2	2	1	-	-	-	-	1	-	-	-	2	-
		ELECTROMAGNETICS	3	3	3	2	-	-	-	-	-	-	-	-	2	-
		PROBABILITY AND RANDOM PROCESSES	3	3	-	-	-	-	-	-	-	-	-	-	1	-
		ADVANCED JAVA PROGRAMMING	3	3	3	2	3	-	-	-	2	2	-	2	3	3
		DATA STRUCTURES AND ALGORITHMS	3	3	3	3	3	-	-	-	2	1	-	2	3	2
		DIGITAL ELECTRONICS LABORATORY	3	3	1	2	1	-	-	-	1	1	-	-	3	-
		MANDATORY COURSE III	-	-	-	-	-	3	3	-	-	-	-	-	2	2
	IV	PRINCIPLES OF MANAGEMENT	-	-	-	-	-	-	-	2	3	2	3	2	2	2
		SIGNALS AND SYSTEMS	3	3	3	3	2	-	-	-	2	-	-	1	3	1
		ANALOG AND DIGITAL COMMUNICATION	3	3	3	2	3	-	-	-	-	-	-	-	2	1

R2022   Department of Electronics and Communication Engineering

Year	Sem	Course	1	2	3	4	5	6	7	8	9	10	11	12	13	14
		ANALOG INTEGRATED CIRCUITS	1	2	2	2	1	2	-	-	1	1	-	-	2	-
		APPLICATION DEVELOPMENT PRACTICES	3	2	3	3	2	-	-	-	1	-	-	1	3	1
		CIRCUITS LABORATORY	3	2	3	3	2	-	-	-	1	-	-	1	3	1
		ANALOG AND DIGITAL COMMUNICATION LABORATORY	1	2	3	3	2	-	-	-	-	-	-	1	3	-
		MINI PROJECT	3	3	3	3	3	3	3	3	3	3	3	3	3	3
III	V	MICROCONTROLLERS AND INTERFACING	1	1	2	2	-	-	-	-	1	-	-	1	2	1
		DATA AND WIRELESS NETWORKS	1	2	1	2	3	-	-	-	2	2	-	-	3	-
		DIGITAL SIGNAL PROCESSING	3	3	3	2	2	-	-	-	-	-	-	1	2	1
		CONTROL ENGINEERING	3	3	2	2	3	-	-	-	-	-	-	1	3	1
		DIGITAL SIGNAL PROCESSING LABORATORY	3	3	3	2	2	-	-	-	-	1	1	1	3	1
		MICROCONTROLLERS LABORATORY	2	1	2	2	2	-	-	-	3	-	-	1	2	1
	VI	EMBEDDED SYSTEMS AND ITS APPLICATIONS	2	3	3	2	1	-	-	-	-	-	-	3	3	2
		ANTENNAS AND WAVE PROPAGATION	3	2	2	2	-	-	-	-	2	2	-	2	-	2
		VLSI DESIGN	3	3	3	2	1	-	-	-	2	1	2	-	3	-
		EMBEDDED SYSTEMS LABORATORY	2	1	2	2	2	-	-	-	3	-	-	1	2	1
		VLSI DESIGN LABORATORY	3	3	3	2	2	-	-	-	1	1	1	1	3	1
IV	VII	MICROWAVE AND OPTICAL COMMUNICATION	3	3	3	2	-	-	-	-	1	-	-	1	3	1
		FUNDAMENTALS OF NETWORK SECURITY	3	3	2	1	-	1	1	1	-	2	-	3	3	2
		MICROWAVE AND OPTICAL COMMUNICATION LABORATORY	3	3	2	1	-	-	-	-	-	-	-	2	3	2
		MINI PROJECT														
	VIII	PROJECT	3	3	3	3	3	3	3	3	3	3	3	3	3	3

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING
REGULATION 2022
CHOICE BASED CREDIT SYSTEM
I – VIII SEMESTER CURRICULUM AND SYLLABI

SEMESTER I

SL. No.	Course Code	Course	L/T/P	Contact hrs./wk.	C	Ext./Int.	Cat.
1	22SB101	Engineering Biology	2/0/0	2	2	60/40	BSC
2	22MA104	Calculus and Transforms I	3/1/0	4	4	60/40	BSC
3	22EC101	Circuit Theory	3/0/0	3	3	60/40	ESC
4	22EN101	Technical Communication Skills	2/0/2	4	3	50/50	HSMC
5	22PH101	Physics for Electronics	3/0/2	5	4	50/50	BSC
6	22CS101	Problem Solving using C++	3/0/2	5	4	50/50	ESC
7	22MC101	Mandatory Course I (Induction Programme)	3 weeks		0	0/100	MC
		TOTAL	**16/1/6**	**23**	**20**	**700**	

SEMESTER II

SL. No.	Course Code	Course	L/T/P	Contact hrs./wk.	C	Ext./Int.	Cat.
1	22GE201	Universal Human Values	3/0/0	3	3	60/40	HSMC
2	22TA101	Heritage of Tamils	1/0/0	1	1	60/40	HSMC
3	22MA304	Calculus and Transforms II	3/1/0	4	4	60/40	BSC
4	22EC201	Electron Devices	3/0/0	3	3	60/40	ESC
5	22CH101	Engineering Chemistry	3/0/2	5	4	50/50	BSC
6	22AD201	Java Programming	3/0/2	5	4	50/50	ESC
7	22IT201	Database Management Systems	3/0/2	5	4	50/50	ESC
8	22EC202	Circuits and Devices Laboratory	0/0/3	3	1.5	40/60	ESC
9	22MC102	Mandatory Course II (Environmental Sciences)	1/0/0	1	0	0/100	MC
		TOTAL	20/1/9	**30**	**24.5**	**900**	

SEMESTER III

SL. No.	Course Code	Course	L/T/P	Contact hrs./wk.	C	Ext./Int.	Cat.
1	22TA201	Tamils and Technology	1/0/0	1	1	60/40	HSMC
2	22EC301	Electronic Circuits	3/0/0	3	3	60/40	PCC
3	22EC302	Digital Electronics	3/0/0	3	3	60/40	PCC
4	22EC303	Electromagnetics	3/0/0	3	3	60/40	PCC
5	22MA307	Probability and Random Processes	3/1/0	4	4	60/40	BSC
6	22CS301	Advanced Java Programming	1/0/4	5	3	50/50	ESC
7	22CS201	Data Structures and Algorithms	1/0/4	5	3	50/50	ESC
8	22EC304	Digital Electronics Laboratory	0/0/2	2	1	40/60	PCC
9	22MCXXX	Mandatory Course III	1/0/0	1	0	0/100	MC
		TOTAL	16/1/10	**27**	**21**	**900**	

SEMESTER IV

SL. No.	Course Code	Course	L/T/P	Contact hrs./wk.	C	Ext./Int.	Cat.
1	22MG701	Principles of Management	3/0/0	3	3	60/40	HSMC
2	22EC401	Signals and Systems	3/0/0	3	3	60/40	PCC
3	22EC402	Analog and Digital Communication	3/0/0	3	3	60/40	PCC
4	22EC403	Analog Integrated Circuits	3/0/0	3	3	60/40	PCC
5	22IT101	Application Development Practices	1/0/4	5	3	50/50	ESC
6	22XXXX	Open Elective-I	1/0/4 Or 3/0/0	5 Or 3	3	60/40	OEC
7	22EC404	Circuits Laboratory	0/0/3	3	1.5	40/60	PCC
8	22EC405	Analog and Digital Communication Laboratory	0/0/2	2	1	40/60	PCC
9	22EC406	Mini Project	0/0/4	4	2	40/60	PROJ
10	22MCXXX	Mandatory Course IV	1/0/0	1	0	0/100	MC
		TOTAL	15/0/17 or 17/0/13	**32 or 30**	**22.5**	**1000**	

SEMESTER V

SL. No.	Course Code	Course	L/T/P	Contact hrs./wk.	C	Ext./Int.	Cat.
1	22EC501	Microcontrollers and Interfacing	3/0/0	3	3	60/40	PCC
2	22EC502	Data and Wireless Networks	3/0/0	3	3	60/40	PCC
3	22EC503	Digital Signal Processing	4/0/0	4	4	60/40	PCC
4	22EC9XX	Professional Elective-1	3/0/0	3	3	60/40	PEC
5	22EE511	Control Engineering	4/0/0	4	4	60/40	ESC
6	22EC504	Digital Signal Processing Laboratory	0/0/2	2	1	40/60	PCC
7	22EC505	Microcontrollers Laboratory	0/0/2	2	1	40/60	PCC
8	22XXXX	Open Elective-2	0/0/6 or 3/0/0	6 Or 3	3	40/60	OEC
		TOTAL	17/0/10 or 20/0/4	**27 or 24**	**22**	**800**	

SEMESTER VI

SL. No.	Course Code	Course	L/T/P	Contact hrs./wk.	C	Ext./Int.	Cat.
1	22EC9XX	Professional Elective-2	3/0/0	3	3	60/40	PEC
2	22EC601	Embedded Systems and its Applications	3/0/0	3	3	60/40	PCC
3	22EC602	Antenna and Wave Propagation	4/0/0	4	4	60/40	PCC
4	22EC603	VLSI Design	4/0/0	4	4	60/40	PCC
5	22XXXX	Emerging Elective-1	3/0/0	4	3	60/40	EEC
6	22EC604	Embedded Systems Laboratory	0/0/2	2	1	40/60	PCC
7	22EC605	VLSI Design Laboratory	0/0/2	2	1	40/60	PCC
8	22XXXX	Open Elective-3	0/0/6 or 3/0/0	6 or 3	3	40/60	OEC
		TOTAL	17/0/10 or 20/0/4	28 or 25	**22**	**800**	

SEMESTER VII

SL. No.	Course Code	Course	L/T/P	Contact hrs./wk.	C	Ext./Int.	Cat.
THEORY							
1	22EC701	Microwave and Optical Communication	3/0/0	3	3	60/40	PCC
2	22EC702	Fundamentals of Network Security	3/0/0	3	3	60/40	PCC
3	22EC9XX	Professional Elective-3	3/0/0	3	3	60/40	PEC
4	22EC9XX	Professional Elective-4	3/0/0	3	3	60/40	PEC
5	22EC9XX	Professional Elective-5	3/0/0	3	3	60/40	PEC
6	22EC9XX	Professional Elective-5	3/0/0	3	3	60/40	PEC
7	22EC703	Microwave and Optical Communication Laboratory	0/0/2	2	1	40/60	PCC
8	22EES01	Employability Enhancement Skills (Summer Internship/Summer Training – 4 weeks)			2	0/100	
		TOTAL	18/0/2	**20**	**21**	**800**	

SEMESTER VIII

SL. No.	Course Code	Course	L/T/P	Contact hrs./wk.	C	Ext./Int.	Cat.
PROJECT							
1.	22EC801	Project Work	0/0/24	24	12	40/60	PROJ
		TOTAL	0/0/24	24	12	500	

SCHEME OF CREDIT DISTRIBUTION - SUMMARY

SL. No.	Stream	Credits/Semester								AICTE	C
		I	II	III	IV	V	VI	VII	VIII		
1	Humanities (HSMC)	3	4	1	3					15*	11
2	Basic Sciences (BSC)	10	8	4						23*	22
3	Engineering Sciences (ESC)	7	12.5	6	3	4				17*	32.5
4	Professional Core (PCC)			10	11.5	12	13	7		61*	53.5
5	Professional Electives (PEC)					3	3	12		12*	18
6	Open Electives/ Emerging Electives (OEC/EEC))				3	3	6			12*	12
7	Project Work (PROJ)				2				12	20*	14
8	Mandatory Course (MC)									Non-Credit	Non-Credit
9	Employability Enhancement Skills							2		-	2
	Total	**20**	**24.5**	**21**	**22.5**	**22**	**22**	**21**	**12**	**160***	**165**

HUMANITIES & SOCIAL SCIENCES INCLUDING MANAGEMENT (11 Credits)

SL. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Cat.
1.	22EN101	Technical Communication Skills	2/0/2	4	3	HSMC
2.	22GE201	Universal Human Values	3/0/0	3	3	HSMC
3	22TA101	Heritage of Tamils	1/0/0	1	1	HSMC
4	22TA201	Tamils and Technology	1/0/0	1	1	HSMC
5	22MG701	Principles of Management	3/0/0	3	3	HSMC

BASIC SCIENCE COURSES (22 Credits)

SL. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Cat.
1	22SB101	Engineering Biology	2/0/0	2	2	BSC
2	22MA104	Calculus and Transforms I	3/1/0	4	4	BSC
3	22PH101	Physics for Electronics	3/0/2	5	4	BSC
4	22CH101	Engineering Chemistry	3/0/2	5	4	BSC
5	22MA304	Calculus and Transforms II	3/1/0	4	4	BSC
6	22M307	Probability and Random Processes	3/1/0	4	4	BSC

ENGINEERING SCIENCE COURSES (32.5 Credits)

SL. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Cat.
1.	22EC101	Circuit Theory	3/0/0	3	3	ESC
2.	22CS101	Problem Solving using C++	3/0/2	5	4	ESC
3.	22EC201	Electron Devices	3/0/0	3	3	ESC

4.	22AD201	Java Programming	3/0/2	5	4	ESC
5.	22IT201	Database Management Systems	3/0/2	5	4	ESC
6.	22EC202	Circuits and Devices Laboratory	0/0/2	2	1.5	ESC
7.	22CS201	Data Structures and Algorithms	3/0/2	5	4	ESC
8.	22CS302	Advanced Java Programming	1/0/4	5	3	ESC
10.	22IT101	Application Development Practices	1/0/4	5	3	ESC
11	22EE511	Control Engineering	4/0/0	4	4	ESC

PROFESSIONAL CORE COURSES (53.5 Credits)

SL. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Cat.
1.	22EC301	Electronic Circuits	3/0/0	3	3	PCC
2.	22EC302	Digital Electronics	3/0/0	3	3	PCC
3.	22EC303	Electromagnetics	3/0/0	3	3	PCC
4	22EC304	Digital Electronics Laboratory	0/0/2	2	1	PCC
5.	22EC401	Signals and Systems	3/0/0	3	3	PCC
6.	22EC402	Analog and Digital Communication	3/0/0	3	3	PCC
7	22EC403	Analog Integrated Circuits	3/0/0	3	3	PCC
8.	22EC404	Circuits Laboratory	0/0/3	3	1.5	PCC
9.	22EC405	Analog and Digital Communication Laboratory	0/0/2	2	1	PCC
10.	22EC501	Microcontrollers and Interfacing	3/0/0	3	3	PCC
11.	22EC502	Data and Wireless Networks	3/0/0	3	3	PCC
12.	22EC503	Digital Signal Processing	4/0/0	4	4	PCC
13.	22EC504	Digital Signal Processing Laboratory	0/0/2	2	1	PCC
14	22EC505	Microcontrollers Laboratory	0/0/2	2	1	PCC
15	22EC601	Embedded Systems and its Applications	3/0/0	3	3	PCC
16	22EC602	Antenna and Wave Propagation	4/0/0	4	4	PCC
17	22EC603	VLSI Design	4/0/0	4	4	PCC
18	22EC604	Embedded Systems Laboratory	0/0/2	2	1	PCC
19	22EC605	VLSI Design Laboratory	0/0/2	2	1	PCC
20	22EC701	Microwave and Optical Communication	3/0/0	3	3	PCC
21	22EC702	Fundamentals of Network Security	3/0/0	3	3	PCC
22	22EC703	Microwave and Optical Communication Laboratory	0/0/2	2	1	PCC

PROFESSIONAL ELECTIVE COURSES (18 Credits)

SL. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Cat.
		Elective Stream I: Embedded Systems				
1	22EC901	Embedded Processors	3/0/0	3	3	PEC
2	22EC902	ARM Processor Architecture and Programming	3/0/0	3	3	PEC
3	22EC903	Real Time Operating Systems	3/0/0	3	3	PEC
4	22EC904	Embedded Product Design	3/0/0	3	3	PEC

5	22EC905	Embedded Systems for Edge computing	3/0/0	3	3	PEC
6	22EC906	Microcontroller Based System Design	3/0/0	3	3	PEC
Elective Stream II: VLSI						
1	22EC907	ASIC Design	3/0/0	3	3	PEC
2	22EC908	System on Chip Design	3/0/0	3	3	PEC
3	22EC909	Electronic Design Automation Tools	3/0/0	3	3	PEC
4	22EC910	Low Power VLSI Design	3/0/0	3	3	PEC
5	22EC911	VLSI for Image and Video Processing	3/0/0	3	3	PEC
6	22EC912	Reconfigurable Architectures	3/0/0	3	3	PEC
Elective Stream III – Networks, Image and Video Processing						
1	22EC913	Wireless Sensor Networks	3/0/0	3	3	PEC
2	22EC914	High Speed Networks	3/0/0	3	3	PEC
3	22EC915	Neural Networks and Deep Learning	3/0/0	3	3	PEC
4	22EC916	Digital Image and Video Processing	3/0/0	3	3	PEC
5	22EC917	Pattern Recognition Techniques	3/0/0	3	3	PEC
6	22EC918	Information Security	3/0/0	3	3	PEC
Elective Stream IV – Next Generation Communication Systems						
1	22EC919	Advanced Wireless Technologies	3/0/0	3	3	PEC
2	22EC920	Satellite Communication and GPS	3/0/0	3	3	PEC
3	22EC921	Smart Antennas	3/0/0	3	3	PEC
4	22EC922	Cognitive Radio Networks	3/0/0	3	3	PEC
5	22EC923	Advanced wireless networks for 5G	3/0/0	3	3	PEC
6	22EC924	Signal Integrity in high speed design	3/0/0	3	3	PEC
Elective Stream V – Microelectronics, IC Design and Photonics						
1	23EC925	SOI device modelling and simulation	3/0/0	3	3	PEC
2	23EC926	Architectural Design of Digital Integrated Circuits	3/0/0	3	3	PEC
3	23EC927	IC Design & Technology	3/0/0	3	3	PEC
4	23EC928	Power Semiconductor Devices and Technology	3/0/0	3	3	PEC
5	23EC929	Photonic integrated circuits	3/0/0	3	3	PEC
6	23EC930	Biophotonics and optical sensors	3/0/0	3	3	PEC
Elective Stream VI – Smart Sensor Technologies and Biomedical Engineering						
1	22EC931	Flexible and Wearable Sensors	3/0/0	3	3	PEC
2	22EC932	Sensor Technology	3/0/0	3	3	PEC
3	22EC933	Medical Robotics	3/0/0	3	3	PEC
4	22EC934	Sensors for Industrial Applications	3/0/0	3	3	PEC
5	22EC935	Biomaterials and its Applications	3/0/0	3	3	PEC
6	22EC936	Ergonomics	3/0/0	3	3	PEC

OPEN ELECTIVE COURSES (12 Credits)
(Offered to Other Branches)

SL. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Cat.
1.	22EC001	Principles of Cyber Physical Systems	3/0/0	3	3	OEC
2.	22EC002	Introduction to Raspberry Pi and Arduino	3/0/0	3	3	OEC

3.	22EC003	IT Workshop SCILAB/MATLAB	3/0/0	3	3	OEC
4.	22EC004	Brain Computer Interface and its Applications	3/0/0	3	3	OEC
5.	22EC005	Wireless wearable Sensors	3/0/0	3	3	OEC
6.	22EC006	Organizational Behavior	3/0/0	3	3	OEC

EMERGING ELECTIVE COURSES (6 Credits)

SL. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Cat.
1.	22EC007	Robotics	3/0/0	3	3	EEC
2.	22EC008	Augmented and Virtual Reality	3/0/0	3	3	EEC
3.	22EC009	Computer Vision	3/0/0	3	3	EEC
4.	22EC010	Bio – inspired Human Machine Interface	3/0/0	3	3	EEC

MANDATORY COURSES (0 credits)

S.No	CourseCode	Course Title	L/T/P	Contact Hrs/Wk	C	Cat.
1.	22MC101	Induction Program		3 weeks	0	MC
2.	22MC102	Environmental Sciences	1/0/0	1	0	MC
3.	22MC103	Soft Skills	1/0/0	1	0	MC
4.	22MC104	Management Organizational Behavior	1/0/0	1	0	MC
5.	22MC105	General Aptitude	1/0/0	1	0	MC
6.	22MC106	Life Skills and Ethics	1/0/0	1	0	MC
7.	22MC107	Stress Management	1/0/0	1	0	MC
8.	22MC108	Constitution of India	1/0/0	1	0	MC
9.	22MC109	Essence of Indian Traditional Knowledge	1/0/0	1	0	MC

VALUE ADDED COURSES OFFERED BY ECE

SL. No.	Course Code	Course Title	Credits
1.	22VA401	Antenna Design using ANSYS HFSS Tool Flow	1
2.	22VA402	Mastering in MATLAB - Math and Optimization	1
3.	22VA403	The Agriculture Industry in Industry 4.0	1
4.	22VA404	Connecting Technologies With Real World	1
5.	22VA405	Arduino Programming model	1
6.	22VA406	PCB Design for Electronic Circuits	1
7.	22VA407	Energy Harvesting and Security Issues in Cognitive Networks	1

EMPLOYABILITY ENHANCEMENT SKILLS (2 Credits)

S.No	Course Code	Name of the Course	L/T/P	Contact Hrs/Wk	C	Cat.
1.	22EES01	Industrial Practice (14 days- 1 Credit) / Publications in Journals (National / Internation -1 Credit)	-	-	2	EES

SEMESTER WISE CREDIT DISTRIBUTION:-

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	20	24.5	21	22.5	22	22	21	12	165

Total Credits: 165

L: Lecture   **T:** Tutorial   **P:** Practical   **C:** Credit   **Cat.:** Category

HSMC	**:** Humanities and Social Sciences including Management	
BSC	**:** Basic Science Courses	
ESC	**:** Engineering Science Courses	
PCC	**:** Professional Core Courses	
PEC	**:** Professional Elective Courses	

OEC :Open Elective Courses
EEC : Emerging Elective Courses
PROJ : Project Work

MC : Mandatory Course

22SB101	**ENGINEERING BIOLOGY**	**2/0/0/2**

Nature of Course	C (Theory Concept)

Course Objectives:

1	To grasp and apply biological engineering principles, procedures needed to solve real-world problems.
2	To give a basic knowledge of the applications of biological systems in relevant Industries
3	To understand the mutual dependence of modern biology and engineering
4	To give a basic knowledge of artificial organs and physiological assist devices.
5	To understand about the use of various nanomaterials towards biological applications

Course Outcomes:
Upon completion of the course, students shall have ability to

C101.1	Explain the structure of human physiology.	[R]
C101.2	Compare biological and artificial neural networks.	[AN]
C101.3	Understand the basic concepts of brain computer interface	[U]
C101.4	Apply the concept of Brain computer interface in different applications	[AP]
C101.5	Understand the compatibility and functioning of artificial organs inside the human being	[U]
C101.6	Integrate the knowledge core of modern physiological assist device and its functionalities.	[AP]
C101.7	Understand the concepts of Nanomaterials for biotechnology	[U]

Course Contents:

HUMAN PHYSIOLOGY AND ARTIFICIAL ORGANS: **10**
Cell and their structure-Transport of ions through cell - Different systems of human body- Biological neural networks- Artificial neural networks-applications of neural networks - Artificial Kidney-Artificial Pancreas

BCI: **10**
Fundamentals of BCI –Working of BCI – Classification of BCI – measuring of surgical and non-surgical BCI –Neurofeedback Training for BCI Control-signal processing and application.

NANOBIOLOGY: **10**
Introduction to Nanobiology, Nanomaterials for antimicrobialcoatings- medical implants– medical anddefence textiles. Biosensors- biodevices and implantable devices. Nanomaterials fordiagnosis and therapy- Implications of Drug delivery- various forms of nanocarriers -Polymeric Nanoparticles as drug carriers - Drug release mechanism- Targeted drug delivery.

	Total Hours:	**30**

Text Books:

1	Leslie Cromwell.Bomedical Instrumentation and measurements-Prentice Hall,2011
2	Bernhard Graimann,BrendenAllison,GertPfurtscheller, Computer Interfaces:Revolutionizing Human-Computer Interaction, Springer 2010
3.	M Arumugam , Bio medical instrumentation,Anuradha Publications,2002
4.	B. Bhushan, Springer Handbook of Nanotechnology, Springer-Verlag, 2004

Reference Books:

1	Malcom Carpenter, —Textbook of Neuroanatomy‖, Mc. Graw hill Edition, 1996.
2	Biology for Engineers, Arthur T. Johnson, CRC Press, Taylor and Francis, 2011
3	MatewsG.G.,Neurobiology,SecondEdition,Blackwell Science,UK,2000

Web References:

1	https://ocw.mit.edu/courses/biological-engineering/20-010j-introduction-to-

	bioengineering-be-010j-spring-2006/videos/Lecture-1-bioengineering/
2	https://www.technicalsymposium.com/alllecturenotes_biomed.html
3	https://ocw.mit.edu/courses/biology/7-28-molecular-biology-spring-2005/
Online Resources:	
1	https://onlinecourses.nptel.ac.in/noc16_ge03
2	https://onlinecourses.nptel.ac.in/noc17_ge04
3	https://onlinecourses.nptel.ac.in/nanobiotechnology

Continuous Assessment				End Semester Examination	Total
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**	**End Semester Examination**	**Total**
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C101.1, C101.4,	Remember, Apply	Group assignment	20
C101.2	Analyse	Seminar	20
C101.3, C101.7	Understand	Assignment	20
C101.5, C101.6	Understand, Apply	Quiz	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	40	40	40
Understand	40	40	40
Apply	10	10	10
Analyse	10	10	10
Evaluate			
Create			

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Course Articulation Matrix														
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	3	2	1	-	-	-	-	-	-	-	-	1	-	-
2	2	2	1	2	-	-	-	-	-	-	-	2	2	-
3	1	2	1	1	-	-	-	-	-	1	-	1	1	1
4	1	2	1	1	1	-	-	-	1	1	-	2	2	1
5	1	1	2	1	-	-	-	-	-	-	-	3	2	-
6	1	2	2	1	1	-	-	-	-	-	-	2	2	-
7	1	2	2	1	1	-	-	-	-	-	-	2	2	-
1	Reasonably agreed			2	Moderately agreed			3	Strongly agreed					

22MA104	CALCULUS AND TRANSFORMS I (ECE/EEE)	3/1/0/4

Nature of Course	B (100% Analytical)

Course Objectives:

1	To find the solution of ordinary differential equations as most of the engineering problems are characterized in this form.
2	To develop logical thinking and analytical skills in evaluating multiple integrals.
3	To gain knowledge in integrals which are needed in Engineering applications.
4	To acquaint the concepts of vector calculus needed for problems in all engineering disciplines.
5	To impart the knowledge of Laplace transform, to find solutions of initial value problems for linear ordinary differential equations.

Course Outcomes:(Theory)
Upon completion of the course, students shall have ability to

C104.1	Understand the concepts of basic differentiation and Integration.	[R]
C104.2	Understand the concepts of ordinary differential equations and Transform.	[U]
C104.3	Apply the numerical method to solve first order ordinary differential equations.	[AP]
C104.4	Compute the multiple integrals and vector-valued functions to solve real world problems.	[AP]
C104.5	Apply Laplace transform techniques in system modelling, solving boundary value problems.	[AP]

Course Contents:

MODULE 1 - ORDINARY DIFFERENTIAL EQUATIONS
Second and Higher order Linear differential equations with constant coefficients – Euler Cauchy's equation – Legendre's Linear equation – Method of Variation of Parameters – Applications of ODE: Solving electrical circuits – Numerical solution to first order ordinary differential equations: Single step methods: Taylor series method - Modified Euler's Method – Runge-Kutta Method of fourth order - Multistep method: Milne's Predictor- Corrector Method- Adam-Bashforth Predictor- Corrector Method.

MODULE 2 - INTEGRAL CALCULUS
Bernoulli's formula – Gamma function – Double integration in Cartesian coordinates – Area as double integral – Change of order of integration - Triple integration in Cartesian coordinates – Volume as triple integral – Vector integration: Gradient of a scalar point function - Directional derivatives - Divergence and Curl of vector point function – Solenoidal and Irrotational vectors – Green's theorem in a plane, Gauss divergence theorem and Stoke's theorem (Statement only) – Simple applications involving cubes and rectangular parallelepipeds.

MODULE 3 - LAPLACE TRANSFORM
Convergence of Laplace transform – Transform of some standard functions (Ramp signal, Sinusoidal signal, Exponential signal) – Unit step function – Unit Impulse function – Properties – Transforms of Derivatives and Integral functions – Initial and final value theorem – Laplace Transform of periodic functions – Inverse Laplace transform – Partial fraction method – Convolution theorem (Excluding Proof) – Solving second order ordinary differential equations using Laplace transform.

	Total Hours:	**60 Hrs**

Text Books:

1	G.B.Thomas and R.L.Finney, Calculus and Analytic Geometry, 14th Edition, Pearson, Reprint, 2018.
2	Kreyszig. E, "Advanced Engineering Mathematics", 10th Edition, John Wiley and

	Sons (Asia) Limited, Singapore 2018.
3	Grewal. B.S, "Higher Engineering Mathematics", 44th edition, Khanna Publications, Delhi, 2018.
4	Grewal B.S, "Numerical Methods in Engineering & Science with programs in C, C++ & MATLAB", 11th Edition, Khanna Publishers, Delhi, 2013.

Reference Books:

1	Veerarajan. T, "Engineering Mathematics II",Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2018.
2	Glyn James,Advanced Modern Engineering Mathematics, Pearson Education, 4th edition, 2012.
3	N.P.Bali and Dr.ManishGoyal,"A Textbook of Engineering Mathematics", 9th edition, Laxmi publications ltd, 2014.

Web References:

1	https://onlinecourses.nptel.ac.in/noc22_ma72/preview
2	https://onlinecourses.nptel.ac.in/noc22_ma03/preview
3	https://onlinecourses.nptel.ac.in/noc21_ma69/preview
4	https://archive.nptel.ac.in/courses/111/106/111106139/

Online Resources:

1	https://www.coursera.org/learn/ordinary-differential-equations
2	https://www.coursera.org/learn/vector-calculus-engineers
3	https://www.danfleisch.com/laplace/
4	https://www.classcentral.com/course/swayam-laplace-transform-19925

Continuous Assessment				Total Continuous Assessment	End Semester Examination	Total
Formative Assessment	Summative Assessment	Total				
80	120	200		40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C104.1	Remember	Quiz	20
C104.2	Understand	Seminar	20
C104.3-C104.4	Apply	Tutorial	20
C104.3-C104.5	Apply	Assignment	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	30	30	30
Apply	50	50	50
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks			**CA 2 : 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

Course Articulation Matrix														
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
1	1	1	1	-	-	-	-	-	-	-	-	-	1	-
2	1	2	1	-	-	-	-	-	-	-	-	-	2	-
3	3	3	2	-	-	-	-	-	-	-	-	-	2	-
4	1	1	2	-	-	-	-	-	-	-	-	-	1	-
5	2	1	2	-	-	-	-	-	-	-	-	-	2	-
1	Reasonably agreed			2	Moderately agreed			3		Strongly agreed				

22EC101		CIRCUIT THEORY		3/0/0/3

Nature of Course	: G (Theory Analytical)

Course Objectives:

	1	To introduce the various circuit components of an electrical network.
	2	To enable the students to understand and simplify circuits using network theorems.
	3	To impart knowledge on transient circuits
	4	To enable the students to design and develop series and parallel Resonance
	5	To demonstrate the knowledge on coupled circuits

Course Outcomes:

Upon completion of the course, students shall have ability to

C101.1	Recalling the basic circuits laws and the basic concepts of DC &AC circuits	[U]
C101.2	Understand the basic principles of network theorems	[U]
C101.3	Understand the concepts and performance of transient circuits.	[U]
C101.4	Understand the conceptsof resonance and coupling circuits	[U]
C101.5	Apply network theorems and analyse the possibilities of deriving the equivalent circuits	[AP]
C101.6	Analyse RLC circuits and it's the frequency response	[AN]

Course Contents:

Basic Concepts : **15**

Basic Components of electric Circuits, Charge, current, Voltage and Power, Voltage and Current Sources, Ohm's law - Kirchhoff's current law – Kirchhoff's voltage law– series and parallel Connected sources- resistors in series and parallel – voltage and current division– Nodal analysis - The single Node – Pair Circuit - Sinusoidal Steady – State analysis , Characteristics of Sinusoids, mesh analysis – source Transformation –problems on delta wye conversion- - Thevenin and Norton theorem, Maximum power transfer, Superposition theorem, Reciprocity theorem. (Both AC and DC)

Transients & Network Topology: **15**

Capacitor–Inductor–energy storage– Introduction to Laplace Transform - DC Response of an RLcircuits using Laplace Transforms -DC Response of an RC circuits using Laplace Transforms - DC Response of an RLC circuits using Laplace Transforms.

Resonance and coupled circuits: **15**

Phasor relationship for R, L and C – Impedance – admittance, series resonance – parallel resonance – their frequency response, bandwidth and quality factor – self-inductance – magnetically coupled Circuits.

	Total Hours:	**45**

Text Books:

	1	Sudhakar. A and Shyam Mohan. SP "Circuits and Network Analysis & Synthesis"5th edition, Tata McGraw Hill, 2015.
	2	William H.Hayt, JV Jack E.Kemmerly and Steven M. Durbin," Engineering Circuits Analysis", McGraw Hill India, 8h edition, 2014.
	3	Schaum's Series, "Basic Circuit Analysis ",2nd Edition, McGraw Hill India Private Ltd., 2011(Reprint)

Reference Books:

	1	Chakrabati A "Circuit Theory Analysis and Synthesis" Dhanpath Rai & Sons New Delhi 2014
	2	NageswaraRao T "Electric Circuit analysis",A R Publications 2007

Web References:

	1	http://nptel.ac.in/courses/117106101/
	2	http://www.thelearningpoint.net/home/electrical-science-and-engineering/

		circuit-theory
	3	http://www.tina.com/course/coursex
Online Resources:		
	1	https://www.edx.org/course/circuits-electronics-1-basic-circuit

Continuous Assessment			Total Continuous Assessment	End Semester Examination	Total
Formative Assessment	**Summative Assessment**	**Total**			
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C101.1	Understand	Assignment	20
C101.2, C101.5	Understand, Apply	Assignment	20
C101.3, C101.4	Understand	Quiz	20
C101.6	Analyse	Group assignment	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	10	10	10
Understand	40	40	40
Apply	40	40	30
Analyse	10	10	20
Evaluate			
Create			

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Course Articulation Matrix														
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	2	2	2	-	-	-	-	-	-	-	-	-	1	-
2	3	2	1	-	-	-	-	-	-	-	-	-	1	-
3	3	3	2	1	1	-	-	-	-	-	-	-	1	-
4	2	3	3	2	1	-	-	-	-	-	-	2	2	1
5	3	3	2	1	2	-	-	-	-	-	-	3	2	1
6	2	2	3	1	1	-	-	-	-	-	-	1	2	-
1	Reasonably agreed			2	Moderately agreed			3	Strongly agreed					

22EN101	TECHNICAL COMMUNICATION SKILLS (MCT/CIVIL/IT/EEE/ECE/AI&DS/CYBER/CSE/CSD) (SEMESTER I) (MECH- SEMESTER II)	2/0/2/3

Nature of Course	: Theory Skill Based
Pre requisites	Basics of English Language

Course Objectives:

1	To enhance learners' LSRW skills.
2	To develop students' ability to understand the process of communicating and interpreting ideas and human experiences.
3	To facilitate learners to acquire effective technical writing skills.
4	To prepare learners for placement and competitive exams.
5	To facilitate effective language skills for academic purposes and real-life situations.

Course Outcomes:

Upon completion of the course, students shall have ability to

C101.1	Remember language skills for technical communication.	[R]
C101.2	Apply communication skills in a corporate environment.	[AP]
C101.3	Understand and communicate effectively in personal and professional situations.	[AP]
C101.4	Understand and analyse a variety of reading strategies to foster comprehension and to construct meaningful and relevant connections to the text.	[U]
C101.5	Apply technical writing skills to write letters, emails and prepare technical documents.	[AP]

Course Contents:

Module I 10

Introduction-Listening: - Listening to News in NDTV and Times Now Channels. **Speaking**: Introduction to Effective Communication - Barriers to Effective Communication- Tips to develop Communication Skills - Self Introduction - Overview of Business Communication-Short Talk on Business Topics -Impromptu Speaking (Public Speaking) - Non-Verbal Communication-SATORI-Sharing Personal Information-**Reading**: Reading Comprehension- Values and its Importance. **Writing**: SWOT Analysis -Book Review - Movie Review-Vocabulary Building.

Module II 10

Listening: Listening to Specific Information. **Speaking**: Speaking on Specific Information. **Reading**: Skimming and Scanning-Reading Short Texts - Comparing Facts and Figures - Short Stories and Scientific Articles. **Writing**: Good and Bad Writing- Note Making - Writing Formal Letters (Inviting, Accepting and Declining Invitations)- Writing Business Letters (Calling for Quotations, Seeking Clarifications, Placing an Order and Complaint Letter)- Transcoding (Bar chart, Flowchart. Pie chart and Table)-Job Application Letter- Resume Writing.

Module III 10

Listening: Listening to Narrations and Persuasive speech and identifying narrative and persuasive techniques. **Speaking**: 21st Century Skills- Narrative Skills- Leadership- Conflict Resolution-Persuasive Speaking-How to Tell a Story with Charts and Graphs **Reading:**Product Description and Product Review. **Writing**: Email Writing –Advantages and Disadvantages-Circular – Agenda and Minutes of the Meeting - Proofreading- Subject Verb Agreement-Tenses-Active Voice- Passive Voice- Impersonal Passive Voice-Report Phrases – Report Writing.

(**30 Hours**)

Lab Components

1	**Listening Comprehension** **1.News in NDTV and Times Now Channels** **2.Listening to Specific Information**	[AP]
2	**Impromptu Speaking**	[AP]
3	**Reading Comprehension related to Competitive Exams**	[U]
4	**Immersion Activity and Presentation**	[AP]
5	**Group Discussion**	[AP]
6	**Group Assignment – Form an NGO**	[AP]
		30 Hours
	Total Hours:	**30+30=60 Hours**

Text Books:

	1	Basic Communication Skills for Technology, by Andrea J Rutherford, Pearson Publishers.2000
	2	Remedial English Grammar. F.T. Wood. Macmillan.2007
	3	Oxford Guide to Effective Writing & Speaking by John Seely, Oxford University Press.2005
	4	Dr Sumanth S, English for Engineers, Vijay Nicole Imprints Private Limited 2015.
Reference Books:		
	1	Touchstone Student's Book 1 by Michael McCarthy, Jeanne McCarten, Helen Sandiford, Cambridge University Press.2005
	2	Communication Skills. Sanjay Kumar and Pushp Lata. Oxford University Press. 2011.
	3	Touchstone Student's Book 2 by Michael McCarthy, Jeanne McCarten, Helen Sandiford, Cambridge University Press.2015
Web References:		
	1	http://www.academiccourses.com/Courses/English/Business-English
	2	https://www.liveworksheets.com/worksheets/en/English_as_a_Second_Language_(ESL)/Technical_English
Online Resources:		
	1	https://www.coursera.org/specializations/business-english
	2	https://www.businessenglishresources.com/learn-english-for-business/student-section/practice-exercises-new/

Assessment									End Semester ExaminatioConti nuous n	Tot al
Theory				Practical			Tot al (A+ B)	Total Continuo us Assessm ent		
Formativ e Assessm ent	Summati ve Assessm ent	Tot al	Tot al (A)	Formativ e Assessm ent	Summati ve Assessm ent	Tot al (B)				
80	120	20 0	10 0	75	25	10 0	200	50	50	100

Formative Assessment based on Capstone Model - Theory

Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (10%) [80 Marks]
C101.1 C101.2	Remember	Quiz	20
C101.3	Apply	Technical Presentation	20
C101.4	Understand	Reading Comprehension	20
C101.5	Apply	Group Assignment	20

Assessment based on Summative and End Semester Examination - Theory

Bloom's Level	Summative Assessment (15%) [120 Marks]		End Semester Examination (25%) [100 Marks]
	CIA1: (60 Marks)	CIA2: (60 Marks)	
Remember	20	20	20
Understand	40	40	40
Apply	40	40	40
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination - Practical

Bloom's Level	Continuous Assessment (25%) [100 Marks]		End Semester Examination (25%) [100 Marks]
	FA: (75 Marks)	SA: (25 Marks)	
Remember	20	20	20
Understand	30	30	30
Apply	50	50	50
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Course Articulation Matrix

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	-	-	-	-	-	-	-	-	-	3	-	-	-	-
2	-	-	-	-	-	-	-	2	-	3	-	-	-	2
3	-	-	-	-	-	-	-	2	-	3	2	-	-	2
4	-	-	-	-	-	-	-	-	-	3	-	-	-	-
5	-	-	-	-	-	-	-	-	-	3	-	3	-	-
1	Reasonably agreed		2	Moderately agreed		3		Strongly agreed						

22PH101	PHYSICS FOR ELECTRONICS (ECE)	3/0/2/4

Nature ofCourse	E (Theory skill based)
Prerequisites	Nil

Course Objectives:

1	To enable the students to understand the basics of harmonic oscillator and Quantum mechanics.
2	To learn the basic concepts of Electrostatics and Magnetism.
3	To familiarize the principle of Laser and Fiber optics.

Course Outcomes:

Upon completion of the course, students shall have the ability to

C101.1	Understand the physical characteristics of Simple harmonic oscillation	[U]
C101.2	Interpret the central concepts and principles in quantum mechanics, such as the Schrödinger equation and the wave function.	[AP]
C101.3	Describe the basic principles of Electrostatics and magnetism.	[U]
C101.4	Recall the basic concept and applications of laser and fiber optics	[R]
C101.5	Apply the gained knowledge to solve the problem related to their field of study.	[AP]

Course Contents:

Oscillations and Quantum mechanics   **15**

Oscillations: Periodic motion – Simple harmonic motion : characteristics of simple harmonic motion – Simple spring-mass system. Resonance – Damped harmonic oscillator - solution of the differential equation of damped oscillator. Energy considerations, comparison with un-damped harmonic oscillator, logarithmic decrement, relaxation time, quality factor.

*Quantum mechanics:*Planck's quantum theory (Derivation) – Matter waves, de-Broglie wavelength, Heisenberg's uncertainty principle – Schrödinger's wave equation: time independent and time dependent – Physical significance of wave function – Particle in a one dimensional potential box.Quantum Tunneling and applications to Scanning Tunneling Microscope and Tunnel diode.

Electrostatics and Magnetism   **15**

Electrostatics: Introduction to Vector Algebra, Co-ordinate System – Rectangular – Cylindrical – Spherical system, Coordinate transformation between Cartesian and Cylindrical, Coordinate - transformation between rectangular and spherical polar. Introduction to line, Surface and Volume Integrals, Gradient, Divergence and Curl. Coulomb's law – Gauss's law. Applications of Gauss's law - Electric field in infinite line of charge. Magnetism: Definitions of fundamental terms – Biot-Savart law and its application (Magnetic field due to Line charge only) – Ampere's law and its application (line charge only) –Maxwell'sequations in free space and dielectric medium(equations only).

Laser and Fiber optics   **15**

Laser: Characteristics of laser – Principle of spontaneous emission and stimulated emission – Einstein's theory of matter radiation interaction and A and B coefficients (derivation) - Population inversion – Pumping –Types of Laser -Nd-YAG laser, CO_2laser.Applications in Remote sensing, holography and optical switching.

Fiber optics: principle and propagation of light in optical fibers – Numerical aperture and acceptance angle –Classification based on materials - refractive index profile and modes Light detector: PIN photo diode – Applications: optical fiber communication system - Fibre optic sensors: temperature and displacement.

	45 *Hours*

	Lab Component:30 Hours	
1	Determination of frequency of transverse and longitudinal wave modes – Melde's experiment.	[E]
2	Determination of Simple harmonic motion – Simulation lab.	[E]
3	Determination of Planck's Constant.	[E]
4	Determination of Stefan's Constant.	[E]
5	Determination of Magnetic field along the axis of current carrying coil – Stewart and Gee method.	[E]
6	Determination of characteristics of LCR circuits.	[E]
7	Determination of characteristics of RC circuit to find the time constant	[E]
8.	Simulate the design of Faraday's Electromagnetic Induction law	[E]
9.	Determination of wavelength, angle of divergence and coherence length of laser source.	[E]
10.	Determination of numerical aperture and acceptance angle parameter of optical fiber using Laser source.	[E]
Life Skills Experiments		
11.	Determination of pressure required to shut off the fuel pump nozzle.	[E]
12.	Determination of capacitance required to shut off the circuit in a circuit breaker.	[E]
13.	Determination of earth, neutral and phase line in a circuit.	[E]
	Total Hours:	**75**

Text Books:

1	David Halliday, Robert Resnick, Jearl Walker "Fundamentals of Physics" Wileyplus.2018
2	Rajendran, V "Engineering Physics" Mc Graw Hill Publications ltd, New Delhi, 2016.

Reference Books:

1	Avadhanulu M.N., Kshirshagar P.G., Arun MurthyTVS "A Text Book of Engineering Physics"S.Chand& Co Ltd, 2018.
2	David J. Griffiths, "Introduction to Quantum Mechanics", 2nd edition , Cambridge university press, 2017.
3	**Richard P. Feynman. Robert B. Leighton, Matthew Sands** "The Feynman Lectures on Physics Vol. II": The New Millennium Edition.2015
4	Karl F. Renk "Basics of Laser Physics" Springer International Publishing, 2017.
5	Sadiku M H, "Principles of Electromagnetics" , Oxford University Press Inc.,New Delhi,2015

Web References/Online Resources

1	https://nptel.ac.in/courses/115/106/115106119/

2	https://ocw.mit.edu/courses/physics/8-04-quantum-physics-i-spring-2016/lecture-notes/
3	http://www.phys.ufl.edu/~korytov/phy2049/old_notes/all_chapters.pdf
4	nptel.ac.in/courses/108104087
5	https://www.tcd.ie/Physics/research/groups/magnetism/files/lectures/5006/5006-2.pdf
6	https://onlinecourses.nptel.ac.in/noc20_ph07/preview
7	https://courses.minia.edu.eg/Attach/10173P304Laserlectures.pdf
8	https://mrcet.com/downloads/digital_notes/ECE/III%20Year/FIBER%20OPTICAL%20COMMUNICATIONS.pdf

Continuous Assessment							Total (A+B)	Total Continuous Assessment	End Semester Examination	Total
Theory				Practical						
Formative Assessment	Summative Assessment	Total	Total (A)	Formative Assessment	Summative Assessment	Total (B)				
80	120	200	100	75	25	100	200	50	50	100

Formative Assessment based on Capstone Model - Theory			
Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (10%) [80 Marks]
C101.1	Understand	Online Quiz - I	20
C101.2	Apply	Assignment - I	20
C101.3	Understand	Online Quiz - II	20
C101.4	Remember	Assignment - II	20
C101.5	Apply		

Assessment based on Summative and End Semester Examination - Theory			
Bloom's Level	Summative Assessment (15%) [120 Marks]		End Semester Examination (35%) [100 Marks]
	CIA1: (60 Marks)	CIA2: (60 Marks)	

Remember	20	20	20
Understand	50	50	50
Apply	30	30	30
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination - Practical

Bloom's Level	Continuous Assessment (25%) [100 Marks]		End Semester Examination (15%) [100 Marks]
	FA: (75 Marks)	SA: (25 Marks)	
Remember	-	-	-
Understand	20	20	20
Apply	30	30	30
Analyse	25	25	25
Evaluate	25	25	25
Create	-	-	-

Assessment based on Continuous and End Semester Examination								
Continuous Assessment (50%)								End Semester Examination (50%)
CA 1 (100 Marks)			CA 2 (100 Marks)			Practical Exam (100 Marks)		Theory Examination (35%)
SA 1 (60M)	FA 1		SA 2 (60M)	FA 2		FA (75M)	SA (25M)	
	Component-I (20 Marks)	Component-II (20 Marks)		Component-I (20 Marks)	Component-II (20 Marks)			Practical Examination (15%)

Course Articulation Matrix														
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	3	2	-	1	-	-	-	-	-	-	-	1	1	1
2	2	1	-	1	-	-	-	-	-	-	-	1	1	1
3	3	2	-	1	-	-	-	-	-	-	-	2	2	2
4	3	2	1	1	-	-	-	-	-	-	-	2	2	2
5	3	2	1	1	-	-	-	-	-	-	-	1	1	1
1	Reasonably agreed			2	Moderately agreed			3	Strongly agreed					

22CS101		PROBLEM SOLVING USING C++	3/0/2/4
Nature of Course		C (Theory Concept), K (Problem Programming)	

Course Objectives:

1	To learn the fundamental programming concepts and methodologies which are essential to build good C++ programs.
2	To gain knowledge on control structures and functions in C++
3	To provide the basic object-oriented programming concepts and apply them in problem solving.
4	To introduce file streams and operations for storing data permanently.
5	To know generic programming paradigm

Course Outcomes:

Upon completion of the course, students shall have ability to

C101.1	Solve problems using operators and control Statements	[AP]
C101.2	Write C++ programs for processing strings and arrays	[AP]
C101.3	Apply the concepts of pointers and functions in programs.	[AP]
C101.4	Develop C++ programs using various object-oriented concepts to solve real world problems	[A]
C101.5	Implement the concepts on file streams and operations	[AP]

Course Contents:

Module I C++ Programming Fundamentals   15

C vs C++, Basic of OOPS, the main () function, Header files, Basic Input and Output (I/O) using cin and cout, Variable, Constant. **Operators:** Arithmetic Operators, Assignment Operators, Relational Operators, Logical Operators, Bitwise Operators, Other Operators, Operator Precedence. Control Statements: if, if...else and Nested if...else, switch..case, break and continue, Loops - for loop, while loop, do while loop, goto. **Arrays and Strings:** 1D array, 2D array, Strings, String functions. **Function:** Basics, call by value, call by reference & return by reference, Inline function, overloading Functions, inline Functions, Recursive Functions. **Pointers:** Pointer, Dynamic Memory Allocation.

Module II Object Oriented Concepts   15

Classes and Objects, public, private, protected. **Constructors and destructors**: Overloaded Constructor, Copy Constructor, Shallow Copying Deep Copying. **Overloading:** this' Pointer, structs vs Classes, Friends of a class, Operator Overloading, Inheritance, Overloading vs Overriding, Polymorphism, Virtual Functions, Pure Virtual Functions and Abstract Classes.

Module III Files and Generic Programming   15

Abstract Classes as Interfaces, Exception, Files, Streams and I/O, STL, Generic Programming,Lambda Expression.

	Total Hours (Theory)	**45**

Lab Component

S.No	Lab Exercises
1.	Practice of C Programming using Branching and Iterative constructs.

2.	Programs using arrays and strings	
3.	Programs using Functions	
4.	Programs using Structures and Pointers.	
5.	Programs using classes and objects	
6.	Programs using constructor and destructor	
7.	Programs using method overloading, operator overloading and polymorphism concepts.	
8.	Programs using friend class	
9.	Programs using virtual functions and abstract class.	
10.	Programs using inheritance concepts	
11.	Programs using exception handling concept	
12.	Programs using Files.	
13.	Mini project	
	Total	**30**
	Total Hours (45+30)	**75**

Text Books:

1.	E Balagurusamy ,"Object Oriented Programming With C++", 4th Edition, Tata McGraw-Hill Education, 2008.
2.	Yashavant P. Kanetkar, "Let us C++", BPB Publications, 2020
3	M. Sprankle, "Problem Solving and Programming Concepts", 9thEdition, Pearson Education, New Delhi, 2011

Reference Books:

1.	Herbert Schildt, "The Complete Reference C++", 4thEdition,MH,2015
2.	John Hubbard, "Schaum's Outline of Programming with C++", MH,2016

Web References:

1	https://www.geeksforgeeks.org/c-plus-plus/
2	http://web.stanford.edu/class/cs106l/

Online Resources:

1	https://nptel.ac.in/courses/106101208
2	https://www.hackerrank.com/domains/cpp
3	https://codeforces.com/blog/entry/74684
4	https://www.hackerearth.com/practice/notes/tricky-and-fun-programming-in-c/

Continuous Assessment									Total Continuous Assessment	End Semester Examination	Total
Theory				Practical				Total (A+B)			
Formative Assessment	Summative Assessment	Total	Total (A)	Formative Assessment	Summative Assessment	Total (B)					
80	120	200	100	75	25	100	200		50	50	100

Formative Assessment based on Capstone Model - Theory			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (10%) [80 Marks]**
C101.1	Apply	Quiz	**20**
C101.2, C101.3	Apply	Assignment	**20**
C101.4	Analyze	Group Assignment	**20**
C101.5	Apply	Case Study	**20**

Assessment based on Summative and End Semester Examination - Theory			
Bloom's Level	**Summative Assessment (15%) [120 Marks]**		**End Semester Examination (35%) [100 Marks]**
	CIA1: (60 Marks)	**CIA2: (60 Marks)**	
Remember	20	20	20
Understand	40	30	30
Apply	40	50	50
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination - Practical			
Bloom's Level	**Continuous Assessment (25%) [100 Marks]**		**End Semester Examination (15%) [100 Marks]**
	FA: (75 Marks)	**SA: (25 Marks)**	
Remember	10	20	20
Understand	30	20	20
Apply	50	60	60
Analyse	10	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination								
Continuous Assessment (50%)								End Semester Examination (50%)
CA 1 (100 Marks)			CA 2 (100 Marks)			Practical Exam (100 Marks)		Theory Examination (35%) Practical Examination (15%)
SA 1 (60M)	FA 1		SA 2 (60M)	FA 2		FA (75M)	SA (25M)	
	Component -I (20 Marks)	Component -II (20 Marks)		Component -I (20 Marks)	Component -II (20 Marks)			

Course Articulation Matrix														
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	3	3	-	-	-	-	-	-	-	-	-	-	3	-
2	3	3	3	2	2	-	-	-	2	1	-	3	3	2
3	3	3	3	2	3	-	-	-	2	1	-	3	3	2
4	3	3	3	3	3	-	-	-	3	2	-	3	3	2
5	3	3	3	3	3	-	-	-	2	2	-	2	3	2
1	Reasonably agreed			2	Moderately agreed			3	Strongly agreed					

22GE201	UNIVERSAL HUMAN VALUES (Common to all branches)	3/0/0/3

Nature of Course	Descriptive

Course Objectives:

1	Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
2	Understanding (or developing clarity) of the harmony in the human being ,family, society and nature/existence.
3	Strengthening of self-reflection.
4	Development of commitment and courage to act.
5	Helping the students to appreciate the essential complementarily between 'VALUES' and' SKILLS' to ensure sustained happiness and prosperity, which are the core aspirations of all human beings.
6	Highlighting plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

CourseOutcomes:
Uponcompletionofthe course,studentsshall have ability to

C201.1	Understand and take responsibilities in life and handle problems to attain sustainable solutions while keeping human relationships and human nature in mind.	[U]
C201.2	Apply responsibilities towards their commitments (human values , human relationship and human society).	[AP]
C201.3	Apply what they have learnt to their own self indifferent day-to-day settings in real life, atleast a beginning would be made in this direction.	[AP]
C201.4	Analyze ethical and unethical practices, and formulate strategies to actualize a harmonious environment wherever they work.	[AN]
C201.5	Understand the harmony in nature and existence, and work out mutually on fulfilling participation in nature.	[U]

CourseContents:

Module 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education, Understanding Harmony in the Human Being-Harmony in Myself!

15

Self-evaluation of the students- Pre-test of UHV**-** Purpose and motivation for the course.Self-Exploration–Its content and process- A look at basic Human Aspirations. Understanding Happiness and Prosperity correctly-Understanding the needs of Self('I') and 'Body'-Understanding the Body as an instrument of 'I'(being the doer, seer and enjoyer)-Understanding the characteristics and activities of 'I' and harmony in 'I' - Understanding theharmony of'I' with the Body- Social activities – Waste Management - Water Conservation-Soil Pollution - Physical Health and related activities - Lectures by eminent persons- Literary activities.

Module 2: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship, Understanding Harmony in the Nature and Existence- Whole existence as Coexistence

15

Understanding values in human relationship - Understanding the harmony in the society (society being an extension of family): - Visualizing a universal harmonious order in society-Understanding the harmony in Nature.-Understanding Existence as Coexistence of mutually

Interacting units in all-pervasive space. Holistic perception of harmony at all levels of existence-Buddy program- Relationships-Homesickness- Managing peer pressure-Projects-Socially responsible engineers-Visit to local areas (orphanages, special children)- Physical activities(games).

Module 3: Implications of the above Holistic Understanding of Harmony on Professional Ethics

15

Natural acceptance of human values- Definitiveness of Ethical Human Conduct- Basis for Humanistic Education-Humanistic Constitution and Humanistic Universal Order-Competence in professional ethics-Case studies of typical holistic technologies, management models and eco-friendly production systems - Strategy for transition from the present state to Universal Human Order-Sum up: Self-evaluation of the students-Post test of UHV.

	Total Hours:	**45**

TextBooks:

1	Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010
2	Rajni Setia, Priyanka Sharma, "Human Values", Genius Publication", Jaipur, 2019.

ReferenceBooks:

1	Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
2	The Story of My Experiments with Truth –by Mohandas Karamchand Gandhi
3	IndiaWins Freedom-MaulanaAbdulKalamAzad.

WebReferences:

1	https://examupdates.in/professional-ethics-and-human-values/
2	http://hvpe1.blogspot.com/2016/06/notes-human-values-and-professional.html
3	https://www.yourmorals.org/schwartz.2006.basic%20human%20values.pdf

OnlineResources:

1	https://nptel.ac.in/courses/109/104/109104068/
2	https://medium.com/the-mission/the-12-important-life-skills-i-wish-id-learned-in-school-f4593b49445b
3	https://www.thebalancecareers.com/life-skills-list-and-examples-4147222

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C201.1	Understand& Apply	Online Quiz	20
C201.2	Understand& Apply	Group Assignment	20
C201.3 & C201.4	Understand& Apply	Presentation	20
C201.5	Apply	Seminar	20

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	10	10	10
Understand	10	20	20
Apply	40	40	40
Analyse	40	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
Course Articulation Matrix														
1	-	-	-	-	-	3	-	-	-	-	-	-	-	-
2	-	-	-	-	-	3	-	-	3	-	-	-	-	-
3	-	-	-	-	-	3	-	3	-	-	-	-	-	3
4	-	-	-	-	-	3	3	3	-	-	2	-	-	3
5	-	-	-	-	-	3	3	-	-	-	-	-	-	-
1	Reasonably agreed			2	Moderately agreed			3	Strongly agreed					

22TA101	HERITAGE OF TAMILS	1/0/0/1

Nature of Course:	C (Theory Concept)
Pre requisites:	NIL

Course Objectives:

1	To know various concepts of Tamil Language families.
2	To know about the essentialities of Heritage.
3	To understand the Aram concepts of Tamils and the cultural influence.

Course Outcomes:

Upon completion of the course, students shall have ability to

C101.1	Know about the language families in India, impact of religions and the contribution of Bharathiyar and Bharathidhasan.	[U]
C101.2	Observe the growth of sculpture, making of musical instruments and the role of temples in socio and economic lives.	[U]
C101.3	Understand the significance of folklore and martial arts.	[U]
C101.4	Learn the sangam literature, sangam age and overseas conquest of Cholas.	[U]
C101.5	Understand the contribution of Tamils to Indian Freedom Struggle, role of Siddha medicine and print history of Tamil Books.	[U]

Course Contents:
Language and Literature: Language Families in India - Dravidian Languages – Tamil as a Classical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature- Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

Heritage - Rock Art Paintings to Modern Art – Sculpture: Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils. **FolkAndMartialArts:** Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

Thinai ConceptOfTamils- Flora and Fauna of Tamils &Aham and Puram Concept from Tholkappiyam and Sangam Literature- Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.ContributionofTamilstoIndiannationalmovementandindianculture:Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

	Total Hours:	**15**

Text-cum-Reference Books:

1	தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே.பிள்ளை(வெளியீடு: தமிழ்நாடுபாடநூல்மற்றும் கல்வியியல் பணிகள் கழகம்).

2	கணினித்தமிழ்-முனைவர்இல. சுந்தரம் . (விகடன்பிரசுரம்).
3	கீழடி-வைகைநதிக்கரையில்சங்ககாலநகரநாகரிகம் (தொல்லியல்துறைவெளியீடு)
4	பொருநை-ஆற்றங்கரைநாகரிகம். (தொல்லியல்துறைவெளியீடு)
5	Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6	Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7	Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8	The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9	Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu).
10	Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author).
11	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu).
12	Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C101.1	Understand	Quiz	20
C101.2	Understand	Seminar	20
C101.3	Understand	Seminar	20
C101.4	Understand	Quiz	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	40	40	40
Understand	60	60	60
Apply	-	-	-
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks			**CA 2 : 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

Course Articulation Matrix														
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
1	-	-	-	-	-	-	-	-	1	-	-	1	-	-
2	-	-	-	-	-	-	-	1	1	-	-	1	-	-
3	-	-	-	-	-	-	-	1	1	-	-	1	-	-
4	-	-	-	-	-	-	-	-	1	-	-	-	-	-
5	-	-	-	-	-	-	-	1	1	-	-	-	-	-
1	Reasonably agreed			2	Moderately agreed			3		Strongly agreed				

22MA304	CALCULUS AND TRANSFORMS II (ECE/EEE)	3/1/0/4

Nature of Course	B (100% Analytical)
Pre requisites	-

Course Objectives:

1	To familiarize with functions of several variables applicable in engineeringand to understand the different possible forms of Fourier series and the frequently needed practical harmonic analysis that an engineer may have to make from discrete data.
2	To acquaint the student with transform techniques which are used in a variety of engineering fields.
3	To study the concept of mathematical formulation of certain practical problems in terms of partial differential equations.
4	Apply the knowledge of differential equation and extreme values of the given functions to solve the engineering problems.

Course Outcomes:

Upon completion of the course, students shall have ability to

C304.1	Remember the basic concepts of partial differentiation and integration.	[R]
C304.2	stand the concepts of Fourier series to solve engineering problems.	[U]
C304.3	Find the extreme values of the given functions to solve the engineering problems.	[AP]
C304.4	te Fourier transform techniques in Signals, System analysis and Digital signal processing and to apply the Z transform techniques in discrete sequences.	[AP]
C304.5	Apply analytical methods to solve the partial differential equations.	[AP]

Course Contents:

MODULE I - FUNCTIONS OF SEVERAL VARIABLES AND FOURIER SERIES   20

Functions of several variables: Total derivatives – Differentiation of implicit functions – Jacobians – Taylor series expansion – Maxima and Minima (excluding constrained maxima and minima)
Fourier Series: Dirichlet's conditions – General Fourier Series – Odd and Even Functions – Half range sine series and cosine series – Parseval's Identity – Harmonic Analysis.

MODULE II - TRANSFORMS   20

Fourier Transform: Complex form of Fourier Transforms – Fourier sine and cosine transforms – Properties – Convolution theorem and Parseval's Identity (Statement only) – Evaluation of integrals using Parseval's Identity.
Z-transform: Convergence of Z-transform – Z-transform of Standard functions – Properties – Inverse Z-transform – Convolution theorem (Statement only) – Solution of difference equations using Z-transform Techniques.

MODULE III - PARTIAL DIFFERENTIAL EQUATIONS   20

Introduction to PDE – Solving PDE by Lagrange's linear equations – Linear homogeneous partial differential equations of second and higher order with constant coefficients – Classifications –Application

of partial differential equations: One dimensional wave equation – One dimensional equation of heat conduction –Fourier series solutions in Cartesian coordinates

		Total hours:	60

Text Books:

1	Kreyszig E, "Advanced Engineering Mathematics" Tenth Edition, John Wiley and Sons (Asia) Limited, Singapore 2018.
2	Grewal B.S, "Higher Engineering Mathematics", 44th edition, Khanna Publications, Delhi, 2018.
3	G.B. Thomas and R.L. Finney, Calculus and Analytic Geometry, 14thEdition, Pearson, Reprint, 2018.

Reference Books:

1	Veerarajan. T, "Transforms and Partial differential equations", 3rd edition, Tata McGraw-Hill Publishing Company Ltd., reprint, 2016.
2	N.P. Bali ,"A Text book of Engineering Mathematics Sem - III/IV" 13th edition, Laxmi Publications Ltd, 2017.
3	Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education, 4th edition, 2016.

Web References:

1	https://www.youtube.com/watch?v=jNC0jxb0OxE
2	https://www.youtube.com/watch?v=iRXXmtcocAQ
3	https://www.youtube.com/watch?v=OGT59INHz3Y

Online Resources:

1	https://nptel.ac.in/courses/111/106/111106111/
2	https://nptel.ac.in/courses/111/107/111107111/
3	https://nptel.ac.in/courses/111/107/111107107/

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%)** **[80 Marks]**
C304.1	Remember	Quiz	20
C304.2	Understand	Seminar	20
C304.3 – C304.5	Apply	Tutorial	20
C304.3– C304.5	Apply	Assignment	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%)** **[120 Marks]**		**End Semester Examination (60%)** **[100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	30	30	30
Apply	50	50	50
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Course Articulation Matrix														
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	1	1	1	-	-	-	-	-	-	-	-	-	1	-
2	1	2	1	-	-	-	-	-	-	-	-	-	2	-
3	3	3	2	-	-	-	-	-	-	-	-	-	2	-
4	1	1	2	-	-	-	-	-	-	-	-	-	1	-
5	2	1	2	-	-	-	-	-	-	-	-	-	2	-
1	Reasonably agreed			2	Moderately agreed			3		Strongly agreed				

22EC201	**ELECTRON DEVICES**	**3/0/0/3**

Nature of Course	: C (Theory Concept)

Course Objectives:

1	To Recall the basic Semiconductor Theory concepts.
2	To introduce most of the basic electronic devices and discuss about their operations.
3	To enable the student to select appropriate devices to design a circuit for a particular application.
4	To study experimentally the characteristics of diodes, BJT, FET, rectifiers and filters.

Course Outcomes:

Upon completion of the course, students shall have ability to

C201.1	Understand the basic Energy band Theory concepts	[U]
C201.2	Understand the concepts of semiconductorphysics	[U]
C201.3	Analyse the electrical characteristics of PN junction diode and Zener diode	[AN]
C201.4	Observe and analyse the operation of wave shaping circuits, rectifiers and filters.	[AN]
C201.5	Analyse the principle, characteristicsand configurations of bipolar junction transistors.	[AN]
C201.6	Analyse the operationmodes and characteristics of field effect transistors.	[AN]

Course Contents:

SEMICONDUCTOR THEORY 15

Energy band theory, Fermi levels;Conductors, Semiconductors and Insulators: electrical properties, band diagrams. Semiconductors: intrinsic and extrinsic, energy band diagram, P-type and N-type semiconductors, drift and diffusion carriers. –Mobility and conductivity- carrier concentration - continuity equation - Hall effect.

DIODES AND THEIR APPLICATIONS 15

Formation of P-N junction, forwardand reverse biased P-N junction – diode current equation-depletion and diffusion capacitances, switching characteristics, V-I characteristics, Zener breakdown, Avalanche breakdown and its reverse characteristics, Tunnel diode. Rectifiers, Filters, Clipper, Clamper, Voltage Doubler, Voltage Dividers, Voltage Regulator.

TRANSISTORS 15

BJT:Principle of transistor action–Current components–Cutoff, active and saturation region–Input and output characteristics–CE, CB, & CC Configurations – Transistor as a switch, Fundamentals of JFETs and the device characteristics – JFET parameters, MOSFET – principle of operation-Depletion and enhancement modes.

Text Books:		
	1	Jacob Millman, Chritos C Halkias, Satyabrata Jit, 'Electronic Devices and Circuits', 4th edition (SIE), McGraw Hill Education India Private Ltd., 2015
	2	Salivhanan, 'Electron Devices and Circuits', 4th edition, McGraw Hill Education India Private Ltd., 2016
	3	Robert Boylestad and Louis Nashelsky, 'Electron Devices and Circuit Theory', 11th edition , Pearson New International Edition , 2013
Reference Books:		
	1	Donald A Neaman, 'Semiconductor Physics and Devices', 4th edition ., McGraw Hill Education India Private Ltd., 2011
	2	Sedra and Smith, 'Microelectronic Circuits', Oxford University Press, 5th Edition, 2005.
Web References:		
	1	www.allaboutcircuits.com
	2	www.circuitstoday.com
Online Resources:		
	1	http://www.electronics-tutorials.ws

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C201.1, C201.2	Understand	Quiz	20
C201.3, C201.4	Analyse	Assignment	20
C201.5	Analyse	Group Assignment	20
C201.6	Analyse	Seminar	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	10	10
Understand	40	40	40
Apply	40	40	30
Analyse		10	20
Evaluate			
Create			

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks			**CA 2 : 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

Course Articulation Matrix														
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
1	2	2	2	-	-	-	-	-	-	-	-	1	2	1
2	2	2	2	-	-	-	-	-	-	-	-	1	2	1
3	2	2	2	-	-	-	-	-	-	-	-	1	2	1
4	2	2	2	-	-	-	-	-	-	-	-	1	2	1
5	2	2	2	-	-	-	-	-	-	-	-	1	2	1
6	2	2	2	1	-	-	-	-	-	-	-	1	3	1
1	Reasonably agreed			2	Moderately agreed			3	Strongly agreed					

22CH1 01	ENGINEERING CHEMISTRY Common for all B.E/ B.Tech Engineering Courses (Except CSBS &M.Tech CSE)	3 /0 /2 /4

Nature of Course	: E (Theory Skill based)
Pre requisites	: NIL

Course Objectives:

1	To understand the principles and applications of electrochemistry and to learn electro analytical methods.
2	To learn the effect of corrosion in materials and the methods for prevention of corrosion.
3	To understand the basic concepts, synthesis, and applications of nanomaterials.
4	To explore the synthesis and properties of important engineering plastics and energy sources.
5	To understand the concepts of photophysical and photochemical processes in spectroscopy.

Course Outcomes:
Upon completion of the course, students shall have ability to

C101.1	Recall the principle and working of reference electrodes and conductivity meters as an analyzer.	[R]
C101.2	Apply the various corrosion control techniques in real time industrial environments.	[AP]
C101.3	Interpret the basic concepts and applications of Nano chemistry.	[U]
C101.4	Use the knowledge of various energy sources in storage devices and polymeric products in engineering field.	[AP]
C101.5	Interpret the principle and working of certain analytical techniques.	[U]

ELECTROCHEMISTRY AND CORROSION   **15**
Electrochemistry-Introduction, Oxidation and reduction potentials-Free energy and emf, cell potentials, Nernst equation and applications. Reference electrodes-standard hydrogen electrode, saturated calomel electrode, glass electrode-pH measurement. Electrochemical cells-electrolytic cell-reversible and irreversible cells. Water treatment-characteristics of water-hardness-types and estimation of hardness by EDTA method with numerical problems. Importance of corrosion-types–mechanism of dry and wet corrosion-galvanic corrosion-differential aeration corrosion. Corrosion protection-electroplating of Chromium-electroless plating of Nickel.

NANO-CHEMISTRY AND ENERGY SOURCE   **15**
Nano Chemistry-Basics-Comparison of molecules, nanomaterials and bulk materials; Types –nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: Electrochemical deposition and electro spinning. Applications of nanomaterials in medicine. Energy Sources-Fuel Cells-Solidoxide and polymer electrolytes in H_2-O_2 fuel cell. Storage Devices-Batteries- Alkaline-Lead acid, Nickel cadmium and Lithium-ion batteries.

POLYMER CHEMISTRY AND SPECTROSCOPIC TECHNIQUES   **15**
 Introduction-monomers and polymers-classification of polymers-Degree of Polymerization (Simple problems). Mechanism of addition polymerization (free radical mechanism). Plastics-classification-preparation, properties and uses of Nylon 6,6, Nylon 6, PVC, Bakelite and

PET.Moulding methods- moulding of plastics for Car parts, bottle caps (Injection moulding), Pipes, Hoses (Extrusion moulding), Mobile Phone Cases, Battery Trays (Compression moulding) and PET bottles (Blow moulding). Spectroscopy-Beer Lambert's law, principle, instrumentation, and applications of Electronic spectroscopy (UV-visible), Vibrational and rotational spectroscopy (IR) and Flame emission spectroscopy (FES).

Field work:

Industrial visit- Moulding and spectroscopic techniques

Theory:		45 hours
Lab Components:		**30 hours**
1	Determination of total, temporary, calcium and magnesium hardness of water sample by EDTA method.	[E]
2	Estimation of alkalinity of water sample.	[E]
3	Estimation of dissolved oxygen in water.	[E]
4	Potentiometry- determination of redox potentials and emf's.	[E]
5	Conductometric titration-mixture of acids vs NaOH..	[E]
6	Determination of strength of strong acid by pH-metry.	[E]
7	Determination of corrosion rate of mild steel in acid medium.	[E]
8	Electroplating of nickel over copper.	[E]
9	Spectrophotometry-Estimation of iron in water.	[E]
10	Determination of single electrode potential of Zinc and Copper by given solution.	[E]
	Total Hours:	**75**

Understanding the concepts by simple Demonstrations/Experiments:

11	To detect the chlorine content in tap water using simple chemical method.
12	To know the presence of dissolved oxygen in given water sample using glucose by redox principle.
13	To illustrate the rate of corrosion in steel nails using acid medium.

Text Books:

1	Dara S.S, Umare S.S, "Engineering Chemistry", First revised Edition by S. Chand & Company Ltd., New Delhi 2015.
2	Jain P. C. & Monica Jain., "Engineering Chemistry", 16th Edition, DhanpatRai Publishing Company (P) Ltd, New Delhi, 2015.
3	Fundamentals of Molecular Spectroscopy, 4th Edition by C. N. Banwell Publishing McGraw-Hill Book Company (P) Ltd, England, 1994.
4	Nanochemistry, 2nd Edition by K. Klabunde, G. Sergeev Springer Publisher, 2013.

Reference Books:

1	Shikha Agarwal., "Engineering Chemistry and Applications", Cambridge University press, 2016.
2	Liliya.,Bazylak.I.,Gennady.E.,Zaikov.,Haghvi.A.K.,"Polymers and Polymeric Composites" CRC Press,2014.
3	Lefrou.,Christine.,Fabry.,Pierre.,Poignet.,Jean-claude.,"Electrochemistry - The Basics, with examples" 2012 ., Springer.
4	Zaki Ahmad, Digby Macdonald, "Principles of Corrosion Engineering and Corrosion Control", Elsevier Science, 2nd Edition 2012.
5	Introduction to Nano: basics to Nanoscience and Nanotechnology, by Sengupta, Amretashis, Sarkar, Chandan Kumar, Springer Publisher, 2015.

Web References:

1	http://www.analyticalinstruments.in/home/index.html
2	www.springer.com › Home › Chemistry › Electrochemistry

3	https://www.kth.se/.../electrochem/welcome-to-the-division-of-applied-electrochemistry
4	www.edx.org/
5	https://www.ntnu.edu/studies/courses
6	www.corrosionsource.com/
Online Resources:	
1	https://ocw.mit.edu/courses/chemistry
2	nptel.ac.in/courses/105106112/1_introduction/5_corrosion.pdf https://alison.com -
3	Spectroscopic technique, Colorimetry
4	https://ocw.mit.edu/courses/chemistry
5	nptel.ac.in/courses/113108051

Continuous Assessment										End Semester Examination	Total
Theory				Practical			Total (A+B)	Total ContinuousAssessment			
Formative Assessment	Summative Assessment	Total	Total (A)	Formative Assessment	Summative Assessment	Total (B)					
80	120	200	100	75	25	100	200	50		50	100

Formative Assessment based on Capstone Model - Theory			
Course Outcome	**Bloom's Level**	**Assessment Component(Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (10%) [80 Marks]**
C101.1	Remember	Online Quiz-I	20
C101.2	Apply	Assignment-I	20
C101.3	Understand	Online Quiz-II	20
C101.4	Apply	Assignment-II	20
C101.5	Understand		
Assessment based on Summative and End Semester Examination - Theory			
Bloom's Level	**Summative Assessment (15%) [120 Marks]**		**End Semester Examination (35%) [100 Marks]**
	CIA 1: [60 Marks]	**CIA 2: [60 Marks]**	
Remember	20	20	20
Understand	35	35	35
Apply	45	45	45
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination - Practical			
Bloom's Level	**Continuous Assessment (25%) [100 Marks]**		**End Semester Examination (15%) [100 Marks]**
	FA: (75 Marks)	**SA: (25 Marks)**	
Remember	-	-	-
Understand	20	20	20
Apply	30	30	30
Analyze	25	25	25
Evaluate	25	25	25
Create	-	-	-

Assessment based on Continuous and End Semester Examination								
Continuous Assessment (50%)								**End Semester Examination (50%)**
CIA 1 (100 Marks)			**CIA 2 (100 Marks)**			**Practical Exam (100 Marks)**		**Theory Examination (35%) Practical Examination (15%)**
SA 1 (60M)	**FA 1**		**SA 2 (60M)**	**FA 2**		**FA (75M)**	**SA (25M)**	
	Component-I (20 Marks)	**Component-II (20 Marks)**		**Component-I (20 Marks)**	**Component-II (20 Marks)**			

Course Articulation Matrix														
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
1	3	2	2	-	1	-	-	-	-	-	-	1	-	1
2	3	2	2	1	1	-	-	-	-	-	-	1	-	1
3	3	3	2	-	1	-	-	-	-	-	-	1	-	1
4	3	2	2	-	1	-	-	-	-	-	-	1	-	1
5	3	2	2	1	1	-	-	-	-	-	-	1	-	1
1	Reasonably agreed			2	Moderately agreed			3		Strongly agreed				

22AD201	JAVA PROGRAMMING	3/0/2/4
Nature of Course	F (Theory Programming)	
Pre requisites	Nil	

Course Objectives:

1	To understand the JavaBeans concepts and basic of core java.
2	To understand and develop Wrapper classes and their utilities.
3	To employ different types of modifiers, loop statements and strings.
4	To implement streams and java console class formatting.

Course Outcomes:

Upon completion of the course, students shall have ability to:

C201.1	Develop the features of core java paradigm.	[AP]
C201.2	Illustrate the usage of different aspects of wrapper in real world scenarios, handling classes, objects, utilities.	[AP]
C201.3	Apply looping statements, strings in real time environment.	[AP]
C201.4	Implement auto boxing, file navigation, pattern matching, tokenizing.	[A]
C201.5	Utilize the functionalities of streams and java console class.	[AP]

Course Contents:

MODULE I   **15**

Identifiers & JavaBeans, Legal Identifiers, Sun's Java Code Conventions, JavaBeans Standards, Declare Classes, Source File Declaration Rules, Class Declarations and Modifiers, Concrete Subclass, Declaring an Interface, Declaring Interface Constants, Declare Class Members, Access Modifiers, Nonaccess Member Modifiers, Constructor Declarations, Variable Declarations, Declaring Enums - An Overview of the Wrapper Classes, Creating Wrapper Objects, Using Wrapper Conversion Utilities, Autoboxing

MODULE II   **15**

if and switch Statements, if-else Branching, switch Statements, Loops and Iterators, using while Loops, Using do Loops, Using for Loops, using break and continue, Unlabelled Statements, Labelled Statements. String, StringBuilder, and StringBuffer, The String Class, Important Facts About Strings and Memory, Important Methods in the String Class, The StringBuffer and StringBuilder Classes, ImportantMethods in the StringBuffer and StringBuilder Classes, File Navigation and I/O.

MODULE III   **15**

Types of Streams, The Byte-stream I/O hierarchy, Character Stream Hierarchy, Random Access File class, The java.io.Console Class, Serialization, Dates, Numbers, and Currency, Working with Dates, Numbers, and Currencies, Parsing, Tokenizing, and Formatting, Locating Data via Pattern Matching, Tokenizing.

	Total Hours:	**45**

Laboratory Component:

S. No.	**List of Experiments**
1	Basic Java Programs.
2	Implementation of Student application using Class and Objects
3	Implement a Java program to perform String operations.

4	Implement a java program using interface
5	Design a java package for numbers. Develop two different classes that belong to the number package, one class for checking if a given number is odd or even, another class is used for checking palindrome or not and access these classes using one main class.
6	Implementation of Multi-threading for generation of Prime Numbers and Fibonacci Series.
7	Implementation of a java program using Set Interface.
8	Implementation of a java program using List Interface.
9	Implementation of a java program using Map Interface.
10	Design and implement a console application using java stream.
	Total Hours: **15**

Text Books:

1	Herbert Schildt, "Java: The Complete Reference", 9th edition, Tata McGraw Hill, 2014.
2	Kathy Sierra, "Head First Java: A Brain-Friendly Guide, 2nd Edition, Oreilly, 2009.
3	Herbert Schildt, "Java A Beginner's Guide, Create, Compile and Run Java Programs Today", 8th edition, Tata McGraw Hill, 2020.

Reference Books:

1	Paul Deitel, Harvey Deitel, "Java How To Program", 10th Edition, Prentice Hall Publications, 2014.
2	Y. Daniel Liang, "Introduction to Java Programming", 9th Edition, Prentice Hall Publications, 2015.
3.	Ed Roman, RIma Patel, Sriganesh, Gerald Brose, "Mastering Enterprise JavaBeans" 3rdEdition, Wiley, 2005.

Web References:

1	http://www.nptel.ac.in
2	http://www.javaworld.com
3	https://www.learnjavaonline.org/
4	https://www.codecademy.com/learn/learn-java

Online Resources:

1	https://www.coursera.org/courses?query=java
2	https://www.tutorialspoint.com/java/index.htm
3	https://www.w3schools.com/java/java_intro.asp

Continuous Assessment										
Theory				**Practical**			**Total (A+B)**	**Total Continuous Assessment**	**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**	**Total (A)**	**Formative Assessment**	**Summative Assessment**	**Total (B)**				
80	120	200	100	75	25	100	200	50	50	100

Formative Assessment based on Capstone Model - Theory

Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (10%) [80 Marks]
C201.1	Apply	Quiz & Assignment	20
C201.2	Apply	Assignment	20
C201.3	Apply	Case study	20
C201.4, C201.5	Analyse, Apply	Group Assignment	20

Assessment based on Summative and End Semester Examination - Theory

Bloom's Level	Summative Assessment (15%) [120 Marks]		End Semester Examination (35%) [100 Marks]
	CIA1: (60 Marks)	CIA2: (60 Marks)	
Remember	40	40	40
Understand	40	40	40
Apply	10	10	10
Analyse	-	-	-
Evaluate	-	-	-
Create	40	40	40

Assessment based on Continuous and End Semester Examination - Practical

Bloom's Level	Continuous Assessment (25%) [100 Marks]		End Semester Examination (15%) [100 Marks]
	FA: (75 Marks)	SA: (25 Marks)	
Remember	10	10	10
Understand	30	30	30
Apply	40	40	40
Analyse	20	20	20
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (50%)								End Semester Examination (50%)
CA 1 (100 Marks)			CA 2 (100 Marks)			Practical Exam (100 Marks)		Theory Examination (35%)
	FA 1			FA 2		FA (75M)	SA (25M)	Practical Examination (15%)
SA 1 (60M)	Component-I (20 Marks)	Component-II (20 Marks)	SA 2 (60M)	Component-I (20 Marks)	Component-II (20 Marks)			

Course Articulation Matrix

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	2	2	2	-	-	-	-	-	2	-	-	2	2	-
2	3	3	3	-	-	-	-	2	2	2	-	2	2	2
3	2	2	3	-	2	-	-	-	2	-	-	3	-	-
4	3	2	2	-	2	-	-	2	2	2	-	3	-	2
5	3	2	2	-	2	-	-	2	2	2	-	3	-	2
1	Reasonably agreed			2	Moderately agreed			3	Strongly agreed					

Continuous Assessment										End Semester Examination	Total
Theory				Practical			Total (A+B)	Total Continuous Assessment			
Formative Assessment	Summative Assessment	Total	Total (A)	Formative Assessment	Summative Assessment	Total (B)					
80	120	200	100	75	25	100	200	50		50	100

Formative Assessment based on Capstone Model - Theory			
Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (10%) [80 Marks]

22IT201		DATABASE MANAGEMENT SYSTEMS	3/0/2/4
Nature of Course:		D (Theory Application)	
Prerequisites:		Nil	

Course Objectives:

1	To describe information and data models and relational databases.
2	To explain an Entity Relationship Diagram and design a relational database for a specific use case.
3	To implement different relational model constraints.
4	To manage database using SQL commands

Course Outcomes:

Upon completion of the course, students shall have ability to:

C201.1	Conceptualize data using the relational model.	[U]
C201.2	Improve the database design through normalization.	[U]
C201.3	Manipulate a database using SQL.	[AP]
C201.4	Implement advanced SQL concepts on database.	[AP]
C201.5	Infer the transactions management in a database environment.	[A]

Course Contents:

MODULE I INTRODUCTION   **15 Hours**

Introduction to DBMS, Characteristics of DBMS, DBMS vs File Systems, need for DBMS, Three Level DBMS Architecture, Data Models – Introduction, Benefits, and Phases, ER Diagrams – Symbols, Components, Relationships, Weak entities, Attributes, Cardinality, Relational Algebra, Domain Relational Calculus, Tuple Relational Calculus, Normalization - 1NF, 2NF, 3NF, BCNF, 4NF

MODULE II CONSTRAINTS AND SQL COMMANDS   **15 Hours**

DDL Commands - Create, Drop, Alter, Truncate, Rename, Keys - primary Key, Foreign Key DML Commands - Select, Insert, Update, Delete, Any, All, In, Exists, Non Exists, Union, Intersection, Subqueries - nested, correlated, Joins- Inner, Outer, and Equi, Functions - SUM, COUNT, AVG, MIN, MAX, Clauses - Group By, Having By, Embedded SQL, Dynamic SQL, Transaction Concepts – Transaction model – ACID Properties – Serializability –Transactions as SQL statements.

C201.1	Understand	Quiz	**20**

MODULE III QUERIES AND TRANSACTIONS	**15**
Hours	

Creation and Dropping of Views, Creation and Execution of Stored Procedures Cursors and Triggers - Opening, Fetching and Closing, Creation , Insertion, Deletion and Updating Database Applications: Payroll Processing Systems, Railway Reservation Systems, Bank Management System Introduction, Storage media and file structures, B+ Tree Hashing – static and Dynamic, Introduction to Query Processing – Issues in query optimization – Steps in query processing, Concurrency control and transactions, Lock based protocols Recovery System – Failure classification.

Lab Experiments:

1**.** Conceptual Database design using E-R DIAGRAM

2. Implementation of SQL commands DDL, DML, DCL and TCL

3. Queries to demonstrate implementation of Integrity Constraints

4. Practice of Inbuilt functions

5. Implementation of Join and Nested Queries AND Set operators

6. Implementation of virtual tables using Views

7. Practice of Procedural extensions (Procedure, Function, Cursors, Triggers)

8. Document Database creation using MongoDB

9.Study of Cloud Storage

10.Mini Project (Application Development)

i) IT Training Group Database

  ii) Blood Donation System

  iii) Salary Management System

  iv) Traffic Light Information System

	Total Hours:	**45+30**

Text Books:

1	Abraham Silberschatz, Henry F Korth, S Sudarshan, "Data base System Concepts", 7th Edition, McGraw hill, 2020.
2	Vijay Krishna Pallaw, "Database Management Systems", 2nd Edition Asian Books Private Limited, 2010.

3	Mark L. Gillenson, "Fundamentals of Database Systems", 7th Edition, Wiley India Pvt. Limited, 2008.

Reference Books:

1	Raghu Ramakrishnan, Johannes Gehrke, Raghu Ramakrishnan, Johannes Gehrke, "Database Management Systems", McGraw-Hill Education, 2017
2	C. Date, "SQL and Relational Theory", O'Reilly Media, Incorporated, 2011.

Web References:

1	http://www.sqlcourse.com/
2	https://www.w3schools.com/sql/
3	https://www.geeksforgeeks.org/dbms/

Online Resources:

1	https://www.coursera.org/learn/database-management
2	https://www.udemy.com/database-management-system/
3	https://onlinecourses.swayam2.ac.in/cec22_cs18/preview

C201.2	Understand	Assignment	**20**
C201.3, C201.4	Apply	Group Assignment	**20**
C201.5	Analyse	Case Study	**20**

Assessment based on Summative and End Semester Examination - Theory

Bloom's Level	Summative Assessment (15%) [120 Marks]		End Semester Examination (35%) [100 Marks]
	CIA1: (60 Marks)	CIA2: (60 Marks)	
Remember	10	10	20
Understand	40	30	30
Apply	50	40	40
Analyse	-	20	10
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination - Practical

Bloom's Level	Continuous Assessment (25%) [100 Marks]		End Semester Examination (15%) [100 Marks]
	FA: (75 Marks)	SA: (25 Marks)	
Remember	20	10	10

Understand	20	20	20
Apply	40	40	40
Analyse	20	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (50%)								End Semester Examination (50%)
CA 1 (100 Marks)			CA 2 (100 Marks)			Practical Exam (100 Marks)		Theory Examination (35%)
	FA 1			FA 2				
SA 1 (60M)	Component-I (20 Marks)	Component-II (20 Marks)	SA 2 (60M)	Component-I (20 Marks)	Component-II (20 Marks)	FA (75M)	SA (25M)	Practical Examination (15%)

Course Articulation Matrix														
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	3	1	-	-	1	-	-	-	-	1	-	1	2	-
2	3	3	3	3	-	-	-	-	2	2	-	3	3	2
3	3	3	2	1	-	-	-	-	2	1	2	3	3	2
4	3	3	2	2	2	-	-	-	2	1	2	2	3	2
5	3	2	2	-	2	-	-	-	1	2	2	3	2	2
1	Reasonably agreed			2	Moderately agreed			3	Strongly agreed					

22EC202	CIRCUITS AND DEVICES LABORATORY	0/0/3/1.5

Nature of Course	: M (Practical application)

Course Objectives:

1	To verify the various laws and theorems of electric circuits.
2	To analyze the characteristics of diodes and transistors.

Course Outcomes:

Upon completion of the course, students shall have ability to

C202.1	Verify the basic laws of electric circuits	[AN]
C202.2	Verify the various theorems of electric circuits	[AN]
C202.3	Observe and analyse the characteristics of PN junction diode.	[AN]
C202.4	Observe and analyse the operation of bipolar junction transistors	[AN]
C202.5	Observe and analyse the operation of field effect transistors	[AN]
C202.6	Observe and analyse the wave shaping circuits	[AN]

Course Contents:

S.No	List of Experiments	CO Mapping	BT
1	Verification of Ohm's Law and Kirchoff's Laws	C202.1	[AN]
2	Verification of Thevenin's Theorem	C202.2	[AN]
3	Verification of Superposition Theorem	C202.2	[AN]
4	Verification of Maximum Power Transfer Theorem	C202.2	[AN]
5	Characteristic analysis of PN Junction Diode Zener Diode	C202.3	[AN]
6	Analysis of Half wave and Full wave Rectifier	C202.3	[AN]
7	Characteristic analysis of BJT	C202.4	[AN]
8	Characteristic analysis of MOSFET devices	C202.5	[AN]
9	Characteristic analysis of wave shaping circuits	C202.6	[AN]

Reference Books:

1	William H.Hayt, JV Jack E.Kemmerly and Steven M. Durbin," EngineeringCircuits Analysis", McGraw Hill India, 8 h edition, 2014.
2	Jacob Millman, Chritos C Halkias, Satyabrata Jit, 'Electronic Devices and Circuits', 4th edition (SIE), McGraw Hill Education India Private Ltd., 2015
3	Robert Boylestad and Louis Nashelsky, 'Electron Devices and Circuit Theory', 11th edition , Pearson New International Edition , 2013

Web References:

1	www.allaboutcircuits.com
2	www.circuitstoday.com

Online Resources:

1	https://www.electronics-tutorials.ws
2	https://www.edx.org/course/circuits-electronics-1-basic-circuit

Continuous Assessment			Total Continuous Assessment	End Semester Examination	Total
Formative Assessment	Summative Assessment	Total			
75	25	100	60	40	100

Assessment based on Continuous and End Semester Examination			
Bloom's Level	Continuous Assessment (60%) [100 Marks]		End Semester Practical Examination (40%) [100 Marks]
	FA (75 Marks)	SA (25 Marks)	
Remember			
Understand			
Apply			
Analyse	30	20	20
Evaluate	30	40	40
Create	40	40	40

Course Articulation Matrix														
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	3	2	2	3	1	-	-	-	2	-	-	2	3	1
2	3	2	2	3	2	-	-	-	2	1	-	2	3	1
3	3	2	2	3	2	-	-	-	2	1	-	2	3	1
4	3	2	2	3	1	-	-	-	2	1	-	2	3	1
5	3	2	2	3	3	-	-	-	2	1	-	2	3	1
6	3	2	2	3	3	-	-	-	2	2	3	2	3	1
1	Reasonably agreed			2	Moderately agreed			3	Strongly agreed					

22TA201	TAMILS AND TECHNOLOGY	1/0/0/1

Nature of Course	C (Theory Concept)
Pre requisites	NIL

Course Objectives:

1	To know about weaving, ceramic, design and construction technologies in sangam age.
2	To know the significance of technologies such as manufacturing, agriculture and irrigation.
3	To understand the development of Scientific Tamils and Tamil Computing.

Course Outcomes :
Upon completion of the course, students shall have ability to

C201.1	Describe about the weaving industry in sangam age and ceramic technology.	[U]
C201.2	Observe the design of houses, sculptures and construction of temples.	[U]
C201.3	Relate the various manufacturing materials and stone types in Silappathikaram.	[U]
C201.4	Understand the significance of agriculture and irrigation technology in ancient period.	[U]
C201.5	Explain the growth of scientific Tamil, Tamil computing and digitization of Tamil books.	[U]

Course Contents:

Module – I: 5

Weaving and Ceramic Technology: Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries. **Design and Construction Technology:** Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple) - Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.

Module – II: 5

Manufacturing Technology: Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel - Copper and gold - Coins as source of history - Minting of Coins – Beads making-industries Stone beads - Glass beads - Terracotta beads - Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram. **Agriculture and Irrigation Technology:** Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola

Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

Module – III :   **5**
Scientific Tamil & Tamil Computing: Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.

	Total Hours	**15**

Text Books:

1.	தமிழக வரலாறு – மக்களும் பண்பாடும் – கே. கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2.	கணினித் தமிழ் – முனைவர் இல. சுந்தரம் . (விகடன் பிரசுரம்).
3.	கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4.	பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5.	Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6.	Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7.	Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8.	The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9.	Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu).
10.	Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author).
11.	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu).

Reference Books:

1.	Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL)

Continuous Assessment			Total Continuous Assessment	End Semester Examination	Total
Formative Assessment	Summative Assessment	Total			
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C201.1	Understand	Seminar	20
C201.2	Understand	Quiz	20
C201.3, C201.4	Understand	Quiz	20
C201.5	Understand	Seminar	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	40	40	40
Understand	60	60	60
Apply	-	-	-
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

	Course Articulation Matrix													
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	-	-	-	-	-	-	-	-	-	1	-	1	-	1
2	-	-	-	-	-	-	-	-	-	1	-	1	-	1
3	-	-	-	-	-	-	-	-	-	1	-	1	-	1
4	-	-	-	-	-	-	-	-	-	1	-	1	-	1
5	-	-	-	-	-	-	-	-	-	1	-	1	-	1
1	Reasonably agreed				2	Moderately agreed			3	Strongly agreed				

22EC301	ELECTRONIC CIRCUITS	3/0/0/3

Nature of Course	G (Theory analytical)	

Course Objectives:

1	To introduce the concept of biasing of BJTs and MOSFETs and enable the students to understand the frequency analysis of amplifiers
2	To enable the students to understand the concept of negative feedback in amplifiers
3	To study about the power amplifiers and their thermal stability.
4	To understand the analysis and design of oscillators
5	To allow students to get familiarized with the concept of tuned amplifiers and applications

Course Outcomes:

Upon completion of the course, students shall have ability to

C301.1	Understand the biasing of BJT & the Basic Concepts of BJT Amplifiers	[U]
C301.2	Understand the biasing of MOSFET & the Basic Concepts of MOSFET Amplifiers	[U]
C301.3	Analyze & Understand the small signal analysis of BJT amplifiers	[AN]
C301.4	Illustrate the operation of various types of Power Amplifiers	[AN]
C301.5	Apply the concepts of negative feedback and positive feedback in amplifiers	[AP]
C301.6	Design and develop a circuit based on the concepts of oscillators	[AN]

Course Contents:

Transistor biasing & Amplifiers:	**15**

Biasing: Operating point, Bias Stability, BJT- Voltage divider biasing, Collector feedback biasing, MOSFET Biasing, Bias Compensation, Amplifiers – Small Signal Analysis of transistor using hybrid model BJT (CE & CC), MOSFET (CS & CD), High Frequency Model of BJT, Cascaded Amplifiers(Two Stage)

Power amplifiers:	**15**

Power Amplifiers: Classification of amplifiers (Class A, B, AB, C) - Efficiency of Class A (Direct coupled and transformer), Class B - Complementary-Symmetry, Push-Pull power amplifiers - Calculation of Power Output, Efficiency and power dissipation - Crossover distortion, heat sink

Feedback amplifiers and Signal generation:	**15**

Feedback amplifiers: Impact of negative feedback on amplifiers properties, Feedback topologies and their properties, analysis of practical feedback amplifiers. Signal Generation: Principles of Oscillators, Sinusoidal oscillators: RC, LC and Crystal oscillators.

	Total Hours:	**45**

Text Books:

1	Jacob Millman, Chritos C Halkias, Satyabrata Jit, 'Electronic Devices and Circuits', 4th edition (SIE), McGraw Hill Education India Private Ltd., 2015

2	Salivhanan, 'Electron Devices and Circuits', 4th edition, McGraw Hill Education India Private Ltd., 2016
3	Sedra and Smith, "Micro Electronic Circuits"; Sixth Edition, Oxford University Press, 2011
Reference Books:	
1	Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory", 11th Edition, Pearson Education / PHI, 2014.
2	Floyd, "Electronic Devices", 9th Edition, Pearson Education, 2011
3	David A. Bell, Electronic Devices & Circuits, 5th Edition, PHI, 2008
4	Donald.A. Neamen, Electronic Circuit Analysis and Design –2 nd Edition, Tata Mc Graw Hill, 2009.
Web References:	
1	http://www.allaboutcircuits.com/
2	http://www.circuitstoday.com/
3	https://circuitdigest.com/electronic-circuits/
4	https://www.eleccircuit.com/
Online Resources:	
1	http://www.nesoacademy.org/electronics-engineering/analog-electronics/analog
2	https://onlinecourses.nptel.ac.in/noc18_ee11

Continuous Assessment				End Semester Examination	Total
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Ca-se Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C301.1	Understand	Quiz	20
C301.2	Understand	Assignment	20
C301.3, C304.4	Apply	Quiz	20
C301.5, C301.6	Apply	Assignment	20

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1: [60 Marks]	CIA2: [60 Marks]	
Remember	20	10	10
Understand	40	40	40
Apply	40	40	30
Analyse		10	20
Evaluate			
Create			

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Course Articulation Matrix														
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	2	2	2	2	-	-	-	-	-	-	-	-	2	-
2	2	2	2	2	-	-	-	-	-	-	-	-	2	-
3	2	2	2	2	-	-	-	-	-	-	-	-	1	-
4	3	3	2	2	-	-	-	-	-	-	-	-	2	-
5	3	3	2	2	2	-	-	-	1	1	-	-	3	-
6	1	2	2	2	-	-	-	-	-	-	-	-	1	-
1	Reasonably agreed			2	Moderately agreed			3		Strongly agreed				

22EC302	DIGITAL ELECTRONICS	3/0/0/3

Nature of Course	:G (Theory & Analytical)

Course Objectives:

1	To introduce the principles of Canonical forms to minimize the logic expression
2	To enable the students to understand the operation of various combinational and sequential logic circuits.
3	To allow students to analyze synchronous sequential circuits.
4	To enable the students to construct PLD's and their roles in digital systems
5	To enable the students to write verilog code for combinational logical circuits.

Course Outcomes:

Upon completion of the course, students shall have ability to

C302.1	Demonstrate knowledge on canonical forms and their realization using logic gates	[U]
C302.2	Applying K- Map and Tabulation method to minimize the Boolean functions.	[AP]
C302.3	Understand various combinational logic and sequential logic circuits and their implementation	[AP]
C302.4	Apply synchronous sequential logic for reducing state reduction.	[AP]
C302.5	Understanding Programmable logic devices and applying for logical function implementation.	[AP]
C302.6	Apply verilog code for realization of combinational logical circuits.	[AP]

Course Contents:

Canonical Forms and Minimization   **15**

Minterms, Maxterms, Complements, Implementation using universal logic gates, Minimizing functions using Karnaugh maps – 2,3 & 4 Variables, Minimization using Quine McClusky method – 4 Variables.

Combinational and Sequential logic circuits: **15**

Adders and Subtractors, Multiplexer, Demultiplexer, Encoders, Decoders, Two Bit Magnitude comparator, Carry Look-ahead adder, Code converters, – Binary to Gray, BCD to Excess-3 Parity generator and Checker. **Sequential logic circuits:** Latches and flip flops, Realization of one flip flop using other flip flops, Asynchronous Up counter and Synchronous counters, Shift registers –SISO,SIPO,PISO,PIPO, Application of Shift registers. Case Study: DTMF Decoder.

Synchronous Sequential logic: **15**

Analysis of Synchronous Sequential Circuits, Sequence generator, State transition diagrams and state transition tables. PLD's - PLA, PAL, Modelling basic combinational circuits using Verilog**.**

	Total Hours:	**45**

Text Books:		
	1	M. Morris Mano, Michael D.Ciletti., "Digital Design",6th Edition, Pearson education, 2018
	2	Donald D. Givone, "Digital principles and Design", 2004, McGraw Hill Education India Private Ltd., 29th Reprint, 2018
	3	Samir Palnitkar,"Verilog HDL: A Guide to Digital Design and Synthesis" Prentice Hall, Second Edition, 2018
Reference Books:		
	1	J. F. Wakerly, "Digital Design - principles and practices", 4th Edition, Pearson Education, 2008.
	2	Thomas L. Floyd, Digital Fundamentals, 10th Edition, Pearson Education, New Delhi, 2017
	3	John.M Yarbrough, "Digital Logic Applications and Design", Thomson Learning, 2006.
Web References:		
	1	https://www.tutorialspoint.com/digital_circuits/digital_circuits_useful_resources.htm
	2	http://www.technologystudent.com/elec1/dig1.htm
	3	*https://www.electronicsforu.com/technology-trends/learn-electronics/digital-electronics-basics*
	4	*https://www.electrical4u.com/digital-electronics/*
Online Resources:		
	1	https://nesoacademy.org/ec/05-digital-electronics
	2	https://www.electronics-tutorials.com/basics/digital-basics.htm
	3	https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/
	4	https://www.tutorialandexample.com/digital-electronics-tutorial

Continuous Assessment				End Semester Examination	Total
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%)** **[80 Marks]**
C302.1	Understand	Quiz	20
C302.2, C302.3	Apply	Assignment	20
C302.4, C302.5	Apply	Assignment	20
C302.6	Apply	Simulation using Logisim	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment** **[120 Marks]**		**End Semester Examination (60%)** **[100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	10	10
Understand	40	40	40
Apply	40	40	30
Analyse		10	20
Evaluate			
Create			

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 **(60 Marks)**	**FA 1 (40 Marks)**		**SA 2** **(60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
Course Articulation Matrix														
1	3	2	1	1	-	-	-	-	1	-	-	-	2	-
2	3	2	1	1	-	-	-	-	-	-	-	-	2	-
3	3	2	1	1	-	-	-	-	-	-	-	-	2	-
4	3	2	2	1	-	-	-	-	-	-	-	-	2	-
5	3	2	2	1	-	-	-	-	-	-	-	-	2	-
6	3	2	2	1	-	-	-	-	-	-	-	-	2	-
1	Reasonably agreed				2	Moderately agreed			3	Strongly agreed				

22EC303	ELECTROMAGNETICS	3/0/0/3

Nature of Course	G (Theory Analytical)

Course Objectives:

1	To review about co-ordinate systems and to enable the students to understand the concepts of electrostatics
2	To enable the students to understand the concepts of static and vector magnetic fields
3	To understand how electric and magnetic fields affect materials and the relation between the fields under time varying situations.
4	To analyze the principles of propagation of uniform plane waves

Course Outcomes:
Upon completion of the course, students shall have ability to

C303.1	Understand the concepts of Electrostatics for various geometries	[U]
C303.2	Apply boundary conditions to solve for fields at interface between two different charge medium	[AP]
C303.3	Understand the basic Magneto static laws and interpret the nature of magnetic fields	[U]
C303.4	Understand the concepts of time varying electric and magnetic fields	[U]
C303.5	Apply the concepts of Maxwell's equations in propagation of uniform plane waves	[AP]
C303.6	Analyze the propagation of electromagnetic waves	[AN]

Course Contents:

ELECTROSTATICS: 15

Introduction to Co-ordinate System, Gradient, Divergence and Divergence theorem, Curl and Stoke's theorem, Laplacian of a Scalar. Coulomb's law, Electric field, Electric potential, Charge densities – Line, Surface, Volume charge densities, Electric flux, Electric flux density. Electric potential due to dipole - Capacitance Energy density in the electrostatic field. Laplace and Poisson's equations- Applications for Laplace's equation - Capacitance - Parallel Plate-Boundary conditions, Electric current, Current density, Point form of Ohm's law.

MAGNETOSTATICS & TIME VARYING FIELD: 15

Magnetic field, Biot-Savart's law, Ampere's law, Magnetic vector potential, Magnetic flux density, Definition of Inductance and inductors-Inductance due to Solenoid and Toroid, Boundary conditions, Time Varying Field-Equation of continuity for time varying fields-
--Maxwells equations, Faraday's law and its significance

UNIFORM PLANE WAVE: 15

Wave, Wave equation, Wave propagation in space, conducting media and Dielectric loss, travelling waves and standing waves Plane waves at interfaces, Normal incidence, Phase velocity, Group velocity, Index of refraction, Power and energy relations,Poynting theorem Polarizations - Linear, Elliptic and Circular.

	Total Hours:	45

Text Books:	
1	Sadiku M H, "Principles of Electromagnetics", Oxford University Press Inc., New Delhi,2015.
2	John D Kraus and Daniel A Fleisch," Electromagnetic with applications", 5th Edition, McGraw-Hill, 2005
3	William H. Hayt, John A. Buck, "Engineering Electromagnetic", 8th Edition, McGraw-Hill, 2014.
Reference Books:	
1	David K Cheng,"Fields and Wave Electromagnetics", Pearson new international edition , Pearson Education Limited 2013
2	J. Edminister, "Schaum's Outline of Electromagnetics", 4th Edition, McGraw-Hill, 2013
3	Martin K.Plonus, "Applied Electromagnetics"-McGraw Hill 1984
Web References:	
1	nptel.ac.in/courses/108104087
2	http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-630-electromagnetics-fall-2006/
3	http://nptel.ac.in/courses/117103065/
4	http://nptel.ac.in/video.php?subjectId=108106073
Online Resources:	
1	Biological effects of EMF –radiation hazards of wearable antennas by Dr. Heather Song University of Colorado Springs, 2014
2	Wearable antennas for off-body radio links at VHF and UHF bandsP Nepa, H Rogier - IEEE antennas and Propagation Magazine, 2015 - ieeexplore.ieee.org
3	On the evaluation of biological effects of wearable antennas on contact with dispersive medium in terms of SAR and bio-heat by using FIT technique https://ieeexplore.ieee.org/document/6521719

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%)** **[80 Marks]**
C303.1,	Understand	Assignment	20
C303.2, C303.3	Apply, Understand	Case Study	20
C303.4 C303.5	Understand, Apply	Assignment	20
C303.6	Analyze	Technical Seminar	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	20	20	20
Apply	30	30	30
Analyse	30	30	30
Evaluate			
Create			

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks			**CA 2 : 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II**		**Component - I**	**Component - II (20 Marks)**	

		(20 Marks)		(20 Marks)		

Course Articulation Matrix													
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	3	3	3	2	-	-	-	-	1	-	-	-	2	-
2	3	2	3	2	-	-	-	-	-	-	-	-	2	-
3	3	2	2	2	-	-	-	-	-	-	-	-	2	-
4	3	2	3	2	-	-	-	-	-	-	-	-	2	-
5	3	2	2	2	-	-	-	-	-	-	-	-	2	-
6	3	2	3	2	-	-	-	-	-	-	-	-	2	-
1	Reasonably agreed			2	Moderately agreed			3	Strongly agreed					

22MA307	PROBABILITY AND RANDOM PROCESSES (ECE)	3/1/0/4

Nature of Course	B(100% Analytical)
Pre requisites	-

Course Objectives:

1.	To classify various types of probability distributions that occurs frequently in communication and signal processing.
2.	To acquire skills in handling situations involving more than one random variable.
3.	To provide necessary basic concepts of random processes and its applications in communication engineering.
4.	To estimate the power spectral density for a given random signal.

Course Outcomes: (Theory)
Upon completion of the course, students shall have ability to

C307.1	Understand the concept of probability and its features	[R]
C307.2	Understand to handle situations involving random variables and Standard distributions.	[U]
C307.3	Apply skills to handle situations involving single and two dimensional random variables and predict the correlation and regression between the random variables	[AP]
C307.4	Use the concepts of random processes in signals and systems	[AP]
C307.5	Apply the concepts of Correlation and spectral density analysis.	[AP]

Course Contents

MODULE I - PROBABILITY AND RANDOM VARIABLES   **20**

Probability concepts – Addition and Multiplication law of probability – Conditional probability – Total probability theorem – Baye's theorem – Problems – One dimensional random variable – Probability mass function – Probability density function – Discrete and continuous random variables – Moment generating function – Properties –Standard distributions – Discrete distributions : Binomial – Poisson – Geometric – Continuous distributions : Uniform – Exponential – Normal distributions .

MODULE II - TWO DIMENSIONAL RANDOM VARIABLES AND RANDOM PROCESS   **20**

Two dimensional random variables – Joint distributions – Marginal and conditional distributions – Covariance – Correlation and Regression – Classification of Random processes – Definitions – strictly stationary processes – wide-sense stationary processes – Poisson process – Markov process – Markov Chain – Transition probabilities

MODULE III - POWER SPECTRAL DENSITY   **20**

Auto correlation – Cross correlation – Properties – Power spectral density – Cross spectral density – Properties – Relationship between cross correlation and cross spectral densities.

	Total Hours	**60**

Text Books:

1.	Peebles Jr. P.Z., "Probability Random Variables and Random Signal Principles", Tata McGraw-Hill Publishers, Fourth Edition, New Delhi, 2016
2.	Palaniammal, S., "Probability and Random Processes", Prentice hall of India, New Delhi, 2014 ,Reprint 2015.
3.	Roy D.Yates , David J.Goodman , "Probability and Stochastic Processes", John Wiley & Sons, Inc, 3rd Edition, 2014.

	Reference Books:
1.	Ross, S., "A First Course in Probability", Ninth edition, Pearson Education, Delhi, 2014
2.	Henry Stark and John W. Woods, "Probability and Random Processes with Applications to Signal Processing", Pearson Education, Fourth Edition, Delhi, 2011
3.	Hwei Hsu, "Schaum's Outline of Theory and Problems of Probability, Random Variables and Random Processes", Tata McGraw Hill Edition, New Delhi, 2004.
	Web References:
1.	http://nptel.ac.in/courses/111104079/
2.	http://www.nptelvideos.in/2012/12/probability-random-variables.html
3.	http://freevideolectures.com/Course/3028/Econometric-Modelling/22
4.	http://freevideolectures.com/Course/2311/Digital-Communication/4
5.	https://nptel.ac.in/courses/111/102/111102111/
	Online Resources:
1.	https://www.coursera.org/learn/probability-intro
2.	https://ocw.mit.edu/resources/res-6-012-introduction-to-probability-spring-2018/
3.	https://www.coursera.org/learn/introductiontoprobability
4.	https://nptel.ac.in/courses/117/103/117103067/

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C307.1	Remember	Quiz	20
C307.2	Understand	Seminar	20
C307.3 – C307.5	Apply	Tutorial	20

C307.3 – C307.5	Apply	Assignment	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%)** **[120 Marks]**		**End Semester Examination (60%)** **[100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	30	30	30
Apply	50	50	50
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination					
Continuous Assessment (40%) **[200 Marks]**					**End Semester Examination (60%)** **[100 Marks]**
CA 1: 100 Marks			**CA 2: 100 Marks**		
SA 1 **(60 Marks)**	**FA 1 (40 Marks)**		**SA 2** **(60 Marks)**	**FA 2 (40 Marks)**	
	Component - I **(20 Marks)**	**Component - II** **(20 Marks)**		**Component - I** **(20 Marks)**	**Component - II** **(20 Marks)**

												Course Articulation Matrix	
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	1	1	-	-	-	-	-	-	-	-	-	-	1	-
2	2	2	-	-	-	-	-	-	-	-	-	-	1	-
3	3	3	-	-	-	-	-	-	-	-	-	-	-	-
4	3	3	-	-	-	-	-	-	-	-	-	-	1	-
5	3	3	-	-	-	-	-	-	-	-	-	-	-	-
1	Reasonably agreed			2	Moderately agreed			3	Strongly agreed					

22CS301	**ADVANCED JAVA PROGRAMMING**	1/0/4/3
Nature of Course	F (Theory Programming)	
Pre requisites	Java Programming	

Course Objectives:

1	To provide insight knowledge of OOP concepts and usage of this, static, super and final keywords.
2	To discuss about different type of Collection Frameworks.
3	To demonstrate threads, JDBC & exception handling with real world examples.
4	To illustrate designing of GUI applications using swing component.

Course Outcomes:
Upon completion of the course, students shall have ability to

C301.1	Illustrate the OOPs concepts like Constructors, Inheritance, Polymorphism and the usage of this, static, super and final keywords.	[AP]
C301.2	Apply the concepts of Exception Handling in real world applications and usage of collection frameworks.	[AP]
C301.3	Develop Multithreaded applications.	[AP]
C301.4	Develop GUI Applications using swing component and to explain the concept of Servlets.	[AP]
C301.5	Develop java application to interact with database by using relevant JDBC Driver.	[AP]

Course Contents

Module 1: Introduction to OOPS **15 Hrs**

Class and Object, Encapsulation and Abstraction, Inheritance, Polymorphism, Message Passing, Keywords : this, super, static, final, extends and implements. Method Signature and Prototype, Mutator Methods and Accessor Methods, Var-Arg Method, hashCode() and toString() methods. Immutable Objects Vs Mutable Objects, User defined Immutable Class, Constructors : Introduction, Default Constructor, User Defined Constructors, Constructor Overloading, Instance Variable, Instance Methods, Instance Block and Instance Flow Of Execution. Regular Expressions (RegEx).
Inheritance Introduction, Types of Inheritance, Up Casting, Down Casting, IS-A Relationship & HAS-A Relationship, Composition Vs Aggregation, **Polymorphism:** Method Overloading, & Method Overriding.

Module 2: Abstraction, Exception Handling & Collections **15 Hrs**
Abstraction: Abstract Methods and Abstract classes. Interfaces, abstract classes and Interfaces, Concrete Methods Vs Abstract Methods, Differences between classes, abstract classes and Interfaces, Marker Interfaces. **Exception** - try catch block, Finally Block, Exception Hierarchy, Multiple Exceptions In a Catch Block, Parameterized Try Block, Overriding Methods And Exception. Creating Your Own Exception, The Assert Keyword, The Generics Framework, **Collections:** Set, List, Map & Tree, The Iterator Interface. Working with Hashtable Collection
Threads: Introduction to Threads, Creating And Starting Threads, Basic Thread Control

Methods. Multithreading, Working with Multiple, threads, Thread Life Cycle, Thread Priorities, Synchronizing Methods.

Module 3: Swings, Servlets & JDBC   **15 Hrs**
Swings: Introduction, JLabel, JButton, JTextField ,JTextArea, JPasswordField, JCheckbox, JComboBox, JRadioButton, JScrollBar, JMenuItem and JMenu.
JDBC: Drivers, CURD operations, Database connectivity
Servlets : Overview of Servlets , Servlet Life Cycle, Servlet Request and Response , web.xml and its need, Servlet Configuration, Session Tracking

	Total Hours	**45**

List of Experiments
1. Implementation of default and parameterized constructors.
2. Implementation of method overloading and overriding.
3. Implementation of Inheritance.
4. Implementation of Abstract and Interface concepts.
5. Programs using collection Interface.
6. Implementation of multithreading Concepts.
7. Program to handle multiple exception using try, catch and finally block.
8. Implementation of swing components.
9. Implement Simple application using servlets.
10.Implement CURD operation using JDBC.

	Total Lab Hours	**30**
	Total Hours	**75**

Text Books:	
1.	Herbert Schildt,"Java:TheCompleteReference",12th edition, Mc craw Hill, 2021.
2.	Robert Liguori, Patricia Liguori, "Java 8 Pocket Guide", O'Reilly Media, 2014.
3.	ShagunBakliwal, Hands-on Application Development using Spring Boot, bpb publisher, 2021.

Reference Books:	
1	Paul Deitel, Harvey Deitel, "Java How To Program",10th Edition, Prentice Hall Publications,2014.
2	Cay S.Horstmann and GaryCornell, "Core Java, Vol.2: Advanced Features", 9th Edition, Prentice Hall,2013.

Web References:	
1	https://www.javatpoint.com/java-tutorial
2	https://www.geeksforgeeks.org/java/
3	http://www.javatpoint.com/java-tutorial

Online Resources:	
1	http://www.coursera.org/specializations/object-oriented-programming

2	http://www.udemy.com/topic/java-certification/
3	http://www.edx.org/learn/jav

Continuous Assessment								Total (A+B)	Total Continuous Assessment	End Semester Examination	Total
Theory				Practical							
Formative Assessment	Summative Assessment	Total	Total (A)	Formative Assessment	Summative Assessment	Total (B)					
80	120	200	100	75	25	100	200	50	50	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	Bloom's Level	Assessment Component	FA (16%) [80 Marks]
C301.1 & C301.2	Apply	Quiz	20
C301.3	Apply	Assignment	20
C301.4 & C301.5	Apply	Case Study	40

Assessment based on Summative and End Semester Examination – Theory		
Bloom's Level	Summative Assessment (15%) [120 Marks]	
	CIA1: (60 Marks)	CIA2: (60 Marks)
Remember	20	20
Understand	40	40
Apply	40	40
Analyse	-	-
Evaluate	-	-
Create	-	-

Assessment based on Continuous and End Semester Examination - Practical			
Bloom's Level	Continuous Assessment (25%) [100 Marks]		End Semester Examination (50%) [100 Marks]
	FA: (75 Marks)	SA: (25 Marks)	
Remember	10	10	10
Understand	30	30	30
Apply	40	40	40

Analyse	20	20	20
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (50%)								End Semester Practical Examination (50%)
CA 1 (100 Marks)			CA 2 (100 Marks)			Practical Exam (100 Marks)		
SA 1 (60M)	FA 1		SA 2 (60M)	FA 2		FA (75M)	SA (25M)	
	Component-I (20 Marks)	Component-II (20 Marks)		Component-I (20 Marks)	Component-II (20 Marks)			

No. of the CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C301.1	3	3	3	1					2	2		2	3	2	3
C301.2	3	3	3	3	2				3	2		2	3	2	2
C301.3	3	3	3	2	3				2	2		2	3	3	3
C301.4	3	3	3	2	3				2	2		2	3	3	3
C301.5	3	3	3	2	3				2	2		2	3	3	3
1	Reasonably Agreed			2		Moderately Agreed			3			Strongly Agreed			

22CS201		DATA STRUCTURES AND ALGORITHMS	1/0/4/3
Nature of Course:		F (Theory Programming)	
Prerequisites:		Problem Solving using C++	

Course Objectives:

1.	To introduce list data structure and its applications.
2.	To impart the importance of stacks and queues in problem solving.
3.	To provide knowledge on Tree and Graph data structures.
4.	To discuss the role of hashing in information storage and retrieval.

Course Outcomes:
Upon completion of the course, students shall have ability to:

C201.1	Implement the basic data structures like array and LinkedList.	[AP]
C201.2	Solve real world problems efficiently by applying stack and queue data structures.	[AP]
C201.3	Illustrate the applications of tree data structures.	[AP]
C201.4	Discuss the importance of hashing techniques in information storage.	[AP]
C201.5	Employ graph algorithms for solving real time computing problems and analyze them.	[A]

Course Contents:

Module I Linked List & Stack **15 Hrs**
Linked List: Array vs Linked list - Types of linked list - Singly, Doubly and Circular Linked list - Applications of linked list. **Stack:** Stack Model**,** Array and Linked list implementation of Stack –Applications of Stack - Infix, Prefix and Postfix expressions - infix to postfix conversion - Expression Evaluation- Balancing Parenthesis.

Module II Queue and Trees **15 Hrs**
Queue: Queue Model, Array and Linked list implementation of Queue-Priority Queue - Applications of Queue. **Trees:** Binary Tree - Binary Search Tree - Insertion, Deletion, Traversal - Inorder, Preorder, Postorder, Level order traversal.

Module III Graphs and Hashing **15 Hrs**
Graphs: Weighted and Directed graphs - Adjacency matrix and list implementation - Traversal – Breadth First Search & Depth First Search. **Hashing:** Direct Address Table, Hash function, Collision resolution techniques, Linear Probing, quadratic probing, double hashing.

	Total Hours (Theory):	45 Hours

Lab Component

S. No.	Lab Exercises
1	Implementation of Singly, Doubly and Circular Linked List.
2	Implementation of Stack using Arrays.
3	Implementation of Stack using Linked List.

4	Implementation of Stack applications		
5	Implementation of Queue using Arrays.		
6	Implementation of Queue using Linked List.		
7	Implementation of Queue applications.		
8	Implementation of Hashing techniques		
9	Implementation of Binary Search Tree.		
10	Implementation of Graph Traversal algorithms.		
		Total Hours (Lab):	**30 Hours**
		Total Hours: (45+30)	**75 Hours**

Text Books:

1	Sartaj Sahni, "Data Structures, Algorithms and Applications in C++", Silicon paper publications, 2004.
2	Anany Levitin, Introduction to the design & analysis of algorithms , 3rd Edition, Pearson Education, 2021.
3	Michael T. Goodrich, "Data Structures and Algorithms in C++", 2nd Edition, Wiley Publication, 2011.

Reference Books:

1	SeymourLipschutz,"DataStructuresbySchaumSeries",2ndedition,TataMcGrawHill, 2013.
2	NarasimhaKarumanchi,"DataStructuresandAlgorithmsMadeEasy:DataStructuresandAlgorithmic Puzzles",5thEdition,CareerMonk,2016.
3	DebasisSamanta,"Classicdatastructures",PrenticeHallofIndia,2ndedition,2014.

Web References:

1	https://www.codingninjas.com/courses/c-plus-plus-data-structures-and-algorithms
2	https://www.edx.org/course/data-structures-algorithms-using-c

Online Resources:

1	https://www.programiz.com/dsa I
2	https://freevideolectures.com/course/2519/c-programming-and-data-structures
3	https://www.cprogramming.com/algorithms-and-data-structures.html

Continuous Assessment									End Semester Examination	Total
Theory				Practical			Total (A+B)	Total Continuous Assessment		
Formative Assessment	Summative Assessment	Total	Total (A)	Formative Assessment	Summative Assessment	Total (B)				
80	120	200	100	75	25	100	200	50	50	100

Formative Assessment based on Capstone Model - Theory

Course Outcome	Bloom's Level	Assessment Component	FA (10%) [80 Marks]
C201.1	Apply	Quiz	**20**
C201.2	Apply	Case Study	**20**
C201.3	Apply	Coding contest	**20**
C201.4, C201.5	Analyze	Assignment	**20**

Assessment based on Summative and End Semester Examination - Theory		
Bloom's Level	**Summative Assessment (15%) [120 Marks]**	
	CIA1: (60 Marks)	**CIA2: (60 Marks)**
Remember	20	20
Understand	40	30
Apply	40	40
Analyse	-	10
Evaluate	-	-
Create	-	-

Assessment based on Continuous and End Semester Examination - Practical			
Bloom's Level	**Continuous Assessment (25%) [100 Marks]**		**End Semester Examination (50%) [100 Marks]**
	FA: (75 Marks)	**SA: (25 Marks)**	
Remember	10	10	10
Understand	30	30	30
Apply	60	40	40
Analyse	-	20	20
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination							
Continuous Assessment (50%)							**End Semester Practical Examination (50%)**
CA 1 (100 Marks)			**CA 2 (100 Marks)**			**Practical Exam (100 Marks)**	
SA 1 (60M)	**FA 1**		**SA 2 (60M)**	**FA 2**		**FA (75M)**	**SA (25M)**
	Component-I (20 Marks)	**Component-II (20 Marks)**		**Component-I (20 Marks)**	**Component-II (20 Marks)**		

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C201.1	3	3	2	2	2	-	-	-	2	-	-	2	3	2	2
C201.2	3	3	2	2	2	-	-	-	2	-	-	2	3	2	2
C201.3	3	3	2	2	2	-	-	-	2	-	-	2	3	2	2
C201.4	3	3	2	2	2	-	-	-	2	-	-	2	3	2	2
C201.5	3	3	2	2	2	-	-	-	2	-	-	3	3	2	2
1	Reasonably Agreed			2	Moderately Agreed				3	Strongly Agreed					

22EC304	DIGITAL ELECTRONICS LABORATORY	0/0/2/1

Nature of Course: M (Practical application)

Course Objectives:
1. To design, construct and debug combinational and sequential circuits based on an abstract functional specification.
2. To simulate and design Digital logic circuits using software Tools.

Course Outcomes

C304.1	Ability to design and analyze various combinational and sequential circuits.	[AP]
C304.2	Analyzing and implementing the various combinational logic circuits and verifying its truth table.	[AN]
C304.3	Analyzing the various sequential logic circuits and its characterization.	[AN]
C304.4	Design of any Digital display using digital IC's.	[AP]
C304.5	Simulation of digital circuits using simulation Tool.	[AP]

Course Content:

S.No	List of Experiments	CO Mapping	BT
1	Analysis and Synthesis of Arithmetic Expressions using Adders/Subtractors	C304.1	[AN]
2	Analysis and Synthesis of Logic Functions using 4 x 1 Multiplexers & 1 x 4 Demultiplexer	C304.2	[AN]
3	Analysis and Synthesis of Logic Functions using Decoders & Encoders	C304.2	[AN]
4	Analysis and Synthesis of Boolean Relations using two bit Digital Comparator	C304.2	[AN]
5	Analysis and synthesis of Code Converter (Binary to Gray and BCD to Excess-3)	C304.2	[AN]
6	Analysis and Synthesis of Multi-bit Sequential Circuits using Shift Registers (SISO,SIPO,PIPO)	C304.3	[AN]
7	Analysis and Synthesis of Multi-bit Sequential Circuits using Asynchronous Counter	C304.3	[AN]
8	Combinational logic circuits design using Verilog	C304.5	[AN]
9	Design a seven segment Electronic clock / Name display.	C304.4	[AN]
10	Design of an Arithmetic and Logical Unit using simulation Tool.	C304.5	[AN]
		Total Hours	**30**

Reference Books:
1. M. Morris Mano, Michael D.Ciletti., "Digital Design",4th Edition Pearson education,2018
2. C. H. Roth Jr., Larry L. Kinney "Fundamentals of Logic Design", 7th Edition, Cengage Learning, 2019
3. Thomas L. Floyd, Digital Fundamentals, 10th Edition, Pearson Education, New Delhi, 2011

Web References:
1. http://www.electrical4u.com/digital-electronics.htm
2.http://www.technologystudent.com/elec1/dig1.htm
3.http://www.allaboutcircuits.com/education/

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
75	25	100	60	40	100

Assessment based on Continuous and End Semester Examination			
Bloom's Level	Continuous Assessment (60%) [100 Marks]		End Semester Practical Examination (40%) [100 Marks]
	FA (75 Marks)	SA (25 Marks)	
Remember			
Understand			
Apply			
Analyse	30	20	20
Evaluate	30	40	40
Create	40	40	40

Course Articulation Matrix														
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	3	2	1	1	-	-	-	-	1	1	-	-	3	-
2	2	3	1	1	-	-	-	-	1	1	-	-	3	-
3	2	2	1	1	-	-	-	-	1	1	-	-	3	-
4	2	2	1	2	-	-	-	-	1	1	-	-	3	-
5	2	2	1	1	1	-	-	-	1	1	-	-	3	-
1	Reasonably agreed		2	Moderately agreed			3		Strongly agreed					

22MG701	PRINCIPLES OF MANAGEMENT	3/0/0/3
Nature of Course	: C (Theory Concept)	

Course Objectives:

1	To enable the students to understand the principles of management and the management concepts
2	To enable the students to understand the need for business process reengineering
3	To enable the students to understand the concepts of organizational behaviour
	To enable the students to understand the human resource management

Course Outcomes:
Upon completion of the course, students shall have ability to

C701.1	Explore their acquired knowledge on recalling the management skills acquired	[R]
C701.2	Understand the concept of principles of management.	[U]
C701.3	Apply the management concepts in an organization.	[AP]
C701.4	Analyse organizational behaviour in an organization.	[AN]
C701.5	Analyse human resource and it's quality.	[AN]

Course Contents:

PRINCIPLES OF MANAGEMENT: **15**
Meaning, Definition and Significance of Management, Basic Functions of Management – Planning, Organizing, Staffing, Directing and Controlling- **ENGINEERS AND ORGANIZATIONAL ENVIRONMENT**: Social, Economic, Technological and Political and Legal - Social Responsibility of Engineers- Current trends and issues in Management

MANAGEMENT CONCEPTS: **15**
MBO, Theory X & Y, Kaizen, Six Sigma, Quality Circles, TQM and TPM **BUSINESS PROCESS REENGINEERING:** Need for BPR, Various phases of BPR, Quality, Factors Influencing Productivity.

ORGANISATIONAL BEHAVIOUR: **15**
Meaning, Definition, Significance of OB, Role of Leadership, Personality and Motivation, Attitudes, Stress at work, Types of Organization. **HUMAN RESOURCE MANAGEMENT:** Meaning, Definition, Importance, Objectives and Functions, Job Analysis and Recruitment, Selection and Placement, Training and Development.

	Total Hours:	**45**

Text Books:

1	Harold Koontz, Heinz Weihrich and Ramachandra Aryasri, "Principles of Management"-Tata McGraw Hill, NewDelhi, 2014.

2	Gary Dessler, "Human Resource Management", Prentice Hall of India, New Delhi, 2009
3.	Stephen P. Robbins and Mary Coulter, 'Management', Prentice Hall of India, 8th edition. 2013

Reference Books:	
1	Mamoria, C. B., "Personnel Management", Sultan Chand and Sons, New Delhi, 2005.
2	Charles W L Hill, Steven L McShane, 'Principles of Management', Mcgraw Hill Education, Special Indian Edition, 2007.
3	Hellriegel, Slocum & Jackson, ' Management - A Competency Based Approach', Thomson South Western, 10th edition, 2007.

Web References:	
1	http://www.nptel.ac.in/courses/110102016

Online Resources:	
1	https:// www.coursera.org/learn/fundamentals-of-management

Continuous Assessment					
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment	End Semester Examination	Total
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C701.1	Remember	Quiz	20
C701.2	Understand	Assignment	20

| C701.3 | Apply | Group Assignment | 20 |
| C701.4 & C701.5 | Analyse | Class Presentation | 20 |

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%)** **[120 Marks]**		**End Semester Examination (60%)** **[100 Marks]**
	CIA1: [60 Marks]	**CIA2: [60 Marks]**	
Remember	20	10	10
Understand	20	20	20
Apply	60	40	40
Analyse	-	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) **[200 Marks]**						**End Semester Examination (60%)** **[100 Marks]**
CA 1: 100 Marks			**CA 2: 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

Course Articulation Matrix														
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
1	-	-	-	-	-	-	-	-	2	-	3	2	1	2
2	-	-	-	-	-	-	-	2	3	2	3	2	-	2
3	-	-	-	-	-	-	-	-	3	2	3	2	-	2
4	-	-	-	-	-	-	-	2	3	2	3	2	-	2
5	-	-	-	-	-	-	-	-	2	2	-	-	2	2
1	Reasonably agreed		2	Moderately agreed		3		Strongly agreed						

22EC401		**SIGNALS AND SYSTEMS**	3/0/0/3

Nature of Course	G (Theory Analytical)

Course Objectives:

1	Understanding the fundamental characteristics of signals and systems.
2	Understanding the characterization of LTI systems in time domain.
3	Understanding time domain and frequency domain analysis of Continuous and Discrete systems.
4	Imparting analytical skills to solve problems involving convolution integral and convolution sum.
5	Imparting knowledge of correlation between signals

Course Outcomes:
Upon completion of the course, students shall have ability to

C401.1	Acquire the knowledge of signal, system and its classifications	[R]
C401.2	Analyze the spectral characteristics of continuous-time periodic and aperiodic signals using Fourier Transform.	[AN]
C401.3	Analyze the response of LTI system using convolution integral and LSI system using convolution.	[AN]
C401.4	Analyze system properties based on impulse response and Frequency Response	[AN]
C401.5	Apply Laplace transform for the analysis of continuous-time systems and Z-transform for the analysis of discrete-time signals and systems.	[AP]

Course Contents:

SIGNALS AND SYSTEMS 15

Signals (discrete / continuous) – Basic signals – Classification of signals – Operations on signals , Systems – Classification of systems, Continuous-time Linear Time Invariant (LTI) systems and Discrete-time Linear Shift Invariant (LSI) systems and its properties

ANALYSIS OF CT SYSTEMS 15

Relationship between Laplace and Fourier transform , system representation using differential equations – System Analysis using Laplace transform and Fourier transform –Input-output behaviour with periodic and aperiodic convergent inputs -Impulse response and step response – Frequency response , Convolution integral

ANALYSIS OF DT SYSTEMS 15

Fourier series representation of discrete-time signals – Discrete Time Fourier Transform (DTFT) and its properties – System representation using difference equations – Relationship between Z-transform and DTFT-System Analysis using Z-transform and DTFT – poles and zeros – stability – impulse response and step response – frequency response , convolution sum, , Correlation between signals – Autocorrelation and Cross correlation

Total Hours:	**45**

Text Books:

1	Allan V. Oppenheim et al," Signals and Systems", Prentice Hall of India, 2/E, 2015
2	Ramakrishna Rao P, "Signals and Systems", McGraw Hill Education, New Delhi, 2/E, 2013.

3	Simon Haykin and Barry VanVeen, Signals and systems, 2007, second edition, Wiley, India.

Reference Books:

1	J. Roberts, "Fundamentals of Signals and Systems", Tata McGraw Hill, 2007.
2	B. P. Lathi, "Signal Processing and Linear Systems", Oxford University Press, 1998.
3	R.F. Ziemer, W.H. Tranter and D.R. Fannin, "Signals and Systems – Continuous and Discrete", Prentice Hall, 4/E, 1998.

Web References:

1	http://www.nptelvideos.in/2012/12/signals-and-system.html
2	http://freevideolectures.com/Course/3177/Signals-and-Systems

Online Resources:

1	https://www.edx.org/course/signals-systems-part-1-iitbombayx-ee210-1x-2
2	https://www.edx.org/course/signals-systems-part-2-iitbombayx-ee210-2x-2

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C401.1	Remember	Quiz	20
C401.2	Analyze	Assignment	20
C401.3	Analyze	Assignment	20
C401.4 and C401.5	Analyze, Apply	Group Assignment	20

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	20	10	10
Understand	40	40	40
Apply	40	40	30
Analyse		10	20
Evaluate			
Create			

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]					End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks		
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)	
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Course Articulation Matrix

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	3	2	1	1	-	-	-	-	2	-	-	1	2	-
2	3	2	2	3	-	-	-	-	2	-	-	-	2	-
3	3	3	2	2	2	-	-	-	2	-	-	-	2	-
4	2	2	3	3	-	-	-	-	2	-	-	-	3	-
5	2	2	3	3	-	-	-	-	-	-	-	-	3	-

1	Reasonably agreed	2	Moderately agreed	3	Strongly agreed

22EC402	ANALOG AND DIGITAL COMMUNICATION	3/0/0/3

Nature of Course	G (Theory analytical)

Course Objectives:

1	To introduce the concepts of analog and pulse communication systems.
2	To equip students with various issues related to analog and pulse communication such as modulation, demodulation, transmitters and receivers.
3	To deliberate different types of baseband and passband transmission systems
4	To study channel capacity concepts.
5	To enable the students to differentiate between source coding and error control coding and understand their roles in digital systems

Course Outcomes:
Upon completion of the course, students shall have ability to

C402.1	Obtain knowledge about modulation concepts and the blocks of analog and pulse communication systems.	R
C402.2	Analyze and design of various modulation and demodulation techniques of analog and pulse communication systems.	AN
C402.3	Apply wave shaping techniques to minimize ISI and analyze modulation techniques with respect to generation, bandwidth and probability of error	AN
C402.4	Acquire knowledge in channel capacity.	U
C402.5	Know the concepts of Source Coding and Error control coding used in Digital Communication	U
C402.6	Differentiate and apply Source Coding and Error control coding in Communication.	AP

Course Contents:

Analog and Pulse modulation:	**15**

Concept of modulation and demodulation, Need for modulation, amplitude modulation (AM) (Frequency Domain Representation, Modulation Index, Single tone AM, Power of single tone AM, Square law diode modulation, Envelope Detector) -vestigial sideband (VSB) modulation (Generation of VSB signals, Time domain representation of VSB signals, Demodulation of VSB signals); AM transmitter and receiver (AM Super heterodyne Receiver), Angle modulation - phase modulation (PM) & frequency modulation (FM) (Concept of Angle modulation, Mathematical representation of FM and PM, Relationship between PM and FM, Phasor representation of angle modulated PM and FM); narrowband and wideband FM (Mathematical representation of Narrow band and Wideband FM), FM modulators and demodulators (LIC method), sampling theorem for band limited signals (Proof of Sampling Theorem, Nyquist Rate and Interval, Signal Reconstruction, Aliasing), pulse amplitude modulation (PAM) (Mathematical Analysis),pulse code modulation (PCM) (Generation, Quantization noise), Differential pulse code modulation.

Baseband and Passband Transmission:	**15**

Geometric representation of signal waveforms (Baseband Pulses), Matched filter; Nyquist rate and wave shaping techniques; (Probability of error due to noise), ISI and Eye Pattern (Nyquist's Criterion for distortion less transmission),Line coding (RZ, NRZ, Manchester, Biphase).Coherent and non-coherent detection of signals in noise (Baseband Transmission Model) - BPSK, BFSK, DPSK, M-ary modulation schemes: QPSK, QAM, MSK, GMSK - Signal

representation, Generation and Detection, Probability of error analysis (M-ary data transmission Systems)

Channel capacity and Error control coding: **15**
Source Coding Theorem, Data Compaction (Lossless data compression - Huffman Coding, Prefix Coding), Discrete memoryless channel, Channel Capacity, Linear Block Codes (Syndrome decoding, Minimum Distance Considerations, Hamming Codes), Cyclic Codes, Convolutional Codes (Viterbi algorithm).

	Total Hours:	45

Text Books:

1	George Kennedy and Bernard Davis," Electronic Communication systems", 6th Edition, TMH, 2017
2	S. Haykin, Micheal Moher, Communication Systems, 5th Ed., John Wiley & Sons, 2021.
3	S. Haykin, Digital Communication Systems, John Wiley & Sons, 2013.
4	H. Taub and D. L. Schilling, Principles of Communication Systems, 4th edition, McGraw Hill, 2017.

Reference Books:

1	J. G. Proakis, Digital Communications, McGraw-Hill, 5th Ed., 2014.
2	A. B. Carlson, Communication Systems: An Introduction to Signals and Noise in Electrical Communication, 4th Ed., McGraw-Hill, 2010.
3	Bernard Sklar, Fredric J. Harris, Digital Communications: Fundamentals and Applications, Pearson Education, 3rd edition, 2020.

Web References:

1	https://moodle.najah.edu/mod/resource/view.php?id=48306
2	https://nptel.ac.in/courses/108102096/
3	https://nptel.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/.../New_index1.html
4	https://ocw.mit.edu/.../lecture-videos/lecture-5-error-correction-syndrome-decoding/

Online Resources:

1	https://lecturenotes.in/subject/580/analog-communication-systems-acs
2	www.eie.polyu.edu.hk/~em/dtss05pdf/00d%20Matched%20filter.pdf
3	people.ee.duke.edu/~mbrooke/.../Material/eyes%20and%20NRZ%20and%20ISI.pdf
4	www.eie.polyu.edu.hk/~em/adc01pdf/L10_PSK.pdf
5	www.dtic.mil/dtic/tr/fulltext/u2/a156195.pdf

Continuous Assessment			Total Continuous Assessment	End Semester Examination	Total
Formative Assessment	Summative Assessment	Total			
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C402.1	Remember	Quiz	20
C402.2, C402.3	Analyze	Assignment	20
C402.4	Understand	Seminar	20
C402.5, C402.6	Apply	Group Assignment	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	10	10
Understand	40	30	30
Apply	20	30	30
Analyse	20	30	30
Evaluate			
Create			

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks			**CA 2 : 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
							Course Articulation Matrix							
1	3	2	2	-	-	-	-	-	-	-	-	2	2	2
2	3	3	2	-	-	-	-	-	-	-	-	2	2	2
3	2	2	2	2	-	-	-	-	-	-	-	2	2	2
4	3	2	2	-	-	-	-	-	-	2	-	-	2	-
5	3	3	2	-	-	-	-	-	2	-	-	2	2	2
6	2	2	2	2	-	-	-	-	2	-	-	-	2	-
1	Reasonably agreed			2	Moderately agreed			3	Strongly agreed					

22EC403	ANALOG INTEGRATED CIRCUITS	3/0/0/3

Nature of Course	G (Theory Analytical)

Course Objectives:

1	To construct the platform for understanding the various functionality of Linear Integrated Circuits
2	To familiarize the linear and non-linear applications of IC 741 operational amplifiers
3	To sense the concepts of VCO and PLL with its applications
4	To interpret the real time signal analysis based on ADC and DAC IC
5	To impart knowledge of integrated circuits on Application specific functions.

Course Outcomes:

Upon completion of the course, students shall have ability to

C403.1	Understand the functional blocks of Linear IC and conceive the Linear application based on Operation amplifier	[U]
C403.2	Understand the operations and characteristics and application areas of operational amplifiers	[U]
C403.3	Enumerate the concept of VCO and PLL	[AP]
C403.4	Apply the properties of operational amplifier in designing ADC's, DAC's for real time signal analysis.	[AP]
C403.5	Apply the concept of Integrated circuits to design Voltage Regulator and Audio/ Video IC's	[AP]
C403.6	Perform simulation based analysis of AC and DC circuits to verify the results and functionality	[AN]

Course Contents:

Basic information of OP-AMP, **Differential amplifier and OP-AMP applications:**   **15**
Differential amplifier with constant current source– Wilson Current –Mirror Circuit - and Widlar Current –Mirror Circuit, characteristics of Op –Amp, OP-AMP design**,** inverting and non-inverting amplifiers, instrumentation amplifier, integrator and differentiator, voltage-to-current converter, Precision rectifier, Schmitt trigger, Active filters, Butterworth filter –LP,HP,BP,BR, Multistage Op Amp

Digital-to-analog converters (DAC), Analog-to-digital converters (ADC):   **15**
VCO, PLL and its applications, Types of DAC**:** Weighted resistor, R-2R ladder, Sample and Hold circuit, Types of ADC**:** flash, counter type, Single slope, dual slope, successive approximation, Astable and Monostable Multivibrators using 555 Timer.

Voltage regulators and Special Function ICs :   **15**
723 General Purpose regulators & L4938 Voltage regulator , switching regulator –Audio Power Amplifier –Video amplifiers – Opto couplers –Isolation Amplifiers –Fiber optic ICs – ac and dc analysis using circuit simulation using SPICE.

Total Hours:	**45**

Text Books:

1	Sergio Franco, "Design with operational amplifiers and analog integrated circuits", McGraw-Hill, 4thedition, 2020. (Reprint)	

1	Sergio Franco, "Design with operational amplifiers and analog integrated circuits", McGraw-Hill, 4th edition, 2020. (Reprint)
2	D.Roy Choudhry, Shail Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd.,4th edition, 2019 (Reprint)
Reference Books:	
1	S.Salivahanan, V S KanchanaBhaaskaran, "Linear Integrated Circuits", McGraw-Hill, 4th edition,2017
2	WilliamD.Stanely, "Operational Amplifiers with Linear Integrated Circuits", Pearson Education, 2014
Web References:	
1	http://www.electronics-tutorials.ws
2	http://www.allaboutcircuits.com
Online Resources:	
1	http://www.nesoacademy.org/electronics-engineering/analog-electronics/analog

Continuous Assessment				End Semester Examinatio n	Tot al
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C403.1-C403.2	Understand	Quiz	20
C403.3	Apply	Assignment	20
C403.4	Apply	Quiz	20
C403.5	Apply	Assignment	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%)** **[120 Marks]**		**End Semester Examination (60%)** **[100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	40	10	10
Understand	60	40	40
Apply		40	30
Analyse		10	20
Evaluate			
Create			

Assessment based on Continuous and End Semester Examination					
Continuous Assessment (40%) **[200 Marks]**					**End Semester Examination (60%)** **[100 Marks]**
CA 1 : 100 Marks			**CA 2 : 100 Marks**		
SA 1 **(60 Marks)**	**FA 1 (40 Marks)**		**SA 2** **(60 Marks)**	**FA 2 (40 Marks)**	
	Component - I **(20 Marks)**	**Component - II** **(20 Marks)**		**Component - I** **(20 Marks)**	**Component - II** **(20 Marks)**

Course Articulation Matrix														
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
1	3	2	2	1	-	-	-	-	-	-	-	-	3	1
2	3	2	2	1	-	-	-	-	1	-	-	-	3	1
3	3	2	2	1	-	-	-	-	1	-	-	-	3	1
4	3	2	3	2	-	-	-	-	-	-	-	-	3	1
5	3	3	2	2	-	-	-	-	1	1	-	-	3	1
6	3	2	2	1	3	-	-	-	1	1	-	-	3	1
1	Reasonably agreed			2	Moderately agreed			3	Strongly agreed					

22IT101	APPLICATION DEVELOPMENT PRACTICES	1/0/4/3
Nature of Course	F (Theory programming)	
Pre requisites	Nil	

Course Objectives:

1.	To discuss the essence of agile development methods.
2.	Ability to understand and apply Scrum framework.
3.	To set up and create a GitHub repository.
4.	To impart the knowledge of web application development platforms.
5.	To create interactive websites using HTML, CSS.
6.	To recognize the user experience design methodologies like Java script for responsive web design.

Course Outcomes

Upon completion of the course, students shall have ability to

C101.1	Identify the driving forces and adopt Agile approaches to software development practices.	[AP]
C101.2	Demonstrate the values and practices of Scrum and how to setup the GitHub repository.	[U]
C101.3	Find the working model and learn basic web concepts to develop Static and Dynamic web pages.	[R]
C101.4	Utilize the knowledge of HTML and CSS code to create personal and/or business websites following current professional and/or industry standards.	[AP]
C101.5	Develop dynamic web page with validation and event handling mechanisms.	[AP]

Course Contents:

Module - I: **15 Hours**

History of Traditional Software Development Model, Software Development Model and SDLC, "Waterfall Model" – An Overview, Waterfall or Sequential Based Development Model, "Real Life" – Waterfall Model, "Waterfall Model" – Advantages, "Waterfall Model" – Disadvantages, Agile Software Development – Definition, Agile Development Model, Graphical Illustration of Agile Development Model, Why use Agile?, Agile Manifesto and Principles, 12 Principles of Agile Methods, Agile Values, What is NOT an Agile software development?, Foundation of an Agile software development Method, Common Characteristics of Agile Methods, Agile Methods and Practices, When to use Agile Model?, Advantages of Agile Model, Disadvantages of Agile Model, Difference between Agile and Waterfall Model, Agile – Myths and Reality, Agile Market Insight. Introduction to SCRUM, Scrum Roles and Responsibilities, Scrum Core Practices and Artifacts, User Story, Sprint, Release Planning Meeting, Sprint Planning Meeting, Daily Scrum Meeting (Daily Stand up), Sprint Review Meeting, Retrospective, Product Backlog, Sprint Backlog, Burn-Down Chart, Velocity, Impediment Backlog. Definition of "Done", Splitting User Story into Task, Why to Split User Story into Task?, Guidelines for Breaking Down a User Story into Tasks, Examples of Scrum Task Board, Planning Poker®, Planning Poker - Process/Steps, What are Story Points?, How do We Estimate in Story Points?, What Goes into Story Points? Introduction to Extreme Programming, The Rules of Extreme Programming, Extreme

Programming (XP) – Principles, Extreme Programming (XP) – Key Terms, Introduction to Lean Software Development, Principles of Lean Software Development, What is Kanban? Introduction to Git - Getting a Git Repository, Recording Changes to the Repository, Viewing the Commit History, Undoing Things, Working with Remotes, Tagging, Git Aliases, Git Branching, Branches in a Nutshell, Basic Branching and Merging, Branch Management, Remote Branches, Rebasing. Introduction to GitHub – Introduction, Set up Git, Create a repository, GitHub Flow, Contribution to Projects, Communicating on GitHub. Linux Basic Commands - Linux Basic Commands, Linux File Permissions, Basic System Administration, Process Management, Archival. Linux Shell Script - Shell Basics, Writing first script, Conditional statements, Loops, Command line arguments, Functions & file manipulations, Background processes, Scheduling processes -At, batch & Cron - Networking.

Module - II: **15 Hours**
HTML Basics - Understand the structure of an HTML page, New Semantic Elements in HTML 5, Learn to apply physical/logical character effects, Learn to manage document spacing. Tables - Understand the structure of an HTML table, Learn to control table format like cell spanning, cell spacing, border. List - Numbered List, Bulleted List, Working with Links, Understand the working of hyperlinks in web pages, Learn to create hyperlinks in web pages, Add hyperlinks to list items and table contents. Image Handling - Understand the role of images in web pages, Learn to add images to web pages, Learn to use images as hyperlinks. Frames - Understand the need for frames in web pages, Learn to create and work with frames. HTML Forms for User Input - Understand the role of forms in web pages, Understand various HTML elements used in forms, Single line text field, Text area, Check box, Radio buttons, Password fields, Pull-down menus, File selector dialog box. New Form Elements - Understand the new HTML form elements such as date, number, range, email, search and data list, Understand audio, video, article tags.

Module - III: **15 Hours**
Introduction to Cascading Style Sheets - What CSS can do, CSS Syntax, Types of CSS. Working with Text and Fonts - Text Formatting, Text Effects, Fonts. CSS Selectors - Type Selector, Universal Selector, ID Selector, Class selector. Colors and Borders – Background, Multiple Background, Colors RGB and RGBA, HSL and HSLA, Borders, Rounded Corners, Applying Shadows in border, Implementing CSS3 in the "Real World" – Modernizr, HTML5 Shims, SASS, and Other CSS Preprocessors, CSS Grid Systems, CSS Frameworks. Introduction to Bootstrap – Introduction, Getting Started with Bootstrap, Bootstrap Basics, Bootstrap grid system, Bootstrap Basic Components, Bootstrap Components, Page Header, Breadcrumb, Button Groups, Dropdown, Nav & Navbars. JavaScript Essentials - Var, Let and Const keyword, Arrow functions, default arguments, Template Strings, String methods, Object de-structuring, Create, apply, prototype, bind method, Spread and Rest operator, Typescript Fundamentals, Types & type assertions, Creating custom object types, function types, Typescript OOPS - Classes, Interfaces, Constructor, Decorator & Spread Operator, Difference == & === , Asynchronous Programming in ES6, Promise Constructor, Promise with Chain, Promise Race.

	Total Hours	**45**

Lab Component:

S. No	**List of Experiments**
1	Draw basic UML diagrams (use case, Activity, class, interaction, State charts, Component and Deployment diagram)

2	Develop DFD model (level-0, level-1)		
3	Design a web page using HTML basic tags.		
4	Develop web site with suitable contents and links.		
5	Design web pages using lists and tables.		
6	Build a web client-side Login, Registration form and Dashboard with drop down menus.		
7	Develop a HTML form and validation using HTML5 features.		
8	Create a website using HTML: To embed an image map in a web page. To fix the hot spots. Show all the related information when the hot spots are clicked.		
9	Apply style specification in HTML page using CSS.		
10	Develop dynamic web application using HTML, CSS and JavaScript.		
	Total Hours		**30**

Text Books:	
1.	Roman Pichler, "Agile Product Management with Scrum Creating Products that Customers Love", Pearson Education, 1st Edition, 2010.
2.	Jeff Sutherland, "Scrum the Art of Doing Twice the Work in Half the Time", Random House Publisher, 1st Edition, 2014.
3.	Scott Chacon, Ben Straub, "Pro GIT", Apress Publisher, 3rd Edition, 2014.
4.	Richard Blum, Christine Bresnahan, "Linux Command Line and Shell Scripting BIBLE", Wiley India Pvt. Limited, 5th Edition, 2008.
5.	Jennifer Niederst Robbins., "Learning Web Design, A beginner's guide to HTML, CSS, JavaScript, and Web Graphics", O'Reilly Media, 5th Edition,2018.
6.	Jennifer Smith and the AGI Creative Team, "Web Design with HTML and CSS", Wiley Publisher, 1st Edition, 2011.
7.	Stephen Blumenthal, "JavaScript: JavaScript for Beginners - Learn JavaScript Programming with ease",1st Edition, 2017.
Reference Books:	
1.	Robert C. Martin, "Agile Software Development, Principles, Patterns and Practices", Prentice Hall, 2nd Edition, 2014.
2.	Mike Cohn, "User Stories Applied: For Agile Software", Addison Wesley, 2nd Edition, 2016.
3.	Thomas a Powell, "HTML & CSS: The Complete Reference", 5th Edition, Tata McGraw Hill Education Private Limited, 2010.
4.	Russ Ferguson, "Beginning JavaScript: The Ultimate Guide to Modern JavaScript Development", Apress Publishers, 3rd Edition, 2019.

5.	Deitel, Deitel, Goldberg, "Internet and World Wide Web – How to program", 5th Edition, Prentice Hall Publishers, 2012.

Web References:

1.	https://www.coursera.org/specializations/agile-development
2.	https://www.edx.org/learn/agile
3.	https://nptel.ac.in/courses/106/105/106105182/
4.	https://developer.mozilla.org/en-US/docs/Web/HTML
5.	https://developer.mozilla.org/en-US/docs/Web/CSS
6.	https://developer.mozilla.org/en-US/docs/Web/JavaScript

Online Resources:

1.	http://www.agilenutshell.com/
2.	https://www.atlassian.com/agile/scrum
3.	https://www.youtube.com/user/AgileMikeCohn
4.	https://www.coursera.org/learn/html-css-javascript-for-web-developers
5.	https://online-learning.harvard.edu/subject/javascript

Formative Assessment based on Capstone Model - Theory			
Course Outcome	**Bloom's Level**	**Assessment Component**	**FA (10%) [80 Marks]**
C101.1	Apply	Assignment - 1	**20**
C101.2, C101.3	Understand Remember	Quiz	**20**
C101.4	Apply	Case Study	**20**
C101.5	Apply	Assignment - 2	**20**

Assessment based on Summative and End Semester Examination - Theory			
Bloom's Level	**Summative Assessment (15%) [120 Marks]**		**End Semester Examination (35%) [100 Marks]**
	CIA1: (60 Marks)	**CIA2: (60 Marks)**	
Remember	40	20	20
Understand	30	30	20
Apply	30	50	60
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Assessment based on Continuous and End Semester Examination – Practical			

Continuous Assessment									End Semester Examination	Total
Theory				Practical			Total (A+B)	Total Continuous Assessment		
Formative Assessment	Summative Assessment	Total	Total (A)	Formative Assessment	Summative Assessment	Total (B)				
80	120	200	100	75	25	100	200	50	50	100

Bloom's Level	Continuous Assessment (25%) [100 Marks]		End Semester Examination (15%) [100 Marks]
	FA: (75 Marks)	SA: (25 Marks)	
Remember	30	20	20
Understand	20	30	30
Apply	50	50	50
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (50%)								End Semester Examination (50%)
CA 1 (100 Marks)			CA 2 (100 Marks)			Practical Exam (100 Marks)		Theory Examination (35%) Practical Examination (15%)
SA 1 (60M)	FA 1		SA 2 (60M)	FA 2		FA (75M)	SA (25M)	
	Component-I (20 Marks)	Component-II (20 Marks)		Component-I (20 Marks)	Component-II (20 Marks)			

Course Outcomes (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C101.1	2	2	1	1								2	3	2	2
C101.2	3	2	3	3	3	2						2	3	3	2
C101.3	3	2	3	3	3	2						2	3	3	2
C101.4	3	2	3	3	3	2						2	3	3	2
C101.5	3	2	3	3	3	2						1	3	3	2

22EC404	CIRCUITS LABORATORY	0/0/3/1.5

Nature of Course	: M (Practical application)

Course Objectives:

1	To design and construct single stage, multistage amplifier circuits and to verify the voltage gain improvements & frequency response characteristics.
2	To design and construct circuits to generate sinusoidal waveforms.

Course Outcomes:

Upon completion of the course, students shall have ability to

C404.1	Understand and construct various types of BJT and MOSFET Audio Amplifiers	[AP]
C404.2	Construct the power amplifier circuits and analyse the efficiency of power amplifiers	[AN]
C404.3	Analyse the performance of amplifier circuits with and without negative feedback configuration	[AN]
C404.4	Construct different circuits to generate sinusoidal and non-sinusoidal waveforms	[AP]
C404.5	Observe the Applications of operational amplifiers in ADC and DAC designs	[AP]
C404.6	Analyse the functionality of various applications of Op-Amp circuits using Simulation Tools	[AP]

Course Contents:

Sl.No	List of Experiments	CO Mapping	RBT
1.	Design of simple Audio amplifiers (CE Amplifier)	C404.1	[AP]
2.	Design and implementation of Class B Power Amplifier	C404.2	[AN]
3.	Design and implementation of Current Series feedback amplifier	C404.3	[AN]
4.	Design and Implementation of radio frequency oscillator(Colpitts Oscillator)	C404.4	[AP]
5.	Inverting and Non Inverting Op – amp.	C404.5	[U]
6.	Applications of Op-Amp (Adder,Subtractor, adder-subtractor)	C404.6	[AP]
7.	**Using Multisim /OrcadPspice/Tina Tool:** Simulation of Common Source MOSFET Amplifier	C404.1	[AP]
8.	Simulation of Multivibrators.	C404.4	[AP]
9.	Simulation of Analog to Digital Converter and Digital to AnalogConverter	C404.5	[AP]
10.	Simulation of applications of op-amp(Integrator, Differentiator and Schmitt Trigger using IC741,)	C404.6	[AP]

		Total Hours:	30

Reference Books:	
1	Millman J and Halkias .C, "Integrated Electronics", 3rd Edition, TMH, 2017
2	Salivhanan, 'Electron Devices and Circuits', 4th edition, McGraw Hill Education (India) Private Ltd., 2017
3	D.Roy Choudhry, Shail Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd.,2017 (Reprint)
4	S.Salivahanan, V S Kanchana Bhaaskaran, Linear Integrated Circuits, McGraw-Hill, 2ndedition,2015
5	Poornachandra Rao.S and Sasikala.B, "Electronics Laboratory Primer: A Design Approach", 2nd edition, S. Chand, 2005.
Web References:	
1	www.allaboutcircuits.com
2	www.circuitstoday.com
Online Resources:	
1	http://iitb.vlab.co.in/index.php?sub=43&brch=223
2	http://vlab.amrita.edu/?sub=3&brch=223

Continuous Assessment				End Semester Examination	Tot al
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
75	25	100	60	40	100

Assessment based on Continuous and End Semester Examination			
Bloom's Level	Continuous Assessment (60%) [100 Marks]		End Semester Practical Examination (40%) [100 Marks]
	FA (75 Marks)	SA (25 Marks)	
Remember			
Understand			
Apply			
Analyse	30	20	20
Evaluate	30	40	40
Create	40	40	40

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Course Articulation Matrix														
1	3	2	2	1	-	-	-	-	-	-	-	-	2	-
2	3	2	2	1	-	-	-	-	-	-	-	-	2	-
3	3	1	2	2		-	-	-	-	-	-	-	2	1
4	3	2	2	2	3	-	-	-	1	-	-	1	3	-
5	3	2	2	2	3	-	-	-	1	-	-	1	3	1
6	3	2	2	2	3	-	-	-	1	-	-	1	3	1
1	Reasonably agreed				2	Moderately agreed			3		Strongly agreed			

22EC405	ANALOG AND DIGITAL COMMUNICATION LABORATORY	0/0/2/1

Nature of Course: M (Practical application)

Course Objectives:

1.	To learn about the performance of Analog and Digital modulation circuits and to experience the use of simulation tools for the communication circuits.
2.	To analyze error performance of aAnalog and Digital communication system in presence of noise and other interferences.

Course Outcomes

C405.1	Construct and analyse the performance of various continuous modulation and demodulation circuits.	[AN]
C405.2	Demonstrate and Analyse the circuit for intermediate frequency.	[AN]
C405.3	Build and verify the circuits for different pulse modulation techniques.	[AP]
C405.4	Construct, analyze and simulate the performance of digital modulation circuits.	[AN]
C405.5	Simulate and analyze the performance of error control codes.	[AN]

Course Content:

S.No	List of Experiments	CO Mapping	RBT
1	Demonstrate amplitude modulation system with envelope detection and study its (a) signal handling and (b) frequency response characteristics.	C405.1	[AN]
2	Implement Frequency modulation.	C405.1	[AN]
3	Study and test a mixer stage for translating AM signal to IF frequency stage.	C405.2	[AN]
4	Implement PAM, PPM and PWM.	C405.2	[AN]
5	Simulation of AM, FM, Sampling Process	C405.3	[AP]
6	Demonstrate and test a BFSK AND BPSK circuits	C405.4	[AN]
7	Simulation of BFSK, BPSK	C405.4	[AN]
8	Simulate and test the circuit of QPSK and DPSK	C405.4	[AN]
9	Signal Constellation of QPSK and QAM	C405.5	[AN]
10	Error Control Coding using MATLAB	C405.5	[AN]
		Total Hours	30

Reference Books:
1. Simon Haykins and Michael Moher, "Communication Systems", 5th Edition, John Wiley and sons, 2021.
2. H. Taub and D. L. Schilling, Principles of Communication Systems, 4th edition, McGraw Hill, 2017.
3. S. Haykin, Digital Communication Systems, John Wiley & Sons, 2013

4.	A. B. Carlson, Communication Systems: An Introduction to Signals and Noise in Electrical Communication, 4th Ed., McGraw-Hill, 2010.	

Web References:
1. www.nptel.ac.in
2. http://www.allaboutcircuits.com/education/
3. shop.a1-cbiss.com/digital_communication_lab_manual_2010.pdf

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
75	25	100	60	40	100

Assessment based on Continuous and End Semester Examination			
Bloom's Level	Continuous Assessment (60%) [100 Marks]		End Semester Practical Examination (40%) [100 Marks]
	FA (75 Marks)	SA (25 Marks)	
Remember			
Understand			
Apply			
Analyse	30	20	20
Evaluate	30	40	40
Create	40	40	40

Course Articulation Matrix														
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	2	2	2	1	2	-	-	-	-	-	-	1	2	1
2	2	2	2	1	1	-	-	-	-	-	-	1	2	1
3	2	2	2	2	1	-	-	-	-	-	-	1	2	1
4	2	2	2	2	2	-	-	-	-	-	-	1	2	1
5	2	2	2	2	2	-	-	-	-	-	-	1	2	1
1	Reasonably agreed			2	Moderately agreed			3		Strongly agreed				

22EC501	**MICROCONTROLLERS AND INTERFACING**	3/0/0/3

Nature of Course	: F (Theory Programming)	

Course Objectives:

1	To introduce the basic concept of 8051 microcontroller
2	To enable the students to understand the MSP Microcontroller and its operation.
3	To enable the student to relate various interfacing devices with microcontrollers.
4	To introduce the basic concept of ARM microcontroller and its operations
5	To allow students to design and analyze various external circuitry with microcontroller
6	To enable the students to differentiate between various types of microcontroller family and its specifications.

Course Outcomes:

Upon completion of the course, students shall have ability to

C501.1	Understand the internal blocks of 8051 microcontroller	[U]
C501.2	Interface peripheral devices with 8051 microcontroller	[AN]
C501.3	Understand the internal blocks of MSP 430 series microcontroller	[U]
C501.4	Relate the various timer modes and interrupts of MSP430 controller	[AN]
C501.5	Understand the architecture and operation modes of ARM processor.	[U]
C501.6	Interface peripheral devices with ARM processor and devise ARM development tools.	[AN]

Course Contents:

8 BIT Microcontroller:	**15**

Introduction to 8051 micro-controller, Architecture, Special Function Registers, PSW and Register banks, Instruction set, Addressing modes, Interrupts, Power down operation, Memory organization, Programming 8051, Micro controller based system designs - LCD – temperature and gas sensors-Stepper motor. Memory Interfacing and I/O interfacing - Serial communication interface – Timer/Counter – Keyboard /display

MSP430 Microcontroller:	**15**

Architecture of MSP430 Microcontrollers: Central Processing Unit and Registers, Port Interrupts, Timers: Timer Block diagram and Operation, Timer Modes, Output Unit, Timer Interrupts, Low Power Down Modes, Watchdog Timer and operation, Communication Peripherals in the MSP430.

ARM Processor	**15**

The ARM architecture-RISC Vs CISC –pipelining – barrel shifter-Data flow model-ARM Bus architecture, ARM7- architecture-modes of operations-flags-control registers-exception handling- interfacing with Bluetooth & Wi Fi and ARM development tools - ARM Instruction Set, Thumb Instruction Set, Memory Mapping

Total Hours:		**45**

Text Books:

1	Muhammad Ali Mazidi, "The 8051 Microcontroller and Embedded systems", Prentice Hall India, New Delhi, 2013
2	John H Devis, MSP430 Microcontrollers Basics, 1st Edition, Newnes Publisher.2008
3	Steve Furber , "ARM System –On –Chip architecture", Addision Wesley, 2000.

Reference Books:

1	Subrata Ghoshal, "8051 Microcontroller- Internals, Instructions, Programming and Interfacing", Pearson, 2010.
2	Andrew N.Sloss, Dominic Symes and Chris Wright " ARM System Developer"s Guide : Designing and Optimizing System Software" , First edition, Morgan Kaufmann Publishers, 2004.
3	Krishna Kant, "Microprocessors and Microcontrollers – Architecture, Programming and System Design 8085, 8056, 8051, 8096", Prentice Hall India, New Delhi, 2007.

Web References:

1	https://exploreembedded.com
2	https://www.elprocus.com/peripherals-interfacing-to-the-microcontroller-8051-in-electronics/
3	http://www.ti.com/microcontrollers/msp430-ultra-low-power-mcus/overview.html

4	https://developer.arm.com/products/architecture/cpu-architecture
Online Resources:	
1	https://freevideolectures.com/course/3018/microprocessors-and-microcontrollers/22
2	www.infocobuild.com/education/audio-video-courses/electronics/.../lecture-05.html
3	https://training.ti.com/msp430-workshop-series
4	www.ee.ic.ac.uk/pcheung/teaching/ee2_computing/ARMbasics4

Continuous Assessment				End Semester Examination	Total
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%)** **[80 Marks]**
C501.1	Understand	Quiz	20
C501.2, C501.3	Analyze	Programming	20
C501.4, C501.5	Apply	Assignment	20
C501.6	Apply	Case study	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	10	10
Understand	40	40	40
Apply	40	40	30
Analyse		10	20
Evaluate			
Create			
Assessment based on Continuous and End Semester Examination			
Continuous Assessment (40%) [200 Marks]			**End Semes**

CA 1 : 100 Marks			CA 2 : 100 Marks			ter Examination (60%) [100 Marks]
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Course Articulation Matrix														
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	1	1	1	1	-	-	-	-	-	-	-	-	1	-
2	1	1	2	2	-	-	-	-	-	-	-	-	2	-
3	1	1	1	1	-	-	-	-	-	-	-	-	1	-
4	1	1	2	1	-	-	-	-	1	-	-	-	2	-
5	1	1	2	2	-	-	-	-	-	-	-	1	3	1
6	1	1	3	2	-	-	-	-	1	-	-	-	3	-
1	Reasonably agreed			2	Moderately agreed			3	Strongly agreed					

22EC502	DATA AND WIRELESS NETWORKS	3/0/0/3

Nature of Course	: C(Theory Concept)	

Course Objectives:

1	To introduce the different layers in data communication.
2	To introduce various addressing mechanisms employed in computer networks.
3	To understand the types and functions of transmission control protocols.
4	To allow students to get familiarized with the concepts behind the web services.
5	To introduce the concept and technologies used in cellular communication.

Course Outcomes:

Upon completion of the course, students shall have ability to

C502.1	Understand the OSI layered architecture and networking models.	[U]
C502.2	Understand concept of different error control techniques in data communications.	[U]
C502.3	Analyse the different routing algorithms and IP addressing modes in computer networks.	[AN]
C502.4	Understand the concepts related to Congestion Control ,QoS and web services.	[U]
C502.5	Understand the fundamental concepts of cellular communication system.	[U]
C502.6	Analyse the channel capacity enhancement in cellular systems.	[AN]

Course Contents:

DATA COMMUNICATIONS:	**15**

Types of networks – Circuit Switching and Packet Switching – ISO / OSI model – Transmission Media – Coaxial Cable – Fiber Optics - TCP/IP protocol suite - Flow Control and Error control - stop and wait – go back-N ARQ – selective repeat ARQ – sliding window – LAN – Ethernet IEEE 802.3 – IEEE 802.4 – IEEE 802.5 – IEEE 802.11 – IEEE 802.15.

NETWORK, TRANSPORT AND APPLICATION LAYER:	**15**

Frame formats for IPV4 and IPV6 – Next generation IP, Transition from IPV4 to IPV6 - Subnetting –- Routing – Distance Vector Routing – Link State Routing, Transport Layer Services –Multiplexing and Demultiplexing – User Datagram Protocol (UDP) – Principles of Reliable Data Transfer – Transmission Control Protocol (TCP), Congestion Control – Quality of services (QOS) – Integrated Services – Differentiated Services – WWW – HTTP – SMTP – FTP – Telnet – Domain name space.

FUNDAMENTALS OF CELLULAR COMMUNICATION	**15**

History of Wireless Communication, Cellular revolution, Cellular Systems, Frequency reuse, Hand-off, Adjacent Channel Interference, Co-channel Interference, Channel Assignment Strategies, Cell Splitting, Cell Sectoring, Microcell Zone Concept, Trunking and Grade of Service.

Total Hours:	**45**

Text Books:

1	Behrouz A. Foruzan, "Data communication and Networking", 5th Edition Tata McGraw-Hill, 2013.
2	William Stallings, "Data and Computer Communication", TenthEdition, Pearson Education, 2013.
3	Theodore S. Rappaport, "Wireless Communications: Principles &Practice",Second Edition, Prentice Hall, 2002.

4	Larry-L-Peterson& Bruce S David, "Computer-Networks a Systems Approach" Morgan Kaufmann Publishers, Fifth Edition, 2011.
Reference Books:	
1	E. Andrew S. Tannenbaum, "Computer Networks", PHI, Fifth Edition, 2011.
2	Vijay K Garg, "Wireless Communications and Networking", Elsevier, 2007
3	CJames F Kurouse& W. Rouse, "Computer Networking: A Top down Approach Featuring", Pearson Education, Sixth Edition, 2012.
Web References:	
1	https://www.tutorialspoint.com/data_communication_computer_network/
2	http://library.aceondo.net/ebooks/Computer_Science/Data_Communication_and_Networking_by_Behrouz.A.Forouzan_4th.edition.pdf
3	http://citengg.blogspot.com/p/behrouz-forouzancomputer-networks4th.html
Online Resources:	
1	https://cosmolearning.org/courses/data-communication-542/video-lectures/
2	https://nptel.ac.in/courses/106105082/
3	https://www.coursera.org/learn/data-communication-network-services
4	https://www.edx.org/course/computer-networks-internet-kironx-fhlcnx

Assessment Methods & Levels (based on Blooms'Taxonomy)			
Formative assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C502.1	Understand	Quiz	20
C502.2	Understand	Assignment	20
C502.3	Analyse		
C502.4	Understand	Seminar	20
C502.5	Understand	Group Assignment	20
C502.6	Analyse		

Continuous Assessment			**Total Continuous Assessment**	**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**			
80	120	200	40	60	100
Assessment based on Summative and End Semester Examination					

Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	40	40	40
Apply	20	40	20
Analyse	20		20
Evaluate			

Create			

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Course Articulation Matrix														
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	1	3	1	1	-	-	-	-	-	-	-	-	2	-
2	1	1	1	1	3	-	-	-	-	-	-	-	2	-
3	1	1	1	2	-	-	-	-	2	-	-	-	3	-
4	1	1	1	2	-	-	-	-	1	2	-	-	2	-
5	1	3	1	2	-	-	-	-	-	-	-	-	2	-
6	1	3	1	2	-	-	-	-	2	-	-	-	3	-
1	Reasonably agreed			2	Moderately agreed			3	Strongly agreed					

22EC503	DIGITAL SIGNAL PROCESSING	4/0/0/4

Nature of Course	G(Theory Analytical)

Course Objectives:

1	To familiarize the students about Discrete Fourier Transform techniques and its applications in filter design
2	To allow students to design and analyze digital filters
3	To enable the students to understand the quantization process and its errors
4	To enable the students to understand the concept of multi rate signal processing and its applications
5	To enable students to design, simulate and evaluate various types of filters

Course Outcomes:
Upon completion of the course, students shall have ability to

C503.1	Understand the concept of transform techniques used for discrete time System analysis and its various properties	[U]
C503.2	Interpret the concept of Fast Fourier Transform algorithms and applications of DFT.	[AN]
C503.3	Analyze various techniques for design of FIR filters.	[AN]
C503.4	Analyze the transformation techniques for analog to digital IIR filter design.	[AN]
C503.5	Understand the concepts of quantization effects and the behavioral Changes in filter response	[U]
C503.6	Explore the concept of Multi rate digital signal processing.	[U]

Course Contents:

Discrete Fourier Transform: **20**
Computation of DFT– Properties–Circular convolution –Fast Fourier Transforms(FFT) algorithms–Decimation in Time algorithm – Decimation in Frequency algorithms–Filtering long data sequences- overlap save and overlap add method.

Design and Implementation of Digital Filter: **20**
Finite Impulse Response (FIR) filters - Symmetric and Anti symmetric FIR filter – Linear phase FIR filters – Design of Linear phase FIR filters using windowing technique – Rectangular, Hamming and Hanning windows – Frequency Sampling methods. Analog filters – Butterworth and Chebyshev Type I filter – Frequency transformation in analog domain –LPF to HPF / BPF / BSF. Design of IIR filter from analog filter using impulse invariance technique and bilinear transformations – Realization Structures for IIR filter (Direct Form I and II, cascade form and Parallel form) and FIR filter (Direct form, Linear phase structure).

Finite word length Effects and Applications of DSP: **20**
Representation of numbers – Quantization process– co-efficient quantization error–Input quantization error – Product quantization error –Limit Cycle Oscillations(LCO) – Multi rate DSP – Decimation – Interpolation – sampling rate conversion by rational factor I/D – Poly phase filter structure. Applications–Biomedical signal Processing–Subband coding of speech signal –Digital Hearing Aid.

Total Hours:60

Text Books:

1	John G. Proakis & Dimitris G. Manolakis, Digital Signal Processing, Pearson, 4thEdition, 2021.
2	Sanjit K. Mitra ,Digital Signal Processing *:* A Computer- Based Approach, The McGraw-Hill Education, 4th Edition 2013
3	Alan V Oppenheim; Ronald W Schafer, Digital Signal Processing, Pearson India, First edition, 2015

Reference Books:

1	B.P.Lathi, "Principles of Signal Processing and Linear Systems", Cambridge University,2014.
2	Emmanuel C..Ifeachor,& Barrie .W. Jervis, "Digital Signal Processing", Second edition, Pearson Education,2002.
Web References:	
1	https://www.tutorialspoint.com//digitalsignalprocessing/index.htm
2	http://www.nptel.ac.in/courses/108105055
Online Resources:	
1	https://www.edx.org/course/discrete-time-signal-processing-mitx-6-341x-1
2	https://ocw.mit.edu/resources/res-6-008-digital-signal-processing
3	www.coursera.org/learn/dsp

Continuous Assessment				End Semester Examination	Total
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Ca-se Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C503.1	Understand	Quiz	20
C503.2	Analyze	Assignment	20
C503.3, C503.4	Analyze Analyze	Assignment	20
C503.5, C503.6	Understand Evaluate	Case Study	20

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1: [60 Marks]	CIA2: [60 Marks]	
Remember	20	20	20
Understand	20	20	20
Apply	30	30	30
Analyse	30	30	30
Evaluate			
Create			

Assessment based on Continuous and End Semester Examination				
Continuous Assessment (40%) **[200 Marks]**				**End Semester Examination (60%)** **[100 Marks]**
CA 1 : 100 Marks		**CA 2 : 100 Marks**		
SA 1 **(60 Marks)**	**FA 1 (40 Marks)**	**SA 2** **(60 Marks)**	**FA 2 (40 Marks)**	
	Component - I **(20 Marks)** / **Component - II** **(20 Marks)**		**Component - I** **(20 Marks)** / **Component - II** **(20 Marks)**	

Course Articulation Matrix														
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
C503.1	3	3	3	2	2	-	-	-	-	-	-	1	2	1
C503.2	3	2	3	2	2	-	-	-	-	-	-	1	2	1
C503.3	3	2	2	2	2	-	-	-	-	-	-	1	2	1
C503.4	3	2	3	2	2	-	-	-	-	-	-	1	2	1
C503.5	3	2	2	2	2	-	-	-	-	-	-	1	2	1
C503.6	3	3	3	2	2	-	-	-	-	-	-	1	2	1
1	Reasonably agreed			2	Moderately agreed			3	Strongly agreed					

22EE511	CONTROL ENGINEERING	4/0/0/4
Nature of Course	: G (Theory Analytical)	

Course Objectives:

1. To understand the methods of systems representation and to derive their transfer function models.
2. To provide an adequate knowledge of systems in time domain and its stability analysis.
3. To accord basic knowledge in obtaining the open loop and closed loop frequency responses of systems.
4. To introduce the Concepts of controllers and compensators.
5. To impart the concept of state variable representation of physical systems.

Course Outcomes:

Upon completion of the course, students shall have ability to

C511.1	Construct the mathematical models of various control systems and obtain The transfer functions of a system.	[AP]
C511.2	Analyze the first and second order systems in time domain and frequency domain.	[A]
C511.3	Analyze the frequency responses using Bode Plot and Polar plot and examine the stability of the control systems using Root locus, Routh-Hurwitz Criteria methods.	[A]
C511.4	Analyze the concepts of Compensators using Bode Plot.	[A]
C511.5	Construct state space model of a system and test its controllability and observability.	[AP]

Course Contents:

Module 1:System modeling 20

Basic elements of control systems - Open loop and closed loop systems - Transfer function modelling: Electrical system and Mechanical system - Translational, Rotational - Blockdiagram reduction using signal flow graph.

Module 2: Time and frequency response analysis 20

Time domain specifications - Types of test signals -First order system response – Step, Ramp, Impulse - Second Order System Response - Step input-- Steady state error - Generalized error coefficients - Concept of stability - Routh Hurwitz criterion - Root locus technique - Frequency domain specifications - Bode plot - Polar plot - Gain margin and Phase margin.

Module 3: Controllers, compensators and state variable analysis 20

Controllers: Introduction to P, PI and PID controllers, Design of PI Controllers - Compensators: Introduction to lag, lead andlag-lead networks –Lag compensator design using Bode plot - Concepts of state variables: State space representation of continuous time systems, state equations, transfer function fromstate variable representation, concepts of controllability and observability.

	Total Hours	60

Text Books:

1	I. J. Nagrath& M. Gopal, Control Systems Engineering, 6th Edition, New Age International Publishers, 2017.
2	KatsuhikoOgata„ModernControlEngineering‚5th edition,Pearson,NewDelhi,2015.
3	Farid Golnaraghi& Benjamin C. Kuo, Automatic Control systems‚ 9th Edition, Wiley, 2014.

	Reference Books:
1	Norman S.Nise,„Control Systems Engineering,Wiley,NewDelhi,2018.
2	Richard Poley, „Control Theory Fundamentals', 2nd Edison, Createspace, 2014.
3	Richard C. Dorf, Robert H.Bishop, „Modern Control Engineering, 13th Edition, Pearson Education, New Delhi, 2016.
4	A.Nagoorkani, "Control Systems Engineering", RBA Publications 2014.
5	S.Palani, "Control Systems Engineering", 2nd Edition, Tata McGraw-Hill Education,2010.
	Web References:
1	http://www.nptel.ac.in/courses/108101037/
2	https://nptel.ac.in/courses/108101037/14

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	Bloom's Level	Assessment Component	Marks
C511.1 & C511.2	Apply	Technical Quiz	**20**
C511.3 & C511.4	Apply	Assignment	**40**
C511.5	Apply	Group Assignment	**20**

Assessment based on Summative and End Semester Examination			
Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	20	20	20
Understand	30	30	30
Apply	20	20	20
Analyse	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination					
Continuous Assessment (40%) [200 Marks]					End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks		
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)	
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C511.1	3	2	1	1	1	1						1	3	
C511.2	3	3	2	2	1							1	3	
C511.3	3	3	2	2								1	3	
C511.4	3	3	3	3	3							1	3	1
C511.5	3	2	1	1	1							1	3	

22EC504	DIGITALSIGNAL PROCESSING LABORATORY	0/0/2/1

Nature of Course: M (Practical application)

Course Objectives:
1. To simulate the basic signals and analyze LTI systems using MATLAB
2. To implementDiscrete Fourier transform algorithms andMultiratesignalprocessing.
3. To implement IIR and FIR filter techniques using MATLAB and TMS320C50 Processor.

Course Outcomes

C504.1	Understand the concepts of basic signals and convolution operation	[U]
C504.2	Construct the applications of discrete Fourier Transform and Multi-rate signal processing.	[AN]
C504.3	Analyze the discrete-time signals using FFT Algorithms	[AN]
C504.4	Examine and simulate the different techniques for designing FIR and IIR filters.	[AN]
C504.5	Analyze the quantization effects on digital filters.	[AN]
C504.6	Demonstrate the FFT algorithms and Convolution operation using TMS320C50 /6713 Processor	[AP]

Course Content:

S.No	List of Experiments	CO Mapping	BT
Analysis and simulation using MATLAB software			
1	Generation of Signals	C505.1	[AP]
2	Linear and circular convolution	C505.1	[AP]
3	Computation of N-Point DFT using DIT and DIF algorithm	C505.3	[AP]
4.	Design of FIR filter using windowing technique	C505.4	[AN]
5	Design of IIR filter using Impulse invariant and Bilinear transformation technique	C505.4	[AN]
6	Quantization effects in digital filter design	C505.5	[AN]
7	Multi-rate Signal processing- Interpolation Decimation	C505.2	[AP]
8	Analysis of ECG signal	C505.2	[AN]
9	Analysis of EEG signal	C505.2	[AN]
Experiments UsingTMS320C50/6713 Processor			
10	Study of architecture of Digital signal processor	C505.6	[U]
11	Implementation of N-Point DFT	C505.6	[AP]
12	Implementation of FFT algorithm	C505.6	[AP]
13	Implementation of Linear Convolution	C505.6	[AP]
14	Implementation of FIR filter	C505.6	[AP]
15	Implementation of IIR filter	C505.6	[AP]
		Total Hours	**30**

Reference Books:
1. Stormy Attaway, Butterworth-Heinemann "MATLAB: A Practical Introduction to Programming and Problem Solving".5th Edition,2018
2. Vinay K Ingle, John G Proakis "Digital Signal Processing Using MATLAB",3rd Edition,2002
3. Samuel D. Stearns and Ruth a David "Signal Processing Algorithms in MATLAB", First Edition,Prentice Hall , 2001

Web References:
1. https://in.mathworks.com/help/matlab/index.html
2. https://onlinecourses.nptel.ac.in/noc21_ee20/preview

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
75	25	100	60	40	100

Assessment based on Continuous and End Semester Examination			
Bloom's Level	Continuous Assessment (60%) [100 Marks]		End Semester Practical Examination (40%) [100 Marks]
	FA (75 Marks)	SA (25 Marks)	
Remember			
Understand			
Apply	20	20	40
Analyse	80	80	60
Evaluate			
Create			

Course Articulation Matrix														
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C504.1	2	2	2	1	2	-	-	-	-	1	-	-	3	-
C504.2	2	2	2	1	2	-	-	-	-	1	-	-	3	-
C504.3	2	2	2	1	2	-	-	-	-	1	-	-	3	-
C504.4	2	2	2	1	2	-	-	-	-	1	-	-	3	-
C504.5	2	2	2	1	2	-	-	-	-	1	-	-	3	-
C504.6	3	3	3	2	2	-	-	-	-	1	1	1	3	1
1	Reasonably agreed			2	Moderately agreed			3	Strongly agreed					

22EC505	MICROCONTROLLERS LABORATORY	0/0/2/1

Nature of Course: M (Practical application)

Course Objectives:

1.	To write and execute the programming for various application using Microcontrollers.

Course Outcomes

C505.1	Understand the addressing modes of 8051 to perform basic arithmetic, Data Transfer and Conditional operations	[U]
C505.2	Apply the interfacing procedures of 8051 with hardware and peripheral devices	[AP]
C505.3	Evaluate the command word format for interfacing with peripherals	[E]
C505.4	Apply the Embedded C codes in microcontroller to perform Interfacing with MSP430	[AP]
C505.5	Understand the Interfacing procedure of ARM	[AP]
C505.6	Analyze the use of Keil Micro vision and perform ARM interfacing	[AN]

Course Content:

S.No	List of Experiments	CO Mapping	RBT
	Programming using 8051 microcontroller		
1	Arithmetic Instructions - Addition, subtraction, multiplication and division.	C505.1	[U]
2	Data Transfer - Block move, Exchange, Sorting, Finding largest element	C505.1	[U]
3	Programs using Conditional CALL & RETURN.	C505.1	[U]
	INTERFACING with 8051 microcontroller		
4	Stepper motor control interface to 8051 microcontroller.	C505.2	[AP]
5	Programmable peripheral interface to 8051 microcontroller.	C505.3	[E]
6	Keyboard and seven segment display interface with 8051 microcontroller.	C505.3	[E]
7	ADC and DAC using 8051 microcontroller.	C505.3	[E]
	Programming using MSP430		
8	LED blinking	C505.3	[AN]
9	Seven segment display interfacing	C505.5	[AP]
	Programming using ARM		
10	LED blinking	C505.6	[AN]
11	Seven segment display interfacing	C505.6	[AN]
12	LCD Interfacing	C505.6	[AN]

	Total Hours:	45	

Reference Books:

1	Muhammad Ali Mazidi, "The 8051 Microcontroller and Embedded systems", Prentice Hall India, New Delhi, 2013
2	Kenneth J Ayala, "The 8051 Microcontroller – Architecture, Programming and Applications", Penram International Publications, Mumbai, India, 2005
3	MSP430 Microcontrollers Basics, John H Devis, 1stEdition, Newnes Publisher.2008

| 4 | ARM on-chip architecture, Pearson Edition,second edition 2009. | |

Web References:		
1	https://exploreembedded.com	
2	https://www.elprocus.com/peripherals-interfacing-to-the-microcontroller-8051-in-electronics/	

Online Resources:		
1	*processors.wiki.ti.com/index.php/MSP430_LaunchPad_Tutorials*	
2	*https://www.electronicshub.org › ARM*	

Assessment Methods & Levels (based on Bloom'sTaxonomy)

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Rubric based Continuous Assessment[60 marks] (in %)	End Semester Examination [40 marks] (in %)
Remember	10	10
Understand	20	20
Apply	30	20
Analyse	30	20
Evaluate	10	10
Create	-	20

Course Articulation Matrix

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	2	1	1	1	1	-	-	-	3	-	-	-	1	-
2	2	1	2	2	2	-	-	-	3	-	-	-	2	-
3	2	1	1	1	1	-	-	-	2	-	-	-	1	-
4	2	1	2	1	2	-	-	-	3	-	-	1	2	1
5	2	1	2	2	3	-	-	-	3	-	-	1	3	1
6	2	1	3	2	3	-	-	-	3	-	-	1	3	1
1	Reasonably agreed				2	Moderately agreed			3	Strongly agreed				

22EC901	**EMBEDDED PROCESSORS**	3/0/0/3

Nature of Course	: F (Theory Programming)

Course Objectives:

1	To introduce the concepts of embedded systems and intertwine it with network
2	To Familiarize with design and debugging of embedded systems
3	To introduce the concept of real time applications of embedded systems
4	To allow students to design and analyze various scheduling algorithm in real time application
5	To enable the students to evaluate the performance of different embedded processors.

Course Outcomes:

Upon completion of the course, students shall have ability to

C901.1	Understand the embedded system design life cycle.	[U]
C901.2	Analyze the instruction set of embedded processors.	[AN]
C901.3	Design embedded systems for different types of applications.	[AN]
C901.4	Describe the different interfacing techniques	[U]
C901.5	Analyze the performance of a multiprocessor system	[AN]
C901.6	Understand the various distributed architectures of an embedded system.	[U]

Course Contents:

INTRODUCTION OF EMBEDDED SYSTEMS   **15**

Complex Systems and Microprocessor - Embedding Computers, Characteristics of Embedded Computing Applications, Use of Microprocessors, Performance in Embedded Computing, Physics of Software, Challenges in Embedded Computing system design, Formalism for System Design -Structural description, Behavioural description, Instruction sets - Preliminaries. Case Study : Model Train Controller.

EMBEDDED PROCESSOR AND COMPUTING SYSTEMS   **15**

ARM Processor - Processor and Memory organization, Data operations, Flow of Control, TIC55xDSP -Processor and Memory organization Addressing modes, Data operations, Flow of Control, System-level performance analysis - parallelism with instructions, The CPU Bus, Memory devices, Input/output devices, Component interfacing, Multiprocessor Performance Analysis, Introduction to vehicle tracking. Case Study : Alarm Clock.

MULTIPROCESSORS AND OPERATING SYSTEMS   **15**

Multiprocessors- CPUs and accelerators, Multiprocessors performance analysis, Consumer electronics architecture, Processes and operating systems - Multiple tasks and multiple processes, Distributed Embedded Architectures,Evaluating operating system performance, Power management and optimization for processes, Case Study : Telephone Answering Machine.

Total Hours:	**45**
Text Books:	

1	Wayne Wolf, Computers as Components: Principles of Embedded Computing System Design,Morgan Kaufman Publishers, 2016.
2	Frank Vahid and Tony Givargis, Embedded System Design: A Unified Hardware/Software Introduction, John Wiley & Sons, 2012.
3	Jane.W.S. Liu, Real-Time systems, Pearson Education Asia, 2009.

Reference Books:

1	C. M. Krishna and K. G. Shin, Real-Time Systems, McGraw-Hill 2E, 2010
2	Raj Kamal, Embedded Systems: Architecture, Programming and Design, Tata McGraw-Hill, 2012.

Web References:

1	https://exploreembedded.com
2	*https://www.codrey.com/embedded-systems/embedded-systems-introduction/*
3	www.eeherald.com/section/design-guide/esmod19.html
4	https://www.embedded.com/design/operating-systems/.../Tasks-and-scheduling

Online Resources:

1	https://www.coursera.org/learn/introduction-embedded-systems
2	www.circuitstoday.com/embedded-systems-an-introduction
3	https://www.embedded.com/design/prototyping-and.../Deadline-Scheduling
4	https://nptel.ac.in/courses/Webcourse-contents/.../Embedded%20systems/.../Lesson-29..

Assessment Methods & Levels (based on Blooms'Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C901.1	Apply	Quiz	**20**
C901.2 & C901.3	Analyze	Problem Solving	**20**
C901.4 & C901.5	Understand	Group Assignment	**20**
C901.6	Analyze	Case Study	**20**

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examinatio(60%) [100 Marks]
	CIA1[60 Marks]	CIA2[60Marks]	
Remember	-	-	-
Understand	40	40	40
Apply	40	20	30
Analyse	20	40	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%)

[100 Marks] |
| CA 1 : 100 Marks | | | CA 2 : 100 Marks | | | |
| SA 1

(60 Marks) | FA 1 (40 Marks) | | SA 2

(60 Marks) | FA 2 (40 Marks) | | |
| | Component - I

(20 Marks) | Component - II

(20 Marks) | | Component - I

(20 Marks) | Component - II

(20 Marks) | |

					Course Articulation Matrix									
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	3	3	3	2	2	2	2		1	1	2	1	3	-
2	3	3	3	2	3	2	2	1	1	1	2	1	3	2
3	3	3	3	2	3	2	1	1	1	2	2	2	3	1
4	3	3	2		1	-	-	-	-	-	1	2	2	-
5	3	3	2		1	-	-	-	-	-	1	2	2	-
6	3	3	3	2	3	2	2	1	1	1	2	1	3	1
1	Reasonably agreed			2	Moderately agreed			3	Strongly agreed					

22EC902	ARM PROCESSOR ARCHITECTURE AND PROGRAMMING	3/0/0/3
Nature of Course	: F (Theory Programming)	

Course Objectives:

1	To study the concepts of Architecture and Assembly language programming of ARM Processor.
2	To study the concepts of Architectural Support for High level language and memory Hierarchy.
3	To study the concepts of Cache memory and ,memory management protection
4	To learn the application development with ARM processor

Course Outcomes:
Upon completion of the course, students shall have ability to

C902.1	Understand the ARM architecture and its pipelining stages,.	[U]
C902.2	Analyze various instructions sets of ARM processor.	[AN]
C902.3	Interpret the importance of co processor interface with ARM	[AP]
C902.4	Understand the function of memory unit and multiple level cache	[U]
C902.5	Illustrate the ARM bus architecture and its features	[AN]
C902.6	Infer the way of interrupt and exception handling scheme related to ARM processor	[AP]

Course Contents:

ARM ARCHITECTURE: **15**
Abstraction in hardware design – MUO -Acorn RISC Machine – Architecture Inheritance – ARM programming model – ARM Development Tools – 3 and 5 Stage Pipeline ARM Organization – ARM 10 TDMI, Abstraction in software design, Data types, Floating point data types, Floating point Architecture.

CACHE AND MEMORY MANAGEMENT PROTECTION: **15**
Memory Technologies - Need for memory Hierarchy - Hierarchical Memory Organization - Virtual Memory. Cache Memory - Mapping Functions - Cache Design - Unified or split cache, multiple level of caches, ARM cache features, - Co-Processes Memory Map - Protected Systems - ARM systems with MPU - memory Protection Unit (MPU). Physical Vs Virtual Memory – Paging - Segmentation.

ARCHITECTURAL SUPPORT FOR SYSTEM DEVELOPMENT: **15**
 Advance Microcontroller Bus Architecture – ARM memory Interface –Emulator – Debug Architecture-Arm Application Development– ARM system control Co processorException Handling – Interrupts – Interrupt handling schemes- Self-Timed Design-VLSI Bluetooth baseband controller-AMULETS.

Total Hours:	45

Text Books:

1	Steve Furber, "*ARM System on Chip Architecture*," 2nd Edition Pearson India, 2014.
2	Andrew N. Sloss, Dominic Symes, Chris Wright, John Rayfield "ARM System Developer's Guide Designing and Optimizing System Software", Morgan Kufmann Publishers, 2011.
3	William Stallings , "Operating Systems", 9th Edition- Pearson Publication, 2017

Reference Books:

1	Ricardo Reis,"Design of System on a Chip: Devices and Components", Springer, 2004.

2	Michael J.Flynn," Computer system design : System on Chip", Wiley, 2012
3	William Hohl," ARM Assembly Language: Fundaments and Techniques, Second Edition, CRC press,2014

Web References:

1	http://infocenter.arm.com/help/index.jsp?topic=/com.arm.doc.set.swdev/index.html
2	http://www.dauniv.ac.in/downloads/MController_PPTs/MicroC2_eCh15L08ARMDevelopmentTools.pdf
3	https://www.ele.uva.es/~jesman/BigSeti/ftp/Microcontroladores/ARM/Arm%20System-On-Chip%20Architecture.pdf

Online Resources:

1	http://nptel.ac.in/courses/108102045/5
2	http://nptel.ac.in/courses/117106111/

Assessment Methods & Levels (based on Blooms'Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C902.1 & C902.2	Understand	Quiz	**20**
C902.3 & C902.4	Understand	Group Assignment	
C902.5	Analyse	Programming	**20**
C902.6	Apply	Case Study	**20**

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examinatio(60%) [100 Marks]
	CIA1[60 Marks]	CIA2[60Marks]	
Remember	-	50	10
Understand	70	50	30
Apply	-	-	30
Analyse	30	-	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination			
Continuous Assessment (40%) [200 Marks]			End Semester
CA 1 : 100 Marks		CA 2 : 100 Marks	
	FA 1 (40 Marks)		FA 2 (40 Marks)	

SA 1	Component - I (20 Marks)	Component - II (20 Marks)	SA 2	Component - I (20 Marks)	Component - II (20 Marks)	Examination (60%) [100 Marks]
(60 Marks)			(60 Marks)			

Course Articulation Matrix														
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	3	3	2	2	-	-	-	-	1	-	-	1	3	1
2	3	3	3	2	2	-	-	-	1	-	-	1	3	1
3	3	3	2	2	-	-	-	-	1	-	-	-	3	-
4	3	3	2	2	-	-	-	-	1	-	-	-	3	-
5	3	3	2	1	-	-	-	-	1	-	-	1	3	1
6	3	3	3	3	-	-	-	-	2	-	-	1	3	1
1	Reasonably agreed			2	Moderately agreed			3	Strongly agreed					

22EC903	REAL TIME OPERATING SYSTEMS	3/0/0/3

Nature of Course	: F (Theory Programming)	

Course Objectives:

1	To introduce the concepts of real time operating systems and intertwine it with basic building block
2	To Familiarize with Scheduling and synchronization of Real time operating systems
3	To introduce the concept of real time applications of multi threading models
4	To allow students to design and analyze of various memory management types and statergies.
5	To enable the students to evaluate the performance of different RTOS.

Course Outcomes:
Upon completion of the course, students shall have ability to

C903.1	Understand the the fundamental concepts of real-time operating systems.	[U]
C903.2	Analyze the real time design issues of real-time operating systems.	[AN]
C903.3	Interpret the importance of scheduling algorithms in RTOS	[AN]
C903.4	Describe the different Multi thread models	[U]
C903.5	Analyze the performance of various RTOS by use of case studies	[AN]
C903.6	Understand the various Pipes memory Management of RTOS	[U]

Course Contents:

INTRODUCTION TO REALTIME OPERAING SYSTEMS   15

Introduction to Operating System: Computer Hardware Organization, BIOS and Boot Process, Multi-threading concepts, Processes, Threads,Scheduling**,** Terminology: RTOS concepts and definitions, real-time design issues, examples, Hardware Considerations: logic states, CPU, memory, I/O, Architectures, RTOS building blocks, Real-Time Kernel

PROCESS MANAGEMENT AND INTER PROCESS COMMUNICATION   15

Concepts, scheduling, IPC, RPC, CPU Scheduling, scheduling criteria, scheduling algorithms Threads: Multi-threading models, threading issues, thread libraries, synchronization Mutex: creating, deleting, prioritizing mutex, mutex internals Messages, Buffers, mailboxes, queues, semaphores, deadlock, priority inversion,

PIPES MEMORY MANAGEMENT AND CASE STUDIES   15

Process stack management, run-time buffer size, swapping, overlays, block/page management, replacement algorithms, real-time garbage collection, Case study Linux POSIX system, RTLinux / RTAI, Windows system, Vxworks, ultron Kernel Design Issues: structure, process states, data structures, inter-task communication mechanism, Linux Scheduling

Total Hours:	45

Text Books:	
1	Labrosse, Jean J., MicroC/ OS-II,The Real-time Kernel, 2nd Ed., 2002,
2	Jane W. S. Liu, *"Real-time systems"*, Prentice Hall, 2000

Reference Books:	
1	W. Richard Stevens, *"Advanced Programming in the UNIX® Environment"*, 2nd Edition, Pearson Education India, 2011
2	Philips A. Laplante, *"Real-Time System Design and Analysis"*, 3rd Edition, John Wley& Sons, 2004
3.	Doug Abbott, *"Linux for Embedded and Real-Time Applications",* Newnes, 2nd Edition, 2011.
Web References:	
1	https://www.toppr.com/guides/computer-science/computer-fundamentals/operating-system/real-time-operating-system-rtos/
2	https://www.javatpoint.com/real-time-operating-system
3	https://www.techtarget.com/searchdatacenter/definition/real-time-operating-system
4	https://www.guru99.com/real-time-operating-system.html
Online Resources:	
1	https://embedded-academy.com/en/courses/real-time-operating-system-en/
2	www.circuitstoday.com/embedded-systems-an-introduction
3	*https://unacademy.com/content/bank-exam/study-material/computer-knowledge/real-time-operating-system/*
4	https://www.arm.com/resources/education/education-kits/real-time-operating-systems

Assessment Methods & Levels (based on Blooms'Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C903.1	Understand	Quiz	**20**
C903.2 & C903.3	Analyze	Problem solving	**20**
C903.4 & C903.5	Understand	Group Assignment	**20**
	Analyze		
C903.6	Understand	Case Study	**20**

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examinatio(60%) [100 Marks]
	CIA1[60 Marks]	CIA2[60 Marks]	
Remember			
Understand	40	40	40
Apply	40	20	30
Analyse	20	40	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination							
Continuous Assessment (40%) [200 Marks]							End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks				
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)			
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)		

Course Articulation Matrix														
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	3	3	3	2	2	2	2		1	1	2	1	3	-
2	3	3	3	2	3	2	2	1	1	1	2	1	3	2
3	3	3	3	2	3	2	1	1	1	2	2	2	3	1
4	3	3	2		1	-	-	-	-	-	1	2	2	-
5	3	3	2		1	-	-	-	-	-	1	2	2	-
6	3	3	3	2	3	2	2	1	1	1	2	1	3	1
1	Reasonably agreed			2	Moderately agreed			3	Strongly agreed					

22EC904	EMBEDDED PRODUCT DESIGN	3/0/0/3

Nature of Course	:C (Theory Concept)

Course Objectives:

1	To enable the students to understand the concept of Embedded system development
2	To gain knowledge about the concept of various communication protocols
3	To enable the students to study the embedded software development
4	To apply the knowledge of real time operating systems for scheduling.
5	To enable the students to design embedded system for various applications

Course Outcomes:

Upon completion of the course, students shall have ability to

C904.1	Learn the basics of embedded system development.	[U]
C904.2	Understand the various components of an embedded system.	[U]
C904.3	Understand the various communication protocols structures.	[U]
C904.4	Understand the embedded Product Life Cycle development cycle.	[U]
C904.5	Apply the knowledge of Real Time Operating Systems for scheduling.	[AP]
C904.6	Design embedded systems for various applications.	[AP]

Course Contents:

MODULE 1: INTRODUCTION TO EMBEDDEDSYSTEM 15

Introduction to Embedded Systems – The build process for embedded systems - Structural units in Embedded processor, selection of processor & memory devices- DMA – Memory management methods - Timer and Counting devices, Watchdog Timer, Real Time Clock, In circuit emulator, Target Hardware Debugging. Embedded Networking: Introduction, I/O Device Ports & Buses, need for device drivers.

MODULE 2: COMMUNICATION AND EMBEDDED FIRMWARE DEVELOPMENT ENVIRONMENT 15

Serial Bus communication protocols - RS232 standard – RS422 – RS485 - CAN Bus -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) – Universal Serial Bus (USB). Parallel Communication – ISA, PCI. Embedded Product Development Life Cycle- objectives, different phases of EDLC, Modeling of EDLC; issues in Hardware-software Co-design

MODULE 3: RTOS BASED EMBEDDED SYSTEM DESIGN AND APPLICATION DEVELOPMENT 15

Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Task communication shared memory, message passing, Inter process Communication – synchronization between processes - semaphores, Mailbox, pipes, priority inversion, priority inheritance, comparison of Real time Operating systems: VxWorks, чC/OS-II, RTLinux. Case Study of Washing Machine- Automotive Application- Smart card System.

Total Hours:	45

Text Books:

1	Rajkamal, Embedded System-Architecture, Programming, Design", McGrawHill, 2017
2	Shibu. K.V, "Introduction to Embedded Systems", Tata McgrawHill,2017
3	Lyla B Das," Embedded Systems-An Integrated Approach", Pearson,2013

Reference Books:

1	Elicia White," Making Embedded Systems", O" ReillySeries, SPD, 2011.
2	Tammy Noergaard, "Embedded Systems Architecture", Elsevier, 2006.
3	Han-Way Huang, "Embedded system Design Using C8051", CengageLearning, 2009.
4	Rajib Mall "Real-Time systems Theory and Practice" Pearson Education, 2007.
5	Peckol, "Embedded system Design", John Wiley &Sons, 2010

Web References:

1	https://booksite.elsevier.com/9780750676052/content/Resources/Chapter1.htm
2	https://acufore.com/embedded-product-design

Online Resources:

1	https://onlinecourses.nptel.ac.in/noc24_cs33/preview
2	https://www.arm.com/resources/education/online-courses/efficient-embedded-systems

Assessment Methods & Levels (based on Blooms'Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C904.1	Understand	Quiz	**20**
C904.2 C904.3	Understand	Problem Solving	**20**
C904.4	Understand	Group Assignment	**20**
C904.5	Apply		
C904.6	Analyze	Case Study	**20**
Summative assessment based on Continuous and End Semester Examination			

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examinatio(60%) [100 Marks]
	CIA1[10 Marks]	CIA2[10 Marks]	
Remember	-	-	-
Understand	40	40	40
Apply	40	20	30
Analyse	20	40	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Course Articulation Matrix														
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	3	3	3	2	2	2	2		1	1	2	1	3	-
2	3	3	3	2	3	2	2	1	1	1	2	1	3	2
3	3	3	3	2	3	2	1	1	1	2	2	2	3	1
4	3	3	2		1	-	-	-	-	-	1	2	2	-
5	3	3	2		1	-	-	-	-	-	1	2	2	-
6	3	3	3	2	3	2	2	1	1	1	2	1	3	1
1	Reasonably agreed			2	Moderately agreed			3	Strongly agreed					

22EC905	EMBEDDED SYSTEMS FOR EDGE COMPUTING	3/0/0/3
Nature of Course	:C (Theory Concept)	

Course Objectives:	
1	To enable the students to understand the concept of advanced microcontroller
2	To gain knowledge about the concept of fundamentals and hardware of edge computing.
3	To enable the students to study the network and communication protocols
4	To apply the knowledge of data handling in edge computing.
5	To enable the students to know about data security in edge computing.

Course Outcomes:
Upon completion of the course, students shall have ability to

C905.1	Understand the basics of embedded systems and advanced micro controllers.	[U]
C905.2	Apply the Programming skills in ARM processor.	[AP]
C905.3	Understand the fundamentals of edge computing	[U]
C905.4	Analyze the Network and communication protocols.	[U]
C905.5	Apply the concepts of Data handling in edge computing	[AP]
C905.6	Interpret the ideas about Data security in edge computing.	[AP]

Course Contents:

Module 1: Foundations of Embedded Systems   15
Introduction to Embedded Systems: Basics of Embedded Systems-Definition and Characteristics, Embedded System Applications, Design Process and Lifecycle. Overview of Microcontrollers and Microprocessors, Architecture of ARM Cortex, AVR, Instruction Sets and Assembly Language.

Module 2: Computing and Communication Protocols   15
Introduction to Edge Computing-Definition and Architecture, Edge vs. Cloud Computing, Use Cases and Applications. Hardware for Edge Computing-Edge Devices and Gateways, Comparison of Popular Edge Platforms (Raspberry Pi, NVIDIA Jetson, Intel NUC), Sensors and Actuators for Edge Devices. Networking Basics: Network Protocols (TCP/IP, HTTP, MQTT), Wireless Communication (Wi-Fi, Bluetooth, Zigbee)

Module 3: Data and Security in Edge Computing   15
Data Processing at the Edge-Data Acquisition and Preprocessing, Local Storage and Database Management, Edge Analytics and Data Reduction Techniques. Middleware for Edge Computing-Middleware Architectures, Data Flow Management. Security in Edge Computing-Edge Device Security, Data Security and Privacy at the Edge, Secure Communication Protocols.

	Total Hours:	**45**

Text Books:	
1	Rajkamal, Embedded System-Architecture, Programming, Design, McGrawHill, 3rd edition, 2017.
2	Ajit Singh, Edge Computing simply in depth, 2019
3	Pethuru Raj and Anupama C. Raman , The Internet of Things: Enabling Technologies, Platforms, and Use Cases; CRC Press. 2017.

Reference Books:

1	Chris Simmonds, Mastering Embedded Linux Programming, PACKT publications.
2	Fadi Al-Turjman, Edge Computing from hype to reality. Springer.
Web References:	
1	https://www.design-reuse.com/articles/44225/embedded-computing-on-the-edge.html
2	https://iies.in/blog/role-of-embedded-processors-in-iot-devices-and-edge-computing/
Online Resources:	
1	https://www.edx.org/learn/edge-computing
2	https://www.se.com/in/en/work/campaign/local/edge-computing.jsp
3	https://www.coursera.org/edgeimpulse

Assessment Methods & Levels (based on Blooms'Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C905.1	Understand	Quiz	**20**
C905.2	Apply	Programming	**20**
C905.3	Understand		
C905.4	Understand	Group Assignment	**20**
C905.5	Apply		
C905.6	Apply	Case Study	**20**
Summative assessment based on Continuous and End Semester Examination			

Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examinatio(60%) [100 Marks]**
	CIA1[60 Marks]	**CIA2[60 Marks]**	
Remember	-	-	-
Understand	70	50	50
Apply	30	50	30
Analyse	-	-	20
Evaluate	-	-	-
Create	-	- -	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Course Articulation Matrix														
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	3	3	2	2	-	-	-	-	1	-	-	1	3	1
2	3	3	3	2	2	-	-	-	1	-	-	1	3	1
3	3	3	2	2	-	-	-	-	1	-	-	-	3	-
4	3	3	2	2	-	-	-	-	1	-	-	-	3	-
5	3	3	2	1	-	-	-	-	1	-	-	1	3	1
6	3	3	3	3	-	-	-	-	2	-	-	1	3	1
1	Reasonably agreed			2	Moderately agreed			3	Strongly agreed					

22EC906	MICROCONTROLLER BASED SYSTEM DESIGN	3/0/0/3

Nature of Course	:C (Theory Concept)

Course Objectives:

1	To enable the students to understand the concept of PIC microcontroller
2	To gain knowledge about the concept of peripheral devices and communication protocols.
3	To enable the students to study the functional blocks of ARM.
4	To apply the knowledge of ARM instruction set for programming.
5	To enable the students to design microcontroller based system using Raspberry Pi.

Course Outcomes:

Upon completion of the course, students shall have ability to

C906.1	Understand the architecture of PIC microcontroller.	[U]
C906.2	Understand the importance of peripheral devices and communication protocols.	[U]
C906.3	Acquire the knowledge of ARM architecture and functional blocks.	[U]
C906.4	Apply the knowledge of ARM instruction set for programming.	[AP]
C906.5	Understand the applications and implementation of ARM.	[U]
C906.6	Design of microcontroller based systems using Raspberry Pi	[AP]

Course Contents:

Module 1: PIC MICROCONTROLLER   15

Introduction to PIC Microcontroller– PIC16C74 Architecture, Pipelining - Program Memory considerations – Register File Structure - Instruction Sets – Addressing modes – Simple Operations. Interrupts- External Interrupts-Interrupt Programming–Loop time subroutine. Timers-I2C Bus for Peripherals Chip Access – Bus operation – Bus subroutines, Serial EEPROM, UART Baud Rate Selection, Data Handling Circuit – Initialization - LCD and keyboard Interfacing, ADC, DAC, and Sensor Interfacing.

Module 2: ADVANCED RISC MACHINE   15

Architecture of ARM 7– ARM 7 programmer's model –ARM 7 Development tools- Memory Hierarchy – ARM Instruction Set – ARM Assembly Language Programming–Simple Examples – Architectural Support for Operating systems– 5-Stage Pipeline ARM Organization–ARM Instruction Execution.

Module 3: ARM IMPLEMENTATION AND RASPBERRY PI   15

ARM Implementation: Data path timing, Adder design, ALU function– ARM coprocessor CP15 interface– Embedded ARM Applications - The VLSI Ruby II Advanced Communication Processor. Introduction to Raspberry PI 3 – Architecture, Raspberry Pi interfacing programs: LED, Keyboard, Sensor, Motor Control, Pulse Width Modulation.

	Total Hours:	45

Text Books:

1	Peatman, J.B., "Design with PIC Micro Controllers" Pearson Education, 3rdEdition, 2004.
2	Furber S., "ARM System on Chip Architecture" Addison Wesley trade Computer Publication, 2000.

3	Lyla B Das," Embedded Systems-An Integrated Approach", Pearson,2013
Reference Books:	
1	Elicia White," Making Embedded Systems", O" ReillySeries, SPD, 2011.
2	Tammy Noergaard, "Embedded Systems Architecture", Elsevier,2 006.
3	Han-Way Huang, "Embedded system Design Using C8051", CengageLearning, 2009.
4	Rajib Mall "Real-Time systems Theory and Practice" Pearson Education, 2007.
5	Peckol, "Embedded system Design", John Wiley &Sons, 2010
Web References:	
1	Mazidi, M.A., "PIC Microcontroller" Rollin Mckinlay, Danny causey, Printice Hall of India, 2007.
2	Simon Monk, "Programming Arduino", Tata McGraw Hill, 2012
Online Resources:	
1	https://www.coursera.org/learn/microcontroller-and-industrial-applications
2	https://www.coursera.org/courses?query=embedded%20systems
3	https://archive.nptel.ac.in/courses/106/105/106105193/

Assessment Methods & Levels (based on Blooms'Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C906.1	Understand	Quiz	**20**
C906.2 C906.3	Understand	Programming	**20**
C906.4	Apply	Group Assignment	**20**
C906.5	Understand	Case study	**20**
C906.6	Apply	Case Study	**5**
Summative assessment based on Continuous and End Semester Examination			

Bloom's Level	**Continuous Assessment**		**End Semester Examination[50 Marks]**
	CIA1[10 Marks]	**CIA2[10 Marks]**	
Remember			
Understand	40	40	40
Apply	40	20	30
Analyse	20	40	30
Evaluate	-		-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Course Articulation Matrix														
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	3	3	3	2	2	2	2		1	1	2	1	3	-
2	3	3	3	2	3	2	2	1	1	1	2	1	3	2
3	3	3	3	2	3	2	1	1	1	2	2	2	3	1
4	3	3	2		1	-	-	-	-	-	1	2	2	-
5	3	3	2		1	-	-	-	-	-	1	2	2	-
6	3	3	3	2	3	2	2	1	1	1	2	1	3	1
1	Reasonably agreed			2	Moderately agreed			3	Strongly agreed					

22EC907	ASIC DESIGN	3/0/0/3

Nature of Course	: C (Theory Concept)

Course Objectives:

1	To study the different types of ASIC
2	To familiarize with the different types of programming technologies and logic devices
3	To gain knowledge about partitioning, floor planning.
4	To gain knowledge about placement and routing of ASIC

Course Outcomes:
Upon completion of the course, students shall have ability to

C907.1	To understand the ASIC design flow and logic synthesis.	[U]
C907.2	To understand the programming technologies of an ASIC and its construction.	[U]
C907.3	Apply partitioning algorithms to partition the network to meet the objectives.	[AP]
C907.4	Apply floor planning algorithms to place the logic cells inside the flexible blocks of an ASIC to meet the objectives.	[AP]
C907.5	Apply routing algorithms to route the channels	[AP]
C907.6	Describing various circuit extraction formats and Investigate the issues and discover solutions in each step of physical design flow of an ASIC.	[AN]

Course Contents:

Overview of ASIC ,PLD and Logic Synthesis : 15
ASIC Design Flow, Types of ASICs, Programming Technologies- Antifuse – Static RAM- EPROM and EEPROM technology, Programmable Logic Devices: ROMs and EPROMs – PLA- PAL, Gate Arrays – CPLDs and FPGAs, Verilog and logic synthesis -VHDL and logic synthesis.

ASIC Partitioning and Floor planning: 15
System Partition - partitioning methods –constructive partitioning-iterative partitioning Improvement Algorithms - K-L Algorithm - FM algorithm - Ratio-Cut Algorithm- Look-Ahead Algorithm, Simulated Annealing, FPGA Partitioning, Power Dissipation. floor planning-channel definition-i/o and power planning-clock planning.

ASIC Placement ,Routing and Circuit Extraction: 15
Placement –Placement Algorithms- – Min-cut Placement, Eigen value Placement, Iterative Placement Improvement and Timing driven Placement algorithms. Routing: Global Routing Measurement – Measurement of Interconnect Delay using Elmore's constant, Global routing for CBIC and GA, Detailed Routing Measurement - Measurement of Channel Density, Detailed routing Algorithms – LEA, Lee Maze and High tower Algorithms, – Circuit Extraction – DRC.

Total Hours:	45

Text Books:

1	M.J. S. Smith, " Application Specific Integration Circuits", Pearson Education, Ninth Indian reprint,13th edition,2004.
2	Neil H.E.Weste, Eshraghian, "Principles of CMOS VLSI Design": Addison Wesley, 1999.
3	Andrew Brown, " VLSI Circuits and Systems in Silicon", McGraw Hill, 1991

Reference Books:

1	Wayne Wolf, "Modern VLSI design" - Addison Wesley, 1998.
2	Neil H.E.Weste, Eshraghian, "Principles of CMOS VLSI Design", Addison Wesley, 1999.
Web References:	
1	https://anysilicon.com/asic-design-flow-ultimate-guide/
2	https://www.einfochips.com/blog/asic-design-flow-in-vlsi-engineering-services-a-quick-guide/
3	https://www.electronics-notes.com/articles/digital-embedded-processing/asic-application-specific-ic/how-to-design-asic.php
4	https://www.easics.com/services/asic-design
Online Resources:	
1	https://freevideolectures.com/subject/vlsi-and-asic-design/
2	https://www.classcentral.com/course/independent-digital-asic-design-859
3	https://www.verifasttech.com/asic-verification-training/

Continuous Assessment				End Semester Examination	Total
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%)** **[80 Marks]**
C907.1 C907.2	Understand	Quiz	20
C907.3	Analyze	Group Assignment	20
C907.4	Understand	Assignment	20
C907.5, C907.6	Analyze	Class presentation	20
Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment** **[120 Marks]**		**End Semester Examination (60%)** **[100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	

Remember	40	10	10
Understand	60	20	40
Apply		40	30
Analyse		30	20
Evaluate			
Create			

Assessment based on Continuous and End Semester Examination					
Continuous Assessment (40%) [200 Marks]					End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks		
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)	
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)

Course Articulation Matrix														
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	3	2	3	3	3							3	2	3
2	2	3	3	3		2						3	3	3
3	2	2	3	3	3	1			2			3	2	3
4	2	2	2	3	3							3	2	3
5	2	3	3	3	3					2		3	3	3
6	2	2	3	3	3					2		3	3	3
1	Reasonably agreed			2	Moderately agreed			3		Strongly agreed				

22EC908	SYSTEM ON CHIP DESIGN	3/0/0/3

Nature of Course	:G (Theory & Analytical)

Course Objectives:

1	To design combinational and sequential logic networks
2	To learn optimization of power in combinational and sequential logic machines
3	To study the design principles of Architecture and Chip Design
5	To learn the principles of CAD System design

Course Outcomes:
Upon completion of the course, students shall have ability to

C908.1	To recall the basic concepts of logic gates	[U]
C908.2	To apply the concepts of interconnects in designing combinational logic networks	[AP]
C908.3	To illustrate the functional ideas of the sequential machines	[U]
C908.4	To develop the subsystem combinational and sequential designs	[AP]
C908.5	To examine Architecture and Chip Design Methods	[AP]
C908.6	To survey and study about CAD Systems	[AN]

Course Contents:

LOGIC GATES AND COMBINATIONAL LOGIC NETWORKS: **15**
Introduction, Combinational Logic Functions, Static Complementary Gates, Switch Logic, Alternative Gate Circuits, Low-Power Gates, Delay Through Resistive Interconnect, Delay Through Inductive Interconnect, Standard Cell-Based Layout, Simulation, Combinational Network Delay, Logic and interconnect Design, Power Optimization, Switch Logic Networks, Combinational Logic Testing.

SEQUENTIAL MACHINES AND SUBSYSTEM DESIGN: **15**
Introduction, Latches and Flip-Flops, Sequential Systems and Clocking Disciplines, Sequential System Design, Power Optimization, Design Validation, Sequential Testing, Subsystem Design Principles, Combinational Shifters, Adders, ALUs, Multipliers, High-Density Memory, Field Programmable Gate Arrays (FPGA), Programmable Logic Arrays (PLA).

ARCHITECTURE DESIGN & CAD SYSTEMS: **15**
Floor Planning Methods- Register Transfer Design- High Level Synthesis- Architecture for Low Power- System on Chips and Embedded CPU-Architecture Testing- Chip Design Methodologies- Kitchen Timer Chip-CAD Systems-Switch level Simulation-Layout Synthesis and Analysis-Logic Synthesis-Test Generation-Hardware/ Software Co-design

Total Hours:		45

Text Books:

1	Wayne Wolf, "Modern VLSI Design – System – on – Chip Design", Prentice Hall, 3rd Edition 2008
2	Wayne Wolf, "Modern VLSI Design – IP based Design", Prentice Hall, 4th Edition, 2008
3	Ray Salemi ,"The UVM Primer A step -by- step Introduction to the universal verification methodology", Boston Light Press , 2nd edition ,2013

References:	
1	RochitRajsuman, "System-on- a-chip: Design and test", Advantest America R & D Center, 2000.
2	B. Al Hashimi, "System on chip-Next generation electronics", The IET, 2006
Web References:	
1	http://users.ece.utexas.edu/~gerstl/ee382m_f18/index.html
Online Resources:	
1	https://www.cl.cam.ac.uk/teaching/1718/SysOnChip/

Continuous Assessment				End Semester Examination	Total
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%)** **[80 Marks]**
C908.1 C908.2	Remember	Quiz	20
C908.3	Understand	Assignment	20
C908.4	Apply	Problem Solving	20
C908.5, C908.6	Analyse	Case Study	20
Assessment based on Summative and End Semester Examination			

Bloom's Level	Summative Assessment [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	20	20	20
Understand	50	40	50
Apply	30	40	30
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Course Articulation Matrix														
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	2	1	-	1	-	-	-	-	-	-	-	2	3	1
2	3	2	1	2	-	-	-	-	-	-	-	3	3	2
3	2	1	-	1	-	-	-	-	-	-	-	2	2	2
4	3	2	1	2	1	-	-	-	-	-	-	3	2	1
5	3	3	3	2	1	-	-	-	-	-	-	1	3	1
6	3	3	3	2	1	-	-	-	-	-	2	1	3	2
1	Reasonably agreed			2	Moderately agreed			3	Strongly agreed					

22EC909	ELECTRONIC DESIGN AUTOMATION TOOLS	3/0/0/3

Nature of Course	G (Theory & Analytical)
Pre requisites	Digital Electronics
Co requisites	CMOS VLSI Design

Course Objectives:

1	To study the various features of VLSI EDA Tools.
2	To understand the concepts of Physical Design Process of simulation and synthesis of HDLs.
3	To realize the circuits using SPICE and simulate them using TSpice for optimization of design .
4	To formulate ECAD design problems by implementing VHDL based algorithms

Course Outcomes:
Upon completion of the course, students shall have ability to

C909.1	Understand overview of impact of EDA tools on physical design methods of VLSI designs	[U]
C909.2	Familiarize about various tools available of EDA family	[U]
C909.3	Interpret the design rule set to achieve optimization in DC & AC circuit analysis	[AN]
C909.4	Apply the different programming tools to understand the program concepts and Construct and simulate various sequential logic circuits using HDL	[AP]
C909.5	Analyze different levels of abstraction and simulation in VLSI circuits	[AN]
C909.6	Apply the knowledge obtained from spice to generate the Layout	[AP]

Course Contents:

Fundamentals on EDA Tools   **15**

VLSI Design Automation tools - An overview of the features of practical CAD tools - FPGA Technology & Tools - Modelsim -Leonardo spectrum -Xilinx ISE- ASIC Technology & Tools- Cadence, Synopsys and Microwind- System C, System Verilog, OVM (open verification methodology) – UVM (Universal Verification Methodology)

ADVANCED VERILOG HDL AND VERILOG TEST BENCHES   **15**

Verilog –Behavior modelling, dataflow and structural modelling -Finite State Machines (FSM) Synthesis in Verilog, Memory Design -Single Port and Dual Port SRAM, Tasks, Functions, User Defined Primitives (UDP)-Timing and Delays,functions – packages- System C basic programming- functions and loops- VHDL(2019) programming System verilog synthesis- Test Benches for Combinational Logic Modules and Sequential Digital Circuits based on VHDL & Verilog

ANALYSIS OF SPICE AND LAYOUT DESIGN   **15**

Introduction -Types of SPICE - Types of Analysis-Circuit description -DC circuit analysis-Transient analysis -AC circuit analysis - VLSI Layout - Design Rules - Stick Diagram level transformations-Testability measures for circuits -Brief to Physical design for 3D circuits	
Total Hours:	45

Text Books:

1.	Ming -Bo Lin, Digital System Designs and Practices using Verilog HDL and FPGAs, Wiley, Reprinted 2018.
2.	Samir Palnitkar, Verilog HDL, Pearson Education, 5th Edition, 2014.
3.	M.H.Rashid, Spice for Circuits and Electronics using Pspice , PHI Reprinted, 2016
4.	Gordon Roberts, Adel Sedra, SPICE, The Oxford Series in Electrical and Computer Engineering, 2nd edition,1996

Reference Books:

1.	M.J.S.Smith, Application Specific Integrated Circuits , Pearson Education, 2008.
2.	J.Bhaskar, A Verilog Primer , Prentice Hall, 2005.
3.	StevenM.Rubin,"ComputerAidsforVLSIDesign",AddisonWesleyPublishing 2017.

Web References:

1.	https://cosmolearning.org/courses/electronic-design-automation-544/
2.	http://www.vlsiacademy.org/open-source-cad-tools.html
3.	https://cdnc.itec.kit.edu/downloads/Praktikum_SS12_Introduction.pdf
4.	http://ngspice.sourceforge.net/resources.html

Online Resources:

1.	https://nptel.ac.in/courses/106105083/
2.	http://www.nptelvideos.in/2012/11/electronic-design-and-automation.html
3.	https://freevideolectures.com/course/2685/electronic-design-and-automation
4.	http://www.ece.lsu.edu/ee3755/2013f/lsli01.pdf

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C909.1 C909.2	Remember	Quiz	20

C909.3	Understand	Assignment	20
C909.4	Apply	Problem Solving	20
C909.5, C909.6	Analyse	Case Study	20

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	40	20	10
Understand	60	20	40
Apply	-	30	30
Analyse	-	30	20
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Course Articulation Matrix

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	3	3	2	3	1	1	1	-	-	-	1	1	-	-
2	3	2	3	2	1	1	1	-	-	-	2	1	-	-
3	3	3	3	3	2	1	2	-	-	-	1	1	-	-
4	2	3	3	2	1	1	1	-	-	-	2	1	-	-
5	3	2	3	2	1	2	1	-	-	-	1	2	-	-
6	3	3	2	3	1	1	1	-	-	-	1	1	-	-
1	Reasonably agreed		2	Moderately agreed			3		Strongly agreed					

22EC910	**LOW POWER VLSI DESIGN**	3/0/0/3

Nature of Course	G (Theory analytical)		
Course Objectives:			
1	To introduce the concepts of low power issues in VLSI circuit designs.		
2	To equip students with various issues related to scaling and short channel effects in MOSFET.		
3	To apply low power design logics in the design of combinational, sequential and random-access memory circuits.		
4	To develop mixed-signal circuits in sub-100nm space and current mirror circuits.		
5	To enable the students to automate the analog design methodologies.		

Course Outcomes:
Upon completion of the course, students shall have ability to

C910.1	Understand the low power issues in VLSI circuit designs.	U
C910.2	Acquire knowledge in Scaling and Short Channel Effects in MOSFET.	U
C910.3	Apply low-power logic in the combinational circuit designs.	AP
C910.4	Design low-power sequential circuits and random-access memories.	AP
C910.5	Design low-power mixed-signal circuits in sub-100nm space and current mirror circuits.	AP
C910.6	Apply the fundamentals of current/voltage references and analog design automation techniques.	AP

Course Contents:

Introduction to Low Power Issues in VLSI Designs: **15**

Low Power IC Design beyond Sub-20 nm Technology, Issues Related to Silicon Manufacturability and Variation, Issues Related to Design Productivity, Limitation Faced by CMOS, Low Leakage MOSFET, Importance of Subthreshold Slope, Subthreshold Leakage and Voltage Limits, Ultralow Voltage Operation, Low Power Analog Circuit Design, Fundamental Consequence of Lowering Supply Voltage, Analog MOS Transistor Performance Parameters, MOSFET Scaling, Gate Oxide Scaling, Gate Leakage Current, Mobility, High-k Gate Dielectrics, Gate Length Scaling, Short Channel Effect in MOSFET.

Digital Circuit Design Logics: **15**

Pseudo-nMOS Gates, Pass-transistor Logic, Complementary Pass Transistor Logic, Sizing of Transistor in CMOS Design Style, Logical Efforts, Transmission Gates, Implementation of Combinational Circuit Using DTMOS Logic for Ultralow Power Application, Sizing Requirements for the Transmission Gates, Clock Skews, Design and Analysis of the Flip-flops Using DTMOS Style, Adiabatic Flipflop, Memory - DRAM Cell, SRAM Cell and operations.

Mixed Signal Circuit Designs: **15**

Mixed-signal Design with Sub-100 nm Technology, Challenges in MS Design in Sub-100 nm Space, Basics of Switched-capacitor Circuits, Current Source/Sink, Low Power Current Mirror, Fundamentals of Current/Voltage Reference, Bandgap Voltage Reference, An Introduction to Analog Design Automation.

	Total Hours:	**45**

Text Books:	
1	Angsuman Sarkar, Swapnadip De, Manash Chanda, Chandan Kumar Sarkar, Low Power VLSI Design, De Gruyter Oldenbourg, 2016
2	Ajit Pal, Low-Power VLSI Circuits and Systems, 1st Ed., Springer India, 2015.
3	Sharma, Manoj, Gautam, Ruchi, Khan, Mohammad Ayoub, Design and Modeling of Low Power VLSI Systems, IGI Global, 2016.
4	Pascal Meinerzhagen, Adam Teman, Robert Giterman, Gain-Cell Embedded DRAMs for Low-Power VLSI Systems-on-Chip, Springer International Publishing, 2017.
Reference Books:	
1	Rohit Dhiman, Rajeevan Chandel, Nanoscale VLSI: Devices, Circuits and Applications, Springer Nature Singapore, 2020.
2	Armin Tajalli, Yusuf Leblebici, Low-Power CMOS Circuits Technology, Logic Design and CAD Tools, CRC Press, 2018.
3	Kaushik Roy, Sharat C. Prasad, Low-Power Cmos VLSI Circuit Design, 1st Ed., Wiley India Pvt. Limited, 2009.
Web References:	
1	https://www.tutorialspoint.com/vlsi_design/
2	www.vlsi-expert.com/p/vlsi-basic.html
3	https://www.engineersgarage.com/articles/vlsi-design-future
4	https://electronicsforu.com/resources/learn-electronics/vlsi-developments-ic-fabrication
Online Resources:	
1	https://www.youtube.com/watch?v=9SnR3M3CIm4
2	https://www.techopedia.com/definition/714/very-large-scale-integration-vlsi
3	www.techulator.com › Resources › Electronics › Circuits & Components
4	electronicsforu.com › Resources › Learning Corner
5	http://www.allaboutcircuits.com/education/

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C910.1	Remember	Quiz	20
C910.2, C910.3	Analyze	Assignment	20
C910.4	Understand	Seminar	20
C910.5, C910.6	Apply	Group Assignment	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	10	10
Understand	40	30	30
Apply	20	30	30
Analyse	20	30	30
Evaluate			
Create			

Assessment based on Continuous and End Semester Examination					
Continuous Assessment (40%) [200 Marks]					**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks			**CA 2 : 100 Marks**		
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**	
	Component - I	Component - II		Component - I	Component - II

	(20 Marks)	(20 Marks)		(20 Marks)	(20 Marks)	

Course Articulation Matrix														
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	3	2	2	2	-	1	1	-	-	-	-	1	2	-
2	3	2	2	2	-	1	1	-	-	-	-	1	2	-
3	2	3	3	3	1	2	1	-	2	1	1	2	3	2
4	3	3	3	3	1	2	1	-	2	1	1	2	3	2
5	3	3	2	3	1	1	1	-	1	-	-	1	2	-
6	3	3	3	2	1	2	1	-	2	-	1	2	2	1
1	Reasonably agreed			2	Moderately agreed			3	Strongly agreed					

22EC911	VLSI FOR IMAGE AND VIDEO PROCESSING	3/0/0/3

Nature of Course	:G (Theory & Analytical)

Course Objectives:

1	To recall various Image Processing Algorithms
2	To acquire the basic knowledge on Image Processors and their architectures
3	To focus on designing and implementation part of Pipelining, 2D and 3D image Processors
4	To equip the students with basic knowledge on various video processing algorithms
5	To study the challenges and design trade-offs in real time video processing

Course Outcomes:
Upon completion of the course, students shall have ability to

C911.1	Analyse various level tasks and operations to realize Image processing algorithms	[AN]
C911.2	Understand the design aspects of Image Processor architectures	[U]
C911.3	Analyse the design and implementation of Pipelining and 2D image Processors	[AN]
C911.4	Deduce and further develop suitable 3D image processing algorithms	[AP]
C911.5	Interpret the significance of various video processing algorithms	[AN]
C911.6	Survey the real time design trade-offs involved in any video processing	[U]

Course Contents:

IMAGE PROCESSING ALGORITHMS AND ARCHITECTURES   (15)
Image Processing Tasks - Low level Image Processing Operations - intermediate level operations Image processor architecture: Requirements and Classification - Uni and Multi processors - MIMD systems - SIMD systems - Pipelines - Design aspects of real-time low-level image processors - Design method for special architectures.

PIPELINED, 2D AND 3D IMAGE PROCESSING ARCHITECTURES   (15)
Architecture of a cellular logic processing element - Second decomposition in data path and control - Real time pipeline for low level image processing - Design aspects of Image Processing architectures - Implementation of Low level 2D and 3D and Intermediate level algorithms- 3D Image Processing: Overview of 3D image - Types and characteristics of 3D image processing - Examples of 3D image processing, Continuous and digitized images, Models of image operations, Algorithm of image operations - Smoothing filter - Difference filter - Differential features of a curved surface - Region growing.

VIDEO PROCESSING ALGORITHMS AND ARCHITECTURES   (15)
Introduction to Video Processing, Video Sampling and Interpolation, Motion Detection and Estimation Algorithms, Video Enhancement and Restoration, Video Stabilization and Mosaicing- Video Segmentation - MPEG-4 Visual and Fast Motion Estimation Algorithms. General design space evaluation - Design space motion estimation architectures - Motion estimation architectures for MPEG-4 - Design Trade-offs - Real time Implementation in designing search engine I and Search engine II.

	Total	45

Text Books:

1.	Peter M. Kuhn, "Algorithms, Complexity Analysis and VLSI Architectures for MPEG-4 Motion Estimation", Springer, 2013.	
2.	Sid Ahmed M.A., "Image Processing - Theory, Algorithm and Architectures", McGraw Hill, 2009.	
3.	Pieter Jonker, "Morphological Image Processing: Architecture and VLSI design", Springer, 2012.	
4.	Junichiro Toriwaki · Hiroyuki Yoshida, "Fundamentals of Three-Dimensional Digital Image Processing", Springer 2009.	
5.	A Murat Tekalp, "Digital Video Processing", Person Education, New Delhi, 2015	

Reference Books:

1.	Suhel Dhanani and Michael Parker, "Digital Video Processing for Engineers", ScienceDirect, 2012.
2.	Oge Marques, "Practical Image and Video Processing Using MATLAB", Wiley, USA, 2011.
3.	Alan C. Bovik, "The Essential Guide to Video Processing", Academic Press, 2009.
4.	King-sun Fu, "VLSI for Pattern Recognition and Image Processing", Springer-Verlag, 2013.

Web References:

1.	https://link.springer.com/article/10.1007/s11554-006-0008-7
2.	https://ieeexplore.ieee.org/document/735383
3.	http://irphouse.com/ijeee/ijeeev3n2_06.pdf
4.	https://www.youtube.com/watch?v=Y8FvvzcocT4
5.	http://web.iiitdm.ac.in/noor/VLSI2023.html

Online Resources:

1.	https://www.coursera.org/learn/digital
2.	https://onlinecourses.nptel.ac.in/noc20_ee44/preview
3.	https://www.digimat.in/nptel/courses/video/117101004/L01.html
4.	http://acl.digimat.in/nptel/courses/video/108106168/L03.html
5.	https://archive.nptel.ac.in/courses/108/105/108105118/

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C911.1 C911.2	[AN]	Assignment	20
C911.3	[AN]	Group Assignment	20
C911.4 C911.5	[AP]	Technical Quiz	20
C911.6	[U]	Case Study	20

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	10	10	10
Understand	30	20	30
Apply	40	30	30
Analyse	20	40	30
Evaluate			
Create			

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12	PSO1	PSO2
1	2	1	2	1	-	2	1	-	-	-	-	1	3	2
2	1	2	3	3	2	1	1	-	-	-	-	-	1	-
3	2	2	2	3	1	1	1	-	-	-	-	-	1	-

4	1	2	2	3	1	1	1	-	-	-	-	-	1	-
5	2	2	3	3	3	1	1	-	2	-	-	-	2	-
6	2	3	2	1	2	1	1	-	-	-	-	-	1	-

1	Reasonably agreed	2	Moderately agreed	3	Strongly agreed

23EC912	RECONFIGURABLE ARCHITECTURES	3/0/0/3

Nature of Course	G (Theory & Analytical)
Pre requisites	Digital Electronics
Co requisites	CMOS VLSI Design

Course Objectives:

1	To acquire knowledge on fundamentals of reconfigurable architectures, classification of FPGA based on the basic blocks, application specific design styles,
2	To Understand the different styles in Routing of FPGA with routing computation
3	To classify and analyze the reconfigurable devices for Technology independent optimization
4	To develop the high-level synthesis and RCS for specific applications

Course Outcomes:
Upon completion of the course, students shall have ability to

C912.1	The student will understand concept of static and dynamic reconfiguration architectures.	[U]
C912.2	Use the knowledge of the FPGAs for designing reconfigurable circuits.	[AP]
C912.3	Enumerate the reconfigurable system model using HDL languages	[AN]
C912.4	Report on the reconfigurable architecture and FPGA fundamentals.	[AP]
C912.5	Analyze the routing process and describe the optimization techniques for technology independent designs and use of RCAs in ASIC design.	[AN]
C912.6	Develop and analyse the applications based on optimized reconfigurable architecture	[AP]

Course Contents:

INTRODUCTION & ROUTING 15

Domain - specific processors - Application specific processors - Reconfigurable Computing Systems (RCS) -Evolution of Reconfigurable systems - Characteristics of RCS and Classification of reconfigurable architecture - fine, coarse, grain & hybrid architectures – examples. **Routing For FPGAS:** General strategy for routing in FPGAS - Routing for row based FPGAS - Segmented channel routing - definitions - Algorithm for I segment and K segment routing - Routing for symmetrical FPGAs – flexibility of FPGA Routing Architectures

HIGH LEVEL DESIGN & FPGA ARCHITECTURE FOR RECONFIGURATION 15

Tradeoffs in flexibility of reconfigurable architecture -Reconfigurable devices for Rapid prototyping, Types: Run-time, Compile time, non-frequently & frequency reconfigurable systems- Architectures for Reconfigurable computing: TSFPGA, High level synthesis of reconfigurable hardware – Language design tools - Simulation of cycle based and event driven based - Synthesis logic - HDL Vs Physically aware-timing analysis - static Vs dynamic - Verification physical design tools.

APPPLICATIONS OF RECONFIGURABLE ARCHITECTURE 15

Power efficient architectures - low energy reconfigurable single chip DSP system- minimizing the memory requirement for condition flow FFT implementation - memory reduction methods for FFT implementation - RCS for embedded cores, image processing. Applications of reconfigurable computing: Various hardware implementations of Pattern Matching such as the Sliding Windows Approach, Automaton-Based Text Searching. Video Streaming

Total Hours:		45

Text Books:

1	Christophe Bobda "Introduction to Reconfigurable Computing Architectures, Algorithms, and Applications" Springer, 2022
2	Anuradha D. Thakare, Sheetal Umesh Bhandari, "Artificial Intelligence Applications and Reconfigurable Architectures", Wiely Publishers, Print ISBN:9781119857297 |Online ISBN:9781119857891, 2023
3	Vaibbhav Taraate, "Digital Logic Design Using Verilog Coding and RTL Synthesis", Springer, IInd Edition, 2022
4	Andre Dehon, "Reconfigurable Architectures for General Purpose Computing", Springer, 2021
5.	Scott Hauck and André DeHon, "Reconfigurable Computing: The Theory and Practice of FPGA-Based Computation", Elsevier Publisher, 2021
6.	Iouliia Skliarova, Piedad Brox Jiménez, Mário Véstias, Pedro C. Diniz, "Applied Reconfigurable Computing. Architectures and Tools," ARC Publishers, Portugal 2024

Reference Books:

1	Stephen M. Trimberger, "Field Programmable Gate Array Technology", Springer, Reprint 2019.
2	Clive Max Maxfield, "The Design Warriors Guide to FPGAs: Devices, Tools and Flows, Newnes",Elsevier, 4th Edition,2020.
3	Russell Tessier and Wayne Burleson, "Reconfigurable computing for Digital Signal Processing: A Survey", 2001.
4.	Jorgen Staunstrup, Wayne Wolf, "Hardware / software Co - Design: Principles and Practice", Kluwer Academic Publishers, 1997.

Web References:

1	VLSI design of low- cost and high- precision fixed- point reconfigurable FFT processors - Xiao - 2018 - IET Computers & Digital Techniques - Wiley Online Library
2	A Novel Reconfigurable Analog VLSI Architecture of M-point DFT Using Complex Matrix Multiplier and Graph-Based Signal Routing Method	Circuits, Systems, and Signal Processing (acm.org)
3	Introductory Digital Systems Laboratory	Electrical Engineering and Computer Science	MIT OpenCourseWare
4	Reconfigurable VLSI Architecture for Real-Time 2D-to-3D Conversion	IEEE Journals & Magazine	IEEE Xplore

Online Resources:

1	Dynamically Reconfigurable Systems: Architectures, Design Methods and Applications	Guide books	ACM Digital Library
2	Introduction to FPGA Design for Embedded Systems Course by University of Colorado Boulder	Coursera
3	The Guide to SystemC (doulos.com)
4	systemc.org

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C912.1 & C912.2	Understand	Quiz	20
C912.3 & C912.5	Analyse	Programming Assignment	20
C912.4	Apply	Tutorials	20
C912.6	Apply	Group Assignment	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	40	10	10
Understand	60	20	40
Apply		40	30
Analyse		30	20
Evaluate			
Create			

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks			**CA 2 : 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

Course Articulation Matrix														
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**

1	3	3	2	3	1	1	1	-	-	-	1	1	2	-
2	3	2	3	2	1	1	1	-	-	-	2	1	2	-
3	3	3	3	3	2	1	2	-	-	-	1	1	2	-
4	2	3	3	2	1	1	1	-	-	-	2	1	1	-
5	3	2	3	2	1	2	1	-	-	-	1	2	2	-
6	3	3	2	3	1	1	1	-	-	-	1	1	2	-

1	Reasonably agreed	2	Moderately agreed	3	Strongly agreed

22EC913	WIRELESS SENSOR NETWORKS	3/0/0/3

Nature of Course	:C (Theory Concept)	

Course Objectives:

1	To obtain a broad understanding of wireless sensor networks	
2	To study the challenges and design issues in wireless sensor networks	
3	To focus on network architectures and energy efficiency	
4	To study the concept of Time Synchronization and Localization	
5	To focus on Routing Protocols and Operating Systems	

Course Outcomes:
Upon completion of the course, students shall have ability to

C913.1	Learn the basics of wireless sensor networks and its applications.	[R]
C913.2	Understand the architecture and elements of wireless sensor networks	[U]
C913.3	Analyze the MAC protocols for wireless sensor networks.	[AN]
C913.4	Apply the concept of Synchronization and Localization for sensor networks	[AP]
C913.5	Understand the various routing protocols of wireless sensor networks	[U]
C913.6	Understand the basics of operating systems needed to establish sensor networks	[U]

Course Contents:

Overview of Wireless Sensor Networks: **15**

Characteristics-Types of Wireless Sensor Networks-Applications. Challenges for Wireless Sensor Networks - Enabling Technologies for Wireless Sensor Networks - Single-Node Architecture**:** Hardware Components - Energy Consumption of Sensor Nodes - Network Architecture: Sensor Network Scenarios - Optimization Goals and Figures of Merit -Design principles for WSNs – Gateway Concepts - Physical Layer and Transceiver design Considerations

Time Synchronization and Localization: **15**

MAC Protocols for Wireless Sensor Networks - S-MAC - Wakeup radio concepts – Introduction to the time synchronization problem - Protocols based on sender/receiver synchronization - Single-hop localization - Positioning in multi-hop environments - Topology-control: Aspects of topology-control algorithms

Routing Protocols and Operating Systems: **15**

Energy-Efficient unicast - Broadcast and multicast - Geographic Routing- Mobile nodes - Operating Systems for Wireless Sensor Networks: Operating System Design Issue - Examples of Operating Systems: TinyOS, MagnetOS and OSPM - Application specific support: Target detection and tracking.

Total Hours:		45

Text Books:

1	Holger Karl and Andreas Willig, "Protocols And Architectures for Wireless Sensor Networks", John Wiley, 1st edition, 2015.
2	Kazem Sohraby, Daniel Minoli and Taieb Znati, "Wireless Sensor Network-Technology, Protocols and Applications", John Wiley, 2nd edition, 2012

	Reference Books:
1	Feng Zhao and Leonidas J. Guibas, "Wireless Sensor Networks - An Information Processing Approach", Elsevier, 1st edition, 2016.
2	Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks – Theory and Practice", John Wiley, 1st edition, 2017.
3	C.S. Raghavendra, Krishna M. Sivalingam, Taieb Znati, "Wireless Sensor Networks", Springer,1st edition, 2010.
	Web References:
1	http://profsite.um.ac.ir/~hyaghmae/ACN/WSNbook.pdf
2	http://ijcttjournal.org/Volume4/issue-8/IJCTT-V4I8P194.pdf
3	*profsite.um.ac.ir/~hyaghmae/ACN/WSNbook.pdf*
4	https://pdfs.semanticscholar.org/e552/059d73eef06be26fd0e1a1e4118d4f4e4b20.pdf
	Online Resources:
1	https://www.coursera.org/lecture/internet-of-things-history/sensor-networks
2	https://nptel.ac.in/courses/106105160/21
3	https://nptel.ac.in/courses/114106035/37
4	https://www.edx.org/course/computer-networks-internet-kironx-fhlcnx

Continuous Assessment			Total Continuous Assessment	End Semester Examination	Total
Formative Assessment	Summative Assessment	Total			
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C913.1& C913.2	Understand	Quiz	20
C913.3	Analyse	Assignment	20
C913.4	Apply	Assignment	20
C913.5 & C913.6	Understand	Group Assignment	20

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1: [60 Marks]	CIA2: [60 Marks]	
Remember	50	20	30
Understand	50	20	30
Apply	-	30	20
Analyse	-	30	20
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1: 100 Marks			CA 2: 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Course Articulation Matrix														
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	2	2	3	-		-	-	-	-	-	-	-	2	-
2	3	3	2	3		-	-	-	-	-	-	-	2	-
3	3	3	3	2	1	-	-	-	2	-	-	-	3	-
4	3	3	3	3		-	-	-	2	-	-	-	2	-
5	3	2	3	2		-	-	-	2	2	-	-	2	-
6	3	3	3	2	1	-	-	-	2	2	-	1	3	1
1	Reasonably agreed			2	Moderately agreed			3		Strongly agreed				

22EC914		**HIGH SPEED NETWORKS**	3/0/0/3
Nature of Course	(C) Theory		

Course Objectives:		
1	To understand the concepts of ATM and frame relay	
2	To understand the congestion and traffic management strategies	
3	To learn the concepts behind TCP and ATM congestion control	
4	To provide an in depth knowledge of Integrated and Differentiated Services	
5	To understand the protocols for QoS support	

Course Outcomes:

Upon completion of the course, students shall have ability to

C914.1	Illustrate the concepts behind ATM and Frame relay networks	[U]
C914.2	Understand the concepts of high speed LAN and Ethernet	[U]
C914.3	Analyze the concepts and congestions associated with TCP and ATM	[AN]
C914.4	Understand the various traffic management strategies of ABR and GFR	[U]
C914.5	Categorize queuing disciplines of Integrated and Differentiated Services	[AN]
C914.6	Explore the various protocols for improvement of QoS support	[U]

Course Contents:

HIGH SPEED NETWORKS AND TRAFFIC MANAGEMENT: 15

Introduction -Frame Relay Networks – Asynchronous transfer mode – ATM Protocol Architecture, ATM logical Connection - ATM Cell – ATM Service Categories – AAL. High Speed LAN, Gigabit Ethernet, TRAFFIC MANAGEMENT: Congestion - Effects of Congestion – Congestion Control in Data Networks and Internets- Traffic Management.

TCP AND ATM CONGESTION CONTROL: 15

TCP Flow control – TCP Congestion Control – Retransmission – Timer Management – KARN's Algorithm – Window management – Performance of TCP over ATM - TCP over 3G/4G wireless networks – TCP/IP performance over Optical Networks - Traffic and Congestion control in ATM – Requirements – Traffic Management Frame work, Traffic Control – ABR traffic Management – ABR rate control. RM cell formats –ABR capacity allocation - GFR traffic management.

SERVICE ARCHITECTURE AND PROTOCOLS FOR QOS SUPPORT: 15

Integrated Services Architecture – Approach, Components, Services - Queuing Discipline – FQ – PS – BRFQ – GPS – WFQ – Random Early Detection – Differentiated Services. Protocols For QOS Support:RSVP – Goals & Characteristics, Data Flow, RSVP operations – Protocol Mechanisms – Multiprotocol Label Switching, Subnet Bandwidth Management – Operations, Label Stacking – Protocol details – RTP – Protocol Architecture – Data Transfer Protocol – RTCP.

	Total Hours:	45

Text Books:

1	William Stallings, "High Speed Networks and Internet", Second Edition, Pearson Education, reprinted edition, 2018.

2	Jean Walrand, Pravin Varaiya, "High Performance Communication Networks", Reprinted Second Edition, Jean Harcourt Asia Pvt. Ltd., 2009.
Reference Books:	
1	Ivan Pepelnjak, Jim Guichard, Jeff Apcar, "MPLS and VPN architectures", Second Edition, Cisco Press, 2005.
2	Abhijit S. Pandya, Ercan Sea, "ATM Technology for Broad Band Telecommunication Networks", First Edition, CRC Press, 2007.
3	Thomas Pötsch "Future Mobile Transport Protocols Adaptive congestion control for unpredictable cellular networks", First Edition, Springer, 2016.
4	Tere Parnell "Building High speed Networks", First Edition, Osborne/McGraw-Hill, reprinted edition, 2009.
Web References:	
1	http://www.informit.com/articles/article.aspx?p=101655&seqNum=4
2	https://fenix.tecnico.ulisboa.pt/downloadFile/3779571512047/Generic%20Framing%20Procedure.pdf
3	http://www.nptel.ac.in/courses/117101050/3
4	https://www.coursera.org/courses?query=computer%20network
Online References:	
1	https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-263j-data-communication-networks-fall-2002/
2	https://www.techopedia.com/definition/24244/high-speed-downlink-packet-access-hsdpa
3	http://www.cs.ust.hk/~hamdi/Class/CSIT560-S13/lecture_notes.htm

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C914.1& C914.2	Understand	Quiz	20
C914.3	Understand	Assignment	20
C914.4	Understand	Assignment	20

C914.5 &C914.6	Analyse, Understand	Class Presentation	20

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1: [60 Marks]	CIA2: [60 Marks]	
Remember	20	20	20
Understand	40	40	40
Apply	-	-	-
Analyse	40	40	40
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1: 100 Marks			CA 2: 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	2	2	2	-	-	-	-	-	-			-	2	-
2	3	3	2		-	-	-	-	-			2	2	2
3	3	2	2	2		-	-	-	-			2	3	2
4	3	2	2	1		-	-	-	-			-	3	-
5	3	2	2	1		-	-	-	1			-	2	-
6	3	2	3	2		-	-	-	1	1		2	3	2
1	Reasonably agreed			2	Moderately agreed			3		Strongly agreed				

22EC915	NEURAL NETWORKS AND DEEP LEARNING		3/0/0/3
Nature of Course	C (Theory Conceptual)		

Course Objectives:

1	To learn the basics of Neural Networks
2	To enable the students to understand Feed Forward Networks.
3	To study about Adaptive Resonance theories.
4	To understand the mathematical challenges in Neural Networks.
5	To study the concepts of Deep learning and Convolutional Neural Networks
6	To enable the students to get familiarized with various model of Deep Learning and analysis of Neural Networks

Course Outcomes:
Upon completion of the course, students shall have ability to

C915.1	Understand the concepts of Neural Networks.	[U]
C915.2	Illustrate the operation of Feed Forward Networks	[U]
C915.3	Recall the concepts of Associative Memory	[R]
C915.4	Enumerate the concepts of Vector Quantization.	[U]
C915.5	Understand the basics of Deep learning and Convolutional Neural Networks	[U]
C915.6	Implement various deep Learning and Neural Networks analysis and Calculation of performance metrics	[AP]

Course Contents:

Simple Neural Nets: **15**
Introduction to Artificial Neural Networks, biological motivation, Terminology, Models of neuron, topology, characteristics of artificial neural networks, types of activation functions, Advanced Neural Networks, Learning Laws, Learning methods, Error correction learning, Hebbian learning, Perceptron XOR Problem, Perceptron learning rule convergence theorem, Adaline; Feed forward networks: Multilayer Perceptron, Back Propagation learning algorithm, Introduction to full Bayesian approach, Universal function approximation, Associative memory: auto association, hetero association, recall and cross talk.

Advanced Neural Networks: **15**
Associative Memory: Autocorrelation, Hetero Correlation, Exponential BAM, Applications; Adaptive Resonance Theory: Vector Quantization, ART1, ART2, applications, Kohonen's Self Organizing Map., Convolutional Neural Networks. Architecture, Convolutional / Pooling layers

Introduction to Deep Learning :   **15**
Linear models ,Intro to Neural Nets, Training a network: loss functions, back propagation and stochastic gradient descent, Neural networks as universal function approximates; Deep Networks: History of Deep Learning, Probabilistic Theory of Deep Learning, Back propagation and regularization, batch normalization, VC Dimension and Neural Nets, Deep versus Shallow Networks; parameters affecting deep learning, Dimentionality Reduction: Linear(PCA, LDA) and manifolds, metric learning, Auto encoders and dimensionality reduction in networks, Introduction to Convnet; Case Study:. Sentiment Analysis using Recursive Neural Networks, Regularization method to reduce the over fitting

of Neural Networks, Calculation of Metrics such as Classification Accuracy, Logarithm Loss and Confusion matrix

Total Hours:		45

Text Books:

1	LaureneFausett, "Fundamentals Of Neural Networks-Architectures, Algorithms and Applications", Pearson Education, fifthEdition,2014.
2	AFreeman and David.M.Skapura, "Neural Networks Algorithms, Applications and Programming Techniques ", Pearson Education, fourth Edition ,2012.
3	Deng & Yu, "Deep Learning Methods and Applications",NowPublishers, ninth Reprint,2013.
4	Lan Goodfellow, YoshuaBengio, Aaron Courville, "Deep Learning", MIT Press, 2016

Reference Books:

1	B.Yegnanarayana,"Artificial Neural Networks",PrenticeHallof India, fifth Edition, 2014.
2	Rajasekaran and G.A.V. Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis and Applications",PHI, tenth Edition,2012.
3	Ian Goodfellow,YoshuaBengio, Aaron Courville, "Deep Learning",MITPress,FirstEdition ,2016.

Web References:

1	https://www.edx.org/course/principles-of-machine-learning
2	https://www.coursera.org/learn/machine-learning
3	https://www.simplilearn.com/big-data-and-analytics/machine-learning-certification-training-course
4	https://in.udacity.com/course/intro-to-machine-learning--ud120-india
5	https://online-learning.harvard.edu/course/data-science-machine-learning
6	https://towardsdatascience.com/handling-overfitting-in-deep-learning-models-c760ee047c6e

Online Resources:

1	https://nptel.ac.in/courses/117105084/
2	http://cs231n.stanford.edu/
3	https://www.technologyreview.com/s/513696/deep-learning/
4	https://www.edx.org/professional-certificate/ibm-deep-learning
5	http://neuralnetworksanddeeplearning.com/chap1.html

Continuous Assessment			Total Continuous Assessment	End Semester Examination	Total
Formative Assessment	Summative Assessment	Total			
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	Bloom's Level	Assessment Component(Choose and map components from the list - Quiz, Assignment, CaseStudy, Seminar, Group Assignment)	FA(16%) [80Marks]
C915.1 C915.2	Analyze Understand	Quiz	20
C915.3	Apply	Assignment	20
C915.4	Understand	Quiz	20
C915.5 C915.6	Apply	Group Assignment	20

Assessment based on Summative and End Semester Examination				
Bloom's Level	Summative Assessment (24%) [120 Marks]		Formative Assessment (16%) [80 Marks]	End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]		
Remember	20	20		20
Understand	30	30	20	30
Apply	20	20	40	20
Analyze	30	30	20	30
Evaluate				
Create				

Assessment based on Continuous and End Semester Examination					
Continuous Assessment (40%) [200 Marks]					End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks		
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)	
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)

Course Articulation Matrix														
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	3	2	2	-	-	-	-	-	-	1	-	-	3	1
2	3	3	2	2	-	-	-	-	-	1	-	-	3	2
3	3	3	2	2	1	-	-	-	-	1	-	1	3	2
4	3	2	2	2	1	-	-	-	-	-	-	1	3	2
5	3	2	3	2	1	-	-	-	-	-	-	1	3	2
6	3	2	2	2	1	-	-	-	-	1	-	1	3	2
1	Reasonably agreed			2	Moderately agreed			3	Strongly agreed					

22EC916	DIGITAL IMAGE AND VIDEO PROCESSING	3/ 0 / 0/ 3

Nature of Course	C(Theory Concept)

Course Objectives:

1	To provide knowledge about the mathematical transforms in image processing
2	To give a view on human visual perception
3	To learn various techniques to improve the visual appeal of the image
4	To analyse the noise removal technique from the degraded images
5	To implement various coding techniques for image and video analysis

Course Outcomes:
Upon completion of the course, students shall have ability to

C916.1	Recall the basic definition of an image and human visual system	[R]
C916.2	Understand the principles of image formation, sampling, quantization and the human visual system to investigate specific image processing techniques	[U]
C916.3	Understand various image intensity transformations and spatial filtering for the purpose of image enhancement	[U]
C916.4	Apply appropriate technique to real problems in image and video analysis	[AP]
C916.5	Understand the principles of colour video processing	[U]
C916.6	Analyse various Estimation techniques to provide better video enhancement	[AN]

Course Contents:

Fundamentals of Image processing and image transform   **15**
Basic steps in Digital Image processing,Image sampling and quantization, Basic relationship between pixels, color images- RGB, HSI and other models. Image Transforms: 2 –D Discrete Fourier Transform, Discrete Cosine Transform (DCT), Discrete Wavelet transforms

Image Processing Techniques   **15**
Image Enhancement-Spatial Domain methods: Histogram Processing, Basics of Spatial Filtering, Smoothing Spatial filters, Sharpening Spatial filters .Frequency Domain methods: Basics of filtering in frequency domain, image smoothing, image sharpening, Homomorphic filtering. Image Segmentation - Segmentation concepts, point, line and Edge detection, Thresholding, region based segmentation.Image Compression models: Lossy and Lossless, Huffmann coding, Arithmetic coding, LZW coding, run length coding, Bit Plane coding, transform coding, predictive coding , JPEG ,MPEG standards

Video Processing and Applications   **15**
Basic concepts and Terminology-Monochrome Analog video, Color in Video, Analog video standards,Digital video basics, Analog to digital conversion, Color representation and chroma sub sampling, sampling of video signals, filtering operations, 2-D Motion Estimation: Optical flow, general methodologies, pixelbased motion estimation, Block matching algorithm, Mesh based motion Estimation, global Motion Estimation, Region based motion estimation, multi resolution motion estimation , Applications of motion estimation in Surveillance systems and autonomous vehicles

Total Hours:45

	Text Books:	
1	Rafael C. González ,Richard E Woods, "Digital image processing" Pearson Education,Third Edition, 2014
2	John W. Wood, Multidimensional Signal, Image, and Video Processing and Coding, Second Edition,Academic Press, 2011
3	Yao Wang,JornOstermann, Ya-Qin Zhang, "Video Processing and Communications", Prentice Hall, First Edition, 2001

	Reference Books:
1	A. Murat Tekalp, "Digital Video Processing", Prentice Hall, Second Edition, 2015.
2	W. K. Pratt, ``Digital Image Processing,'' John Wiley and Sons, Second Edition, 2008
3	Alan C. Bovik, "The Essential Guide to Video Processing", Elsevier Science, Second Edition, 2009

	Web References:
1	http://web.stanford.edu/class/ee368/handouts.html
2	http://www.ee.columbia.edu/~sfchang/course/dip/
3	http://diwakar-marur.blogspot.com/search/label/Digital%20Television

	Online Resources:
1	nptel.ac.in/downloads/117104020/
2	https://www.coursera.org/learn/digital
3	https://www.edx.org/course/computer-vision-image-analysis-1

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C916.1& C916.2	Remember Understand	Quiz	20
C916.3	Apply	Assignment	20
C916.4	Apply	Quiz	20

C916.5& C916.6	Apply	Group Assignment		20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1: [60 Marks]	**CIA2: [60 Marks]**	
Remember	20	20	20
Understand	20	20	30
Apply	40	20	20
Analyse	20	40	30
Evaluate			
Create			

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks			**CA 2 : 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

Course Articulation Matrix														
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
C916.1	3	2	2	-	-	-	-	-	-	-	-	-	3	1
C916.2	3	3	2	1	-	-	-	-	-	-	-	-	3	1
C916.3	3	3	2	1	-	-	-	-	1	1	-	1	3	1
C916.4	3	2	2	1	-	-	-	-	-	-	-	1	3	1
C916.5	3	2	3	1	-	-	-	-	-	-	-	1	3	1
C916.6	3	2	2	1	-	-	-	-	-	1	-	1	3	1
1	Reasonably agreed			2	Moderately agreed			3	Strongly agreed					

22EC917	PATTERN RECOGNITION TECHNIQUES	3/0/0/3

Nature of Course	:G (Theory & Analytical)

Course Objectives:

1	To enable the students to understand pattern recognition theories
2	To enable the students to gain knowledge about various algorithms
3	To enable the students to identify various models and apply non-parametric techniques
4	To allow students to understand and analyse neural networks

Course Outcomes:
Upon completion of the course, students shall have ability to

C917.1	Demonstrate knowledge on design principles of pattern recognition	[R]
C917.2	Understand the concepts of statistical pattern recognition	[U]
C917.3	Analyse the various Pattern Recognition models.	[AN]
C917.4	Apply the non parametric and non parametric techniques in Pattern Recognition	[AP]
C917.5	Perform Feature extraction, feature reduction and structural pattern recognition.	[AN]
C917.6	Apply pattern recognition techniques for biosignal and medical image applications	[AP]

Course Contents:

INTRODUCTION AND STATISTICAL PATTERN RECOGNITION: **15**
Introduction: Basics of pattern recognition – Design principles of pattern recognition system – Learning and adaptation – Pattern recognition approaches. Mathematical foundations: Linear algebra – Probability theory – Expectation – Mean and Covariance – Normal distribution – Multivariate normal densities – Chi square test of hypothesis. Statistical Patten Recognition: Bayesian Decision Theory – Classifiers – Normal density and discriminant functions.

MODELS AND NON PARAMETRIC TECHNIQUES: **15**
Parameter estimation methods: Maximum-Likelihood estimation – Bayesian Parameter estimation – Dimension reduction methods – Principal Component Analysis (PCA) – Fisher Linear discriminant analysis – Independent Component Analysis. Expectation – maximization (EM) – Hidden Markov Models (HMM) – Gaussian mixture models.
Nonparametric Techniques: Density Estimation – Parzen Windows - K-Nearest Neighbor Estimation – Nearest Neighbor Rule – Fuzzy classification. Perceptron Algorithm-LMSE Algorithm- Pattern classification by distance functions -minimum distance Pattern classifier. Unsupervised learning and clustering - Criterion functions for clustering. Algorithms for clustering: K-Means.

FEATURE EXTRACTION, STRUCTURAL PATTERN RECOGNITION AND APPLICATIONS   15
KL Transforms, Regression-Linear, Non-linear and Logistic, Prediction, Elements of formal grammars, syntactic description, stochastic grammars, Structural representation. Application of PR in image segmentation – CAD system in Breast cancer detection, ECG signal analysis, Fingerprint identification Pattern classification by distance functions. Clusters and cluster seeking algorithms. Pattern classification by likelihood functions. Baye's classifier and performance measures.

Total Hours:		45

Text Books:

1	Richard O. Duda, Peter E. Hart and David G. Stork, "Pattern Classification",JohnWiley,SecondEdition,2012.
2	Bishop, Christopher M., "Pattern Recognition and Machine Learning", Springer,First Edition,2011.

3	Robert Schalkoff, "Pattern Recognition: Statistical, Structural and Neural Approaches",JohnWiley& sons,2014.
Reference Books:	
1	Chen C.H, "Handbook of Pattern Recognition and Computer Vision",World Scientific Co, Pvt.Ltd,Fourth Edition,2010
2	C.M.Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.
3	M. Narasimha Murthy and V. Susheela Devi, "Pattern Recognition", Springer 2011.
4	Menahem Friedman , Abraham Kandel, "Introduction to Pattern Recognition Statistical, Structural, Neural and Fuzzy Logic Approaches", World Scientific publishing Co. Ltd, 2000.
5	Geoff Dougherty,"Pattern Recognition and Classification: An Introduction", Springer,2013.
6	S. Theodoridis, K. Koutroumbas, "Pattern Recognition", Academic Press, Fourth Edition,2009.
Web References:	
1	https://www.byclb.com/TR/Tutorials/neural_networks/ch11_1.htm
2	https://courses.cs.washington.edu/courses/cse576/book/ch4.pdf
3	https://onlinelibrary.wiley.com/doi/book/10.1002/0470854774
4	http://www.cs.ukzn.ac.za/~sviriri/Books/Machine-Learning-Pattern-Recognition/book3.pdf
Online Resources:	
1	https://freevideolectures.com/course/3194/pattern-recognition
2	https://nptel.ac.in/courses/117108048/13
3	https://ocw.mit.edu/courses/media-arts-and-sciences/mas-622j-pattern-recognition-and-analysis-fall-2006/
4	http://dspace.mit.edu/handle/1721.1/41935

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms'Taxonomy)			
Formative assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%)** **[80 Marks]**
C917.1	Remember	Quiz	20
C917.2	Understand		
C917.3	Analyse	Assignment	20
C917.4	Apply		
C917.5	Analyse	Class Presentation	20
C917.6	Apply	Group Assignment	20

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	20	10	10
Understand	40	40	40
Apply	40	40	30
Analyse		10	20
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Course Articulation Matrix														
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	3	2	2	-	-	-	-	-	-	1	-	-	3	1
2	3	3	2	2	-	-	-	-	-	1	-	-	3	2
3	3	3	2	2	1	-	-	-	-	1	-	1	3	2
4	3	2	2	2	1	-	-	-	-	-	-	1	3	2
5	3	2	3	2	1	-	-	-	-	-	-	1	3	2
6	3	2	2	2	1	-	-	-	-	1	-	1	3	2
1	Reasonably agreed			2	Moderately agreed			3		Strongly agreed				

22EC918		**INFORMATION SECURITY**	3/0/0/3
Nature of Course		C (Theory Concept)	

Course Objectives:	
1	To learn the layers of Networking devices and different types of network layer attacks
2	To learn about firewalls and intrusion detection and prevention systems.
3	To study the concepts of virtual private networks and WAN topologies.
4	To study the concepts of main security threats and techniques involved.

Course Outcomes:		
Upon completion of the course, students shall have ability to		
C918.1	Recall the different network layers and various attacks possible on networking devices.	[R]
C918.2	Understand the concept of a firewall and its types and understand the intrusion detection and prevention of the system.	[U]
C918.3	Identify the concepts of virtual private networks and their types	[U]
C918.4	Understand the various methods, protocols, and WAN topologies.	[U]
C918.5	Interpret various threats and authentication models.	[AP]
C918.6	Analyze the Security and privacy in Wireless Mobile Systems with security policies and standards	[AN]

Course Contents:	

Introduction To Network Security:	**15**

Networking Devices (Layer1, 2, 3) - Different types of network layer attacks–Firewall (ACL, Packet Filtering, DMZ, Alerts and Audit Trials) – IDS, IPS and its types (Signature based, Anomaly based, Policy based, Honey pot based).

Virtual Private Networks and MPLS:	**15**

VPN and its types –Tunneling Protocols – Tunnel and Transport Mode –Authentication Header-Encapsulation Security Payload (ESP) - IPSEC Protocol Suite – IKE PHASE 1, II – Generic Routing Encapsulation(GRE) - WAN Topologies - Standard IP based Switching – CEF based Multi-Layer switching - MPLS Characteristics - Frame Mode MPLS Operation – MPLS VPN.

Threats and Authentication Models:	**15**

Threats, Vulnerabilities- Attack vectors and their counter measures-Identity Management – Identification, Authorization and Access Controls –Categories-Models, Challenges, Principles, Techniques and Practices, Concept of trust and trustworthiness. Authentication Methods, Passwords, Biometrics, Challenge Response based authentication, Two-Factor Authentication-Single Sign-On and Web Cookies. Wi-Fi Security (WEP, WPA, WPA-Enterprise), Information security management – Monitor systems and apply controls - security assessment using automated tools – Backups of security devices – security polices and standards.

	Total Hours:	**45**

Text Books:	
1	Charlie Kaufman, Radia Perlman, Mike Speciner, "Network Security: Private communication in a public world", Prentice Hall, Second edition, 2011.
2	Charles Pfleeger, Shari Lawrence Pfleeger ,"Security in computing", Prentice Hall, 5th Edition, 2015.

3	William Stallings, "Cryptography and Network Security", Pearson Education, 6th Edition, 2013.
4	Jyrki T J Penttinen, "Wireless Communication Security: Solutions for the Internet of Things", Wiley Publication, 1st Edition, 2016.

Reference Books:

1	Christopher Dawson,"Internet security you can afford: using Untangle as your internet gateway", Cengage Learning, 1st Edition,2015.
2	William Stallings and Lawrie Brown, "Computer Security Principles and Practice", Published by Pearson Education, 5th edition, 2024.
3	Chimay J Anumba, Xiangyu Wang"Mobile and pervasive computing in construction", Wiley-Blackwell, 1st Edition,2012.

Online Resources:

1	https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-857-network-and-computer-security-spring-2014/
2	http://www.nptelvideos.in/2012/11/cryptography-and-network-security.html
3	http://freevideolectures.com/Course/3027/Cryptography-and-Network-Security

Web References:

1	https://ahsanghazi.files.wordpress.com/2017/03/263973122-security-in-computing-5-e-charles-p-pfleeger-pdf1.pdf
2	http://www.ccs.neu.edu/home/noubir/Courses/CS7780/F14/slides/crypto-use-misuse.pdf
3	https://securityintelligence.com/media/podcast-cybersecurity-challenges-facing-telecommunications-and-media-entertainment/

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C918.1	Remember	Quiz	20
C918.2	Understand	Group Assignment	20
C918.3	Understand	Case Study	20
C918.4	Understand		
C918.5	Apply	Assignment	20
C918.6	Analyse		

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	30	30	30
Apply	20	20	20
Analyse	30	30	30
Evaluate	-	-	-
Create	-	-	-
Assessment based on Continuous and End Semester Examination			
Continuous Assessment (40%) [200 Marks]			**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks		**CA 2 : 100 Marks**	
SA 1 (60 Marks) **FA 1 (40 Marks)**		**SA 2 (60 Marks)** **FA 2 (40 Marks)**	

Continuous Assessment table detail:

SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		End Semester Examination (60%) [100 Marks]
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Course Articulation Matrix														
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
1	1	-	2	2	-	-	-	-	1	2	-	1	3	-
2	2	2	2	1	-	-	-	-	2	2	-	1	2	-
3	2	1	2	2	-	-	-	-	2	2	-	1	2	1
4	2	1	2	2	-	-	-	-	2	2	-	1	3	-
5	2	1	2	2	-	-	-	-	2	2	-	1	2	1
6	2	2	2	1	-	-	-	-	2	2	-	1	2	1
1	Reasonably agreed			2	Moderately agreed			3		Strongly agreed				

22EC919	ADVANCED WIRELESS TECHNOLOGIES	3/0/0/0

Nature of Course	C(Theory Concept)	

Course Objectives:

1	To learn about 4G technologies and LTE-A in mobile cellular network
2	To study the emerging techniques in 5G network
3	To understand the evolving paradigm of cooperative communication
4	To understand the different power saving strategies and energy efficient signal, system and network design
5	To study the design principles in cooperative communications, cognitive systems and relay channels

Course Outcomes:
Upon completion of the course, students shall have ability to

C919.1	Analyze the difference of LTE-A network design from 4G standard	[AN]
C919.2	Explore the network architecture of the current 5G standard	[U]
C919.3	Appreciate the necessity and the design aspects of cooperative communication in OFDM and MIMO cellular relay networks	[U]
C919.4	Understand the different power saving strategies and energy efficient signal, system and network design	[U]
C919.5	Learn and impart new techniques in cognitive systems and relay channels	[U]
C919.6	Impart the design principles in cooperative communications and its transmission schemes	[AN]

Course Contents:

EVOLUTION OF 4G AND 5G CELLULAR NETWORKS	**15**

Introduction to LTE-A – Requirements and Challenges, network architectures – EPC, E- UTRAN architecture - mobility management, resource management, services, channel - logical and transport channel mapping, 4G Protocol, WiMax IEEE 802.16d/e – WiMax Internetworking with 3GPP - 5G Roadmap - Pillars of 5G - 5G Architecture, The 5G internet - IoT and context awareness - Networking reconfiguration and virtualization support - Mobility QoS control - emerging approach for resource over provisioning.

COOPERATIVE COMMUNICATIONS AND TECHNIQUES	**15**

Network architectures and research issues in cooperative cellular wireless networks; Cooperative communications in OFDM and MIMO cellular relay networks: issues and approaches, Cooperative techniques for energy efficiency, Cooperative base station techniques for cellular wireless networks; Turbo base stations, Cooperative communications in 3GPP LTE-Advanced, Partial information relaying and Coordinated multi-point transmission in LTE-Advanced.

USER COOPERATIVE COMMUNICATIONS	**15**

User Cooperation and Cognitive Systems, Relay Channels: General Three-Node Relay Channel, Wireless Relay Channel - User Cooperation in Wireless Networks: Two user cooperative transmission schemes - Decode and forward - Amplify and forward Coded cooperation - Compress and forward relaying schemes, Cooperative Wireless Network, Multihop Relay Channel.

	45

Text Books:

1	Sassan Ahmadi, "LTE-Advanced – A practical systems approach to understanding the3GPP LTE Releases 10 and 11 radio access technologies", Elsevier, 2014.
2	Jonathan Rodriguez, "Fundamentals of 5G Mobile networks", John Wiley, 2015.
3	Y.-W. Peter Hong, Wan-Jen Huang, C.-C. Jay Kuo, Cooperative Communications and Networking: Technologies and System Design, Springer.

Reference Books:

1	Ekram Hossain, Dong In Kim, Vijay K. Bhargava, "Cooperative Cellular Wireless Networks", Cambridge University Press, 2011.
2	Murat Oysal, Cooperative Communications for Improved Wireless Network for virtualantenna array signals by, information science reference. Transmission: framework.
3	Savo G, Glisic, "Advanced Wireless Communications and Internet: Future Evolving Technologies", Wiley, 2011.

Web References:

1	https://nptel.ac.in/courses/117104099
2	https://www.coursera.org/lecture/computer-networking/introduction-to-wireless-networking-technologies-RgXEN
3	https://www.udemy.com/course/wireless-technologies-for-iot

Online Resources:

1	https://www.slideshare.net/ShashikantAthawale/advanced-wireless-technologies
2	https://www.slideserve.com/jeroen/wireless-technology-powerpoint-ppt-presentation
3	https://1000projects.org/4g-wireless-technologies-ppt-slides.html
4	http://homes.ieu.edu.tr/hozcan/CE360/Lect1-Wireless-Introduction.pdf
4	http://homes.ieu.edu.tr/hozcan/CE360/Lect1-Wireless-Introduction.pdf

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C919.1	Analyse	Quiz	20
C919.2	Understand	Assignment	20

C919.3,C919.4, C919.5	Understand	Class Presentation	**20**
C919.6	Analyze	Case Study	**20**

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	20	10	10
Understand	30	40	40
Apply	30	30	20
Analyse	20	20	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	2	-	-	-	-	-	1	-	-	2	3	2
2	3	2	2	-	-	-	-	-	-	-	-	2	3	2
3	3	2	2	-	-	-	-	-	1	1	-	2	3	
4	2	-	-	-	-	1	-	-	-	-	-	2	3	2
5	3	-	-	-	-	2	-	-	-	1	-	2	3	
6	3	3	3	2	1	-	-	-	-	-	-	2	3	2
1	Reasonably agreed			2	Moderately agreed			3		Strongly agreed				

22EC920	SATELLITE COMMUNICATION AND GPS	3/0/0/3

Nature of Course	G (Theory Analytical)

Course Objectives:

1	To enable the students to understand the concept of Orbital Mechanics
2	To gain knowledge about the concept of spacecraft subsystems and the earth station
3	To acquire knowledge about the propagation characteristics design parameters of satellite links
4	To enable the students to understand satellite navigation multiple access techniques and Communication satellites
5	To enable the students to study the concept of GPS with its types and its applications

Course Outcomes:
Upon completion of the course, students shall have ability to:

C920.1	Understand the basic concepts of Orbital Dynamics	[U]
C920.2	Analyse the concepts of geostationary orbits, launch vehicles and spectrum allocations for satellite systems	[AN]
C920.3	Understand the concept of spacecraft sub systems	[U]
C920.4	Analyse the design of earth stations space links	[AN]
C920.5	Understand the concepts of satellite television systems	[U]
C920.6	Apply the concepts of satellite navigation and GPS in futuristic networks	[AP]

Course Contents:

Orbital Mechanics: 15
Kepler's laws of motion, Orbits, Orbit Equations, Orbit Description, The Geostationary Orbit: Antenna Look Angles, Limits of Visibility - Orbital Perturbations, Orbit Determination, Launch Vehicles, Orbital Effects in Communication System, Effects of the sun and the moon - Sun transit outage, Performance Attitude control, Satellite launch vehicles - spectrum allocations for satellite systems.

Spacecraft Sub Systems and Earth Station: 15
Spacecraft Subsystems, Altitude and Orbit Control, Telemetry and Tracking TTC&M, Power Systems and Communication Subsystems, Transponders, Antennas, Equipment Reliability, Earth Station Space Links: Introduction, Satellite Link Design ,Satellite uplink, down link power Budget, Basic Transmission Theory, System Noise Temp, G/T Ratio, Noise Figure, Downlink Design, Satellite link models and design - Satellite system parameters - Link budget design - Design of Satellite Links for Specified C/N, Microwave Propagation on Satellite, Earth Paths, Interference between satellite circuits, Rain attenuation.

Communication Satellites and GPS: 15
Communication Satellites: VSAT, PSLVs, GSLVs - DTH television principles - Direct Broadcast Satellite Television systems, Satellite Navigation: Introduction, GLONASS, Galileo Satellite System Compass, Indian Regional Navigation Satellite System Overview, GPS: Differential and Augmented GPS, Applications, Role of satellites in future networks, AI/ML role in satellite communication and satellite based navigation.

	45

Text Books:

1	Dennis Roddy, "Satellite Communications", Mc Graw Hill International Editions, 4th Edition 2017.
2	Bruce R.Elbert, "The Satellite Communication: Ground Segment and Earth Station", Artech House Inc. Second edition, 2014.
3	Timothy Pratt, Charles W. Bostian, Jeremy Allnutt, "Satellite Communications", Wiley, John& Sons, 2nd Edition, 2003.
Reference Books:	
1	A Nejat Ince "Digital satellite communication systems and technologies", Springer science, Second edition, 2012.
2	MohinderS.Grewal, Lawrence R.Weill, Angus P.Andrews, "Global positioning systems - Inertial Navigation and Integration", John wily &sons, Second edition, 2007.
3	Ahmed El-Rabbany, "Introduction to GPS: Global Positioning System", Artech House, 2006.
Web References:	
1	http://www.braeunig.us/space/orbmech.htm
2	http://tele.rb.railnet.gov.in/raw-attachment/wiki/UpLoads/Chapter_22.pdf
3	http://ecb6212.weebly.com/uploads/1/2/9/8/12983968/multiple_access_techniques_and_network_aspects.pptx
Online Resources:	
1	https://lecturenotes.in/subject/102/satellite-communication-system-scs
2	textofvideo.nptel.ac.in/117105131/lec2.pdf
3	https://nptel.ac.in/courses/117105131/

Continuous Assessment				End Semester Examination	Total
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C920.1	Understand	Quiz	**20**
C920.2	Analyze	Assignment	**20**
C920.3, C920.4	Understand, Analyze	Class Presentation	**20**

C920.5, C920.6	Understand, Apply	Case Study	**20**

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	10	10
Understand	30	40	40
Apply	30	30	30
Analyse	20	20	20
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]					End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks		
SA 1 **(60 Marks)**	FA 1 (40 Marks)		**SA 2** **(60 Marks)**	FA 2 (40 Marks)	
	Component - I **(20 Marks)**	**Component - II** **(20 Marks)**		**Component - I** **(20 Marks)**	**Component - II** **(20 Marks)**

Course Articulation Matrix														
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**
1	3	2	2	2	-	2	-	-	-	-		1	3	1

2	3	2	2	2	-	-	-	-	1	-	-	2	3	1
3	3	2	2	2	-	-	-	-	1	-	-	1	3	1
4	3	2	2	2	-	-	-	-	-	-	-	2	3	1
5	3	2	2	2	-	-	-	-	1	-	-	2	3	1
6	3	2	2	2	-	-	-	-	-	-	-	1	3	1

1	Reasonably agreed	2	Moderately agreed	3	Strongly agreed

22EC921		SMART ANTENNAS	3/0/0/3
Nature of Course		G (Theory Analytical)	
Course Objectives:			
1		To gain knowledge in smart antenna radiation properties.	
2		To analyze various narrow band signal processing.	
3		To analyze various algorithms in estimating solution converges to optimal solution.	
4		To acquire knowledge in broad band signal processing in time domain and frequency domain	
5		To enable students to understand and analyze direction of arrival estimation	
Course Outcomes:			
Upon completion of the course, students shall have ability to			
C921.1	Recall the basic components of antenna and smart antennas		[R]
C921.2	Analysis and optimization of various Narrowband Signal processing in the absence of errors		[AN]
C921.3	Analysis of various algorithms to show how estimated solution converges to optimal solution		[AN]
C921.4	Apply Broadband Signal processing in time domain and frequency domain and realize broadband signal processing		[AP]
C921.5	Analyze performance of smart antenna using various direction of arrival estimation methods		[AN]
C921.6	Understand Conventional DOA Estimation Methods		[AN]

Course Contents:

INTRODUCTION: **15**

Antenna gain, wavelength, Directivity, beamwidth, phased array antenna, power pattern, beam steering, degree of freedom, optimal antenna, adaptive antennas, smart antenna – key benefits of smart antenna technology, wide band smart antennas, Digital radio receiver techniques and software radio for smart antennas, Narrow Band Processing**:** Signal model conventional beamformer, null steering beamformer, optimal beam former. Flexible /wearable antennas, Reconfigurable antennas/ Reconfigurable Intelligent surfaces(6G applications), Massive MIMO 5G Antennas

ADAPTIVE PROCESSING AND BROADBAND PROCESSING: **15**

Sample matrix inversion algorithm, unconstrained LMS algorithm, Gradient Estimate, Recursive Least Mean Square (RLS) Algorithm, normalized LMS algorithm, Constrained LMS algorithm, Neural network Approach. Tapped delay line structure, Digital beam forming, Broad band processing using DFT method.
.

DIRECTION OF ARRIVAL ESTIMATION METHODS: **15**

Spectral estimation methods, linear prediction method, Maximum entropy method, Maximum likelihood method, Eigen structure methods, Conventional DOA Estimation Methods, Conventional Beam forming Method, Capon's Minimum Variance Method, MUSIC Algorithm, ESPRIT Algorithm, Uniqueness of DOA Estimates

Total Hours:	**45**

Text Books:

1	Lal Chand Godara, "Smart Antennas" CRC press, 1st edition,2004.

2	Balanis, "Antenna Theory", John Wiley and Sons, 4th edition, 2016.
3	R. S. Elliot, "Antenna Theory and Design", Wiley-IEEE Press, revised edition,2003
4	Constantine A. Balanis & Panayiotis I. Ioannides, "Introduction to Smart Antennas", Morgan & Claypool Publishers' series-2007

Reference Books:

1	T.S Rappaport, "Smart Antennas Adaptive Arrays Algorithms and Wireless Position Location", IEEE press 1998, PTR – PH publishers 1999.
2	Robert A.Monzingo, R.L.Haupt, T.W. Miller, "Introduction to Adaptive Arrays",Yesdee Publishing Pvt.Ltd.,Reprint, 2012
3	Frank B.Gross,"Smart Antennas for wireless Communications",Mcgraw Hill, 1st edition,2005

Web References:

1	http://nptel.ac.in/courses/117107035/
2	https://elearning.nxp.com/enrol/index.php?id=213
3	https://ocw.mit.edu/resources/res-ll-002-adaptive-antennas-and-phased-arrays-spring-2010/

Online Resources:

1	*downloads.hindawi.com/books/9789775945099.pdf*
2	https://www.electronics-tutorials.com/basics/antenna-basics.htm
3	http://www.comlab.hut.fi/opetus/333/2004_2005_slides/Adaptive_antennas_text.pdf
4	http://www.wtec.org/loyola/wireless/chapter06.pdf

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list- Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%)[80 Marks]
C921.1	Remember	Quiz	20
C921.2 & C921.3	Apply	Problem Solving	20
C921.4 & C921.5	Analyze	Group Assignment	20
C921.6	Analyze	Case Study	20

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1: [60 Marks]	CIA2: [60 Marks]	

Remember	20	20	20
Understand	40	40	40
Apply	20	40	20
Analyse	20		20
Evaluate			
Create			

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CIA 1-100 Marks			CIA 2-100 Marks			
SA 1 (60 marks)	Component 1- (20marks)	Component 2- (20marks)	SA 2 (60 marks)	Component 1- (20marks)	Component 2- (20marks)	

Course Articulation Matrix														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	1	-	-	-	-	-	-	-	-	-	2	-
2	1	2	2	1	1	1	-	-	-	-	-	-	3	-
3	1	2	2	1	1	-	-	-	1	-	-	-	3	-
4	1	2	2	1	2	-	-	-	-	-	-	-	3	-
5	1	3	2	1	1	-	-	-	1	-	-	-	3	-
6	1	3	2	1	1	1	-	-	1	-	-	-	2	-
1	Reasonably agreed			2	Moderately agreed			3	Strongly agreed					

22EC922	**COGNITIVE RADIO NETWORKS**	3/0/0/3

Nature of Course	C (Theory Concept)

Course Objectives:

1	To understand the fundamental concepts of Software Defined Radio and Architecture
2	To understand DSP and SDR based architecture and interfacing topologies
3	To understand wireless networks based on the cognitive radios.
4	To analyse the radio resources of cognitive network
5	To understand spectrum techniques and Acquisition

Course Outcomes:
Upon completion of the course, students shall have ability to

C922.1	Understand the basics of Software Defined Radio, Architecture and its implications	[U]
C922.2	Analyse Digital Signal Processor and various interfacing	[AN]
C922.3	Understand the evolution of Cognitive Radio from Software Defined Radio	[U]
C922.4	Analyse the radio resources and Artificial Intelligence Techniques	[AN]
C922.5	Interpret the basics of various spectrum sensing techniques	[U]
C922.6	Understand the concepts of cooperative spectrum sensing and Acquisition	[U]

Course Contents:

Introduction to Software Defined Radio and Architecture: 15
Definitions and potential benefits – Software radio architecture evolution– technology trade-offs and architecture implications – Essential functions of the software radio – basic SDR – Digital Signal Processor and SDR Baseband architecture, top level component interfaces, interface topologies among plug and play modules.

Introduction to Cognitive Radios and Architecture: 15
Making radio self-aware – cognitive techniques – position awareness– environment awareness in cognitive radios – optimization of radio resources– Artificial Intelligence Techniques- Cognitive Radio – functions – components and design rules – Cognition cycle – orient, plan, decide and act phases – Inference Hierarchy – Architecture maps – Building the Cognitive Radio Architecture on Software defined Radio Architecture-Overview of IEEE 802.22 standard for broadband wireless access in TV bands.

Spectrum Sensing and Cooperative Spectrum Acquisition: 15
Introduction –Spectrum Sensing – Multiband Spectrum Sensing – Sensing Techniques-Basics of cooperative spectrum sensing–Examples of spectrum acquisition techniques – cooperative transmission techniques – sensing strategies– Acquisition in the Presence of Interference: Chase combining HARQ –Regenerative cooperative Diversity– spectrum overlay– spectrum handoff-Overview of security issues in cognitive radios-Cognitive radio for Internet of Things.

Total Hours:	**45**

Text Books:

1	Joseph MitolaIII, "Software Radio Architecture: Object-Oriented Approaches to Wireless System Engineering", John Wiley & Sons Ltd. 2000.
2	Markus Dillinger, Kambiz Madani, Nancy Alonistioti, "Software Defined Radio: Architectures, Systems and Functions", Wiley Publications, 2003.
3	Joseph Mitola, III, "Cognitive Radio Architecture: The Engineering Foundations of Radio XML", A John Wiley and Sons, INC Publications, 2006

Reference Books:

1	Ahamed Khattab, Dmitri Perkins,BagdyByoumi,"Cognitive Radio Networks from Theory to practice" 2013th edition.
2	HasariCelebi, HuseyinArslan, "Enabling Location and Environment Awareness in Cognitive Radios", Elsevier Computer Communications, Jan 2008.
3	Alexander M. Wyglinski, Maziarnekovee, Y. Thomas Hu, "Cognitive Radio Communication and Networks", Elsevier, 2010
4	Huseyin Arslan (Ed.), Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems, Springer, 2007.
Web References:	
1	http://www.radio-electronics.com/info/rf-technology-design/cognitive-radio-cr/technology-tutorial.php
2	https://www.sciencedirect.com/science/book/9780123747150
3	https://www.xgtechnology.com/innovations/cognitive-radio-networks/
Online Resources:	
1	http://nptel.ac.in/courses/108107107/
2	http://technav.ieee.org/tag/401/cognitive-radio
3	https://www.comsoc.org/publications/best-readings/cognitive-radio

Continuous Assessment				End Semester Examination	Total
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C922.1 & C922.2	Remember	Quiz	**20**
C923.3	Understand	Assignment	**20**
C923.4	Understand	Assignment	**20**
C923.5 & C923.6	Understand	Presentation	**20**

Assessment based on Summative and End Semester Examination			

Bloom's Level	Summative Assessment [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	20	10	10
Understand	30	40	40
Apply	30	40	30
Analyse	20	10	20
Evaluate			
Create			

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Course Articulation Matrix														
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	3	2	-	-	-	-	-	-	-	-	-	-	3	-
2	3	2	-	-	-	-	-	-	-	-	-	2	3	-
3	-	3	-	-	-	-	-	-	-	-	-	3	3	-
4	-	2	3	-	-	-	-	-	-	-	-	-	3	-
5	3	-	-	-	-	-	-	-	-	-	-	3	3	-
6	-	3	-	-	-	-	-	-	-	-	-	-	3	-
1	Reasonably agreed			2	Moderately agreed			3	Strongly agreed					

22EC923	ADVANCED WIRELESS NETWORKS FOR 5G	3/0/0/3

Nature of Course	C (Theory Concept)

Course Objectives:

1	To understand the basics of 5G network and its standards
2	To gain knowledge on various multiple access techniques
3	To understand physical and MAC layer functionality
4	To learn about channel hierarchy
5	To enrich knowledge on various 5G technologies and security aspects

Course Outcomes:
Upon completion of the course, students shall have ability to

C923.1	Understand the evolution of 5G network and its spectrum	[U]
C923.2	Compare various channel access methods	[AN]
C923.3	Understand the network architecture and its spectrum management	[U]
C923.4	Analyse various channel models of 5G network	[AN]
C923.5	Associate different types of communication methods	[U]
C923.6	Discuss Radio Access Network and security	[U]

Course Contents:

Evolution of 5G Network and channel access methods: **15**
Introduction to 5G - Evolving LTE to 5G Capability- 5G NR and 5G core network (5GCN) - 5G Standardization - 3GPP and IMT2020 - Spectrum for 5G – 5G deployment - Options, Challenges and Applications. OFDM and OFDMA – MIMO OFDM. Generalized Frequency Division Multiplexing (GFDM) – Non-Orthogonal Multiple Access (NOMA) - Universal Filtered OFDM -Filter bank multicarrier (FBMC)- Sparse Code Multiple Access (SCMA) –Comparison of multiple access methods

Radio Access Network and channel models for 5G NR: **15**
5G Architecture -User Plane Protocols-Radio Link Control - Medium-Access Control – Physical Layer functions -Control Plane Protocols - Network Slicing- RAN virtualization-Spectrum Management in 5G. Channel Hierarchy in 5G NR – Logical Channels and Transport Channels in 5G NR - Physical Layer Data Channels in 5G NR - Downlink Physical Channel and Uplink Physical Channels - Propagation Channel models for 5G

Enabling Technologies for 5G and Security: **15**
Device-to-Device (D2D) Communication - 5G for Massive Machine Type Communication and Massive IoT- V2X Communication - Full Duplex and Green Communication - mmWave Communications -Massive MIMO and Beamforming Techniques NR requirements - 5G Core Network Architecture - Radio-Access Network (RAN)- Radio Protocol, **5G Security and Privacy.**

Total Hours:		45

Text Books:

1	Saad Z. Asif, "5G Mobile Communications Concepts and Technologies, CRC Press, 1st Edition, 2019.
2	Jonathan Rodriguez, "Fundamentals 5G Mobile Networks", John Wiley & Sons, 1st Edition, 2015.
3	Long Zhao, Hui Zhao, Kan Zheng, Wei Xiang, "Massive MIMO in 5G Networks: Selected Applications", Springer, 1st Edition, 2018.

Reference Books:

1	Erik Dahlman, Stefan Parkvall, Johan Skold "5G NR: The Next Generation Wireless Access Technology", Academic Press, 1st Edition, 2018.
2	Robert W. Heath Jr., Angel Lozano, "Foundations of MIMO Communication", Cambridge University Press, 1st Edition, 2019
3	Jonathan Rodriguez, "Fundamentals 5G Mobile Networks", John Wiley & Sons, 1st Edition, 2015
4	Madhusanka Liyanage, Ijaz Ahmad, Ahmed Bux Abro, Andrei Gurtov, Mika Ylianttila, "A Comprehensive Guide to 5G Security", Wiley, 2018.

Web References:

1	https://onlinecourses.nptel.ac.in/noc22_ee56/preview
2	https://www.coursera.org/learn/5g-network-fundamentals
3	https://www.huawei.com/en/huaweitech/industry-insights/outlook/mobile-broadband/insights-reports/5g-network-architecture

Online Resources:

1	https://www.udemy.com/course/5g-network-training-key-technologies-architecture-and-protocols/
2	https://ieeexplore.ieee.org/document/7169508
3	https://archive.nptel.ac.in/courses/108/105/108105134/

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C923.1	Remember	Quiz	20
C923.2 & C923.3	Understand	Assignment	20
C923.4, C923.5	Apply	Group Assignment	20
C923.6	Understand	Assignment	20

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	20	10	10
Understand	30	40	40
Apply	30	40	30
Analyse	20	10	20
Evaluate			
Create			

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Course Articulation Matrix														
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	3	2	-	-	-	-	-	-	-	-	-	2	3	-
2	3	2	-	2	-	-	-	-	-	-	-	1	3	-
3	-	3	-	-	-	-	-	-	-	-	-	-	3	-
4	-	2	3	-	-	-	-	-	-	-	-	-	3	-
5	3	-	-	3	-	-	-	-	-	-	-	3	3	-
6	-	3	-	2	-	-	-	-	-	-	-	2	3	-
1	Reasonably agreed		2		Moderately agreed			3		Strongly agreed				

22EC924	**SIGNAL INTEGRITY IN HIGH-SPEED DESIGN**	3/0/0/0

Nature of Course	C(Theory Concept)

Course Objectives:

1	To acquire knowledge on fundamentals of electromagnetics for signal integrity, its importance for high-speed applications.
2	To identify sources affecting the speed of digital circuits.
3	To understand the concept of differential signaling
4	To Understand the fundamental principles of physical transmission line model and apply these principles to specific applications

Course Outcomes:

Upon completion of the course, students shall have ability to

C924.1	Understand the electromagnetic fundamentals for signal integrity	U
C924.2	Acquire knowledge on Vector equations relevant for signal integrity	R
C924.3	Analyze the sources affecting the speed of digital circuits	AN
C924.4	Understand the concept of differential signaling	R
C924.5	Physical transmission line model and understand its design parameters	AP

Course Contents:

ELECTROMAGNETIC FUNDAMENTALS FOR SIGNAL INTEGRITY   15

The importance of signal integrity - new realm of bus design - Electromagnetic fundamentals for signal integrity - Maxwell equations common vector operators - wave propagations - Electrostatics – magneto statics - Power flow and the poynting vector - Reflections of electromagnetic waves.

CROSS-TALK   15

Introduction - mutual inductance and capacitance-coupled wave equation - coupled line analysis – modal analysis - cross talk minimization signal propagation in unbounded conductive media - classic conductor model for transmission model.

DIFFERENTIAL SIGNALLING AND PHYSICAL TRANSMISSION LINE MODEL   15

Removal of common mode noise - Differential Cross talk - Virtual reference plane-Propagation of model voltages common terminology - drawbacks of differential signaling. Introduction - non ideal return paths - Vias - IO design consideration - Push-pull transmitter – CMOS receivers - ESSD protection circuits - On chip Termination- Case study: Signal Integrity in high speed design in PCB layout.

	45

Text Books:

1	Stephen H. Hall, Howard L. Heck, "Advanced Signal Integrity for High-Speed Digital Designs", Wiley IEEE Press, 2012.
2	James Edgar Buchanan, "Signal and power integrity in digital systems: TTL, CMOS, and BiCMOS ", Mc Graw Hill,2011
3	Greg Edlund, "Timing Analysis and Simulation for Signal Integrity Engineers", Prentice Hall of India, 2008

Reference Books:

1	Stephen C. Thierauf, "Understanding Signal Integrity", Pages displayed by permission Artech Publishing House, 2011.
2	Eric Bogatin, "Signal and Power Integrity - Simplified", 2nd Edition, Prentice Hall of India, 2010.
3	Mike Peng Li, "Jitter, Noise and Signal Integrity at High-Speed", Prentice Hall of India, 2008

Web References:

1	https://onlinecourses.nptel.ac.in/noc24_ee67/
2	https://www.classcentral.com/course/communications-and-high-speed-signals-with-raspbe-110657
3	https://www.oreilly.com/library/view/pcb-signal-integrity/9780133548563/

Online Resources:

1	https://suddendocs.samtec.com/notesandwhitepapers/samtec-signal-integrity-handbook.pdf
2	https://www.edn.com/signal-integrity-and-power-integrity-in-high-speed-design/
3	https://www.sciencedirect.com/topics/computer-science/signal-integrity

Assessment Methods & Levels (based on Blooms'Taxonomy)

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C924.1 & C924.2	Understand & Remember	Quiz	20
C924.3	Analyse	Assignment	20
C924.4	Remember	Quiz	20
C924.5	Apply	Group Assignment	20

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	20	10	10
Understand	30	40	40
Apply	30	40	30
Analyse	20	10	20
Evaluate			
Create			

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Course Articulation Matrix														
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	3	2	-	-	-	-	-	-	-	-	-	-	3	-
2	3	2	-	-	-	-	-	-	-	-	-	2	3	-
3	3	3	-	-	-	-	-	-	-	-	-	2	3	-
4	3	2	-	-	-	-	-	-	-	-	-	-	3	-
5	3	2	2	-	-	-	-	2	2	-	-	3	3	-
1	Reasonably agreed		2	Moderately agreed			3	Strongly agreed						

22EC925	SOI DEVICE MODELLING AND SIMULATION		3/0/0/3
Nature of Course	:C (Theory Concept)		

Course Objectives:		
1	To Obtain a thorough knowledge of semiconductor materials, devices and their characterization.	
2	To provide detail understanding of unipolar devices, required for designing VLSI & ULSI circuits.	
3	To Understand semiconductor device modeling aspects useful for designing devices in electronic and microelectronic applications.	
4	To introduce the field of compact modeling.	
5	To familiarize the tools and methods used in industry-standard model.	

Course Outcomes:

Upon completion of the course, students shall have ability to

C925.1	Discuss the operation of several basic semiconductor devices.	[U]
C925.2	Discuss advanced physical concepts in Semiconductor Electronics such as carrier and impurity statistics, and hot carriers transport effects	[U]
C925.3	Apply the concepts related to device physics and modelling to solve problems	[AP]
C925.4	Categorize semiconductors for their applications in device fabrication	[AN]
C925.5	Explain the CMOS fabrication, device and process integration using technology computer-aided designed (TCAD) simulation tools	[U]

Course Contents:

Overview of Semiconductor Devices: **15**

Introduction to basic device structures (BJT, FET and MOSFETs), basic concepts of Carrier transport; drift-diffusion, hydrodynamic, energy balance. Schottky junctions: Metal Semi-conductor junctions, Band structures across junctions, Schottky diode and its I-V Characteristics. Unipolar devices: JFETs, MESFETs, Band Structure, CV curves, Strong inversion condition, MOSFET characteristics, short-channel and hot-carrier effects, HEMT, HBT

Device Modeling :   **15**

Introduction to Numerical Modelling methods, meshing (fixed & adaptive), numerical solutions, common methods (Newton, Gummel etc.) -Modeling of LASER diode: Rate equations, Numerical schemes - MESFET Modeling: Bridging between time and frequency domains - Introduction to Quantum Device Modeling: Double barrier resonant tunnelling diode, Device modeling through transfer matrix approach.

Process and Circuit Simulation: **15**

Process Simulation – Overview of basic FET ad BJT process flows, physical models and simulation techniques for unit process such as etching, thermal oxidation, diffusion, ion implantation and process integration. Circuit Simulation –Nodal equations, Linear Equation Solution, Gaussian elimination and LU factorization, Linear dc and transient analysis, Sparse matrix behaviour, Nonlinear Equation Solution, DC & AC Simulation, Transient Simulation.

Total Hours:		**45**

Text Books:	
1	S.M. Sze "Physics of Semi-conductor Devices"Fourth edition – Wiley, 2016.
2	Jim Plummer, Michael D. Deal, and Peter B. Griffin "Silicon VLSI Technology: Fundamentals, Practice and Modeling", Second Edition - Pearson, 2017.

Reference Books:

1	J.S. Yuan, J.J. Liou, "Semiconductor Device Physics and Simulation", Springer, 2015.
2	Leonard I. Schiff "Quantum Mechanics", Third Edition - Tata Mc-Graw-Hill, 2010
3	S Selberherr "Analysis and Simulation of Semiconductor Devices", Springer-Verlag, 2013

Web References:

1	https://www.cambridge.org/core/books/introduction-to-semiconductor-devices/CF31F9C075AF924F47B63AC57873D4E6
2	https://www.scribd.com/document/191859092/Semiconductor-Device-Modelling

Online Resources:

1	https://nielit.gov.in/calicut/content/lab-workshop-vlsi-fundamentals
2	https://nptel.ac.in/courses/117101004
3	https://www.coursera.org/learn/mosfet

Continuous Assessment				Total Continuous Assessment	End Semester Examination	Total
Formative Assessment	Summative Assessment	Total				
80	120	200		40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C925.1	Understand	Quiz	20
C925.2	Understand	Assignment	20
C925.3	Apply	Group Assignment	20
C925.4	Analyze		
C925.5	Understand	Seminar	20

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	20	20	20
Understand	40	30	30
Apply	40	20	20
Analyze	-	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Course Articulation Matrix

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	2	2	2	2	1	-	-	-	-	-	-	1	2	1
2	3	3	2	3	1	-	-	-	-	-	-	1	2	1
3	3	3	2	2	1	-	-	-	-	-	-	1	2	1
4	3	3	2	3	1	-	-	-	-	-	-	1	2	1
5	3	2	2	2	1	-	-	-	-	-	-	1	2	1
1	Reasonably agreed			2	Moderately agreed			3		Strongly agreed				

22EC926	ARCHITECTURAL DESIGN OF DIGITAL INTEGRATED CIRCUITS	3/0/0/3

Nature of Course	:C (Theory Concept)

Course Objectives:

1	To provide knowledge ofdigital IC design.
2	To acquaint the fundamental concepts of CMOS Inverter.
3	To familiarize the tools and techniques used in designing combinational circuits.
4	To introduce the design methods involved in sequential circuits.
5	To Understand the timing concepts and issues in digital ICs.

Course Outcomes:
Upon completion of the course, students shall have ability to

C926.1	Design CMOS inverters with specified noise margin and propagation delay.	[AP]
C926.2	Implement efficient techniques at circuit level for improving power and speed of digital circuits	[U]
C926.3	Identify sources of power consumption in a given VLSI Circuit	[U]
C926.4	Analyze the dynamic and leakage power components in a DSM VLSI circuit	[AN]
C926.5	Estimate power consumption at different levels of abstraction in a VLSI system.	[AP]

Course Contents:

Introduction to Digital IC and CMOS Inverter: 15

Issues and Quality Metrics of Digital Integrated Circuit Design - The Static CMOS Inverter - An Intuitive Perspective; Evaluating the Robustness of the CMOS Inverter: The Static Behaviour; Performance of CMOS Inverter: The Dynamic Behaviour; Computing the Capacitances; Propagation Delay - Dynamic Power Consumption, Analysing Power Consumption - Technology Scaling and its Impact on the Inverter Metrics

Designing Combinational And Sequential Circuits: 15

Static CMOS Design; Complementary CMOS; Pass-Transistor Logic; Dynamic CMOS Design; Designing Logic for Reduced Supply Voltages. Timing Metrics for Sequential Circuits; Classification of Memory Elements; Static Latches and Registers; The Bistability Principle; Multiplexer-Based Latches; Master-Slave Edge-Triggered Register; Low-Voltage Static Latches; Dynamic Latches and Registers; Dynamic Transmission-Gate Edge-triggered Registers.

Timing Issues In Digital Circuits: 15

Timing Classification of Digital Systems - Synchronous Interconnect - Mesochronous interconnect; Plesiochronous Interconnect; Asynchronous Interconnect; Synchronous Design — An In-depth Perspective; Synchronous Timing Basics; Sources of Skew and Jitter; Clock-Distribution Techniques. Latch-Based Clocking, Clocking in IC's: Basic Concepts PLL and DLL; Building Blocks of a PLL - Distributed Clocking Using DLLs.

Total Hours:		45

Text Books:

1	Jan Rabaey, AnanthaChandrakasan and Borivoje Nikolic, "Digital Integrated Circuits: A Design Perspective", SecondEdition –Pearson Education India, 2016.
2	N. Weste and D. Harris, "CMOS VLSI Design: A Circuits and Systems Perspective", Third Edition - Pearson, 2005.

Reference Books:

1	R.A. Saleh, "Analysis and Design of Digital Integrated Circuits in Deep Submicron Technology", 3rd edition - McGraw Hill, 2004.

| 2 | Stephen Brown and Zvonko Vranesic,"Fundamentals of Digital Logic with Verilog Design ', Third Edition -Tata McGraw-Hill, 2016. |
| 3 | G.D.Michelli,"Synthesis and optimization of Digital Circuits ', Springer, 2005. |

Web References:

| 1 | https://www.academia.edu/35159613/Fundamentals_of_Digital_Logic |
| 2 | https://www.scribd.com/document/568490866/Digital-Ic-Design |

Online Resources:

1	https://nielit.gov.in/calicut/content/lab-workshop-advanced-arm
2	https://nptel.ac.in/courses/117105080
3	https://www.coursera.org/learn/introduction-to-semiconductor-packaging

Continuous Assessment			Total Continuous Assessment	End Semester Examination	Total
Formative Assessment	Summative Assessment	Total			
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C926.1	Apply	Quiz	20
C926.2	Understand	Assignment	20
C926.3	Understand	Group Assignment	20
C926.4	Analyze		
C926.5	Apply	Seminar	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	20	20	20
Understand	40	30	30
Apply	40	20	20

Analyze	-	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Course Articulation Matrix														
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	2	2	2	2	1	-	-	-	-	-	-	1	3	1
2	3	3	2	3	1	-	-	-	-	-	-	1	3	1
3	3	3	2	2	1	-	-	-	-	-	-	1	3	1
4	3	3	2	3	1	-	-	-	-	-	-	1	3	1
5	3	2	2	2	1	-	-	-	-	-	-	1	3	1
1	Reasonably agreed		2	Moderately agreed		3	Strongly agreed							

22EC927	IC DESIGN AND TECHNOLOGY	3/0/0/3

Nature of Course	: C (Theory Concept)

Course Objectives:

1	To study the basics of analog IC designing
2	To understand the frequency response , noise issues in amplifiers
3	To understand the implementation of linear and non-linear analog block implementation
4	To gain knowledge about digital circuits and systems

Course Outcomes:
Upon completion of the course, students shall have ability to

C927.1	To understand the basic analog building blocks.	[U]
C927.2	To understand the working of the different amplifiers.	[U]
C927.3	Analyze the noise representation in circuits and noise in differential amplifiers	[AN]
C927.4	To understand the concept of PLL and its applications.	[U]
C927.5	To analyzethe characteristics of digital circuits and the noise in digital circuits	[AN]
C927.6	Describing various Programmable Logic Arrays and structured logic forms	[AN]

Course Contents:

Analog Building Blocks and Amplifiers: **15**
Analog building blocks - Switches, Active Resistors, Current and Voltage sources, Current Mirrors, Current and voltage references, Voltage regulators. Amplifiers- Differential amplifiers, Operation amplifiers, Output amplifiers

Noise in amplifiers and PLL: **15**
Types, Representation of noise in circuits, Noise in differential amplifiers. Simple PLL, Charge-pump PLLs, Non ideal effects in PLL, Applications of PLL.

Digital Circuits and Systems: **15**
Design Abstraction ,Characteristics of Digital Circuits ,Noise in digital circuits, Random Logic versus Structured Logic Forms, Programmable Logic Arrays, Structured Gate Layout, Logic Gate arrays

Total Hours:	45

Text Books:

1	Randall L. Geiger, Phillip E. Allen,Noel R. Strader, "VLSI design techniques for analog and digital circuits", McGraw-Hill Publishing Company, First edition, 2010.
2	Behzad Razavi, "Design of Analog CMOS Integrated Circuits" McGraw-Hill International edition 2017.

Reference Books:

1	Tony Chan Carusone, David Johns, Kenneth Martin "Analog Integrated Circuit Design" - Wiley, 2013
2	Jan M. Rabaey, AnanthaChandrakasan,Borivoje Nikolic,"Digital Integrated Circuits – A design perspective ", Pearson Education India , 2016.

Web References:	
1	https://www.synopsys.com/glossary/what-is-analog-design.html
2	https://www.d.umn.edu/~htang/ECE5211_doc_files/ECE5211_files/Chapter2.pdf
3	https://ieeexplore.ieee.org/document/1269996?denied=
4	https://cs.stackexchange.com/questions/80454
Online Resources:	
1	https://onlinecourses.nptel.ac.in/noc20_ee26/preview
2	https://www.udemy.com/course/cmos-digital-integrated-circuit-design/?couponCode=NVDPRODIN35
3	https://dl.acm.org/doi/pdf/10.1145/1478559.1478567

Continuous Assessment				End Semester Examination	Total
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C927.1 C927.2	Understand	Quiz	20
C927.3	Analyze	Group Assignment	20
C927.4	Understand	Assignment	20
C927.5,6	Analyze	Class presentation	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	40	10	10
Understand	60	20	40
Apply		40	30
Analyse		30	20

Evaluate			
Create			

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Course Articulation Matrix														
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	3	2	3	2								3	2	3
2	3	2	3	2	2							3	2	3
3	3	2	2	3			1		2			2	2	3
4	3	2	3	2								3	2	3
5	3	2	2	2						2		2	2	3
6	3	2	2	2						2		3	2	3
1	Reasonably agreed			2	Moderately agreed			3		Strongly agreed				

22EC928	POWER SEMICONDUCTOR DEVICES AND TECHNOLOGY	3/0/0/3

Nature of Course	G (Theory analytical)

Course Objectives:

1	To Understand the Fundamental Concepts of Power Bipolar Junction Transistors.
2	To Induce the Knowledge of BJT Structures and Characteristics.
3	To Understand the Fundamental Concepts of Power Semiconductor Devices.
4	To Induce the Knowledge of Device Optimization and Performance Enhancement Techniques.
5	To Analyze the Operation and Performance Characteristics of Power MOSFET Technologies
6	To Apply the Knowledge of Silicon Carbide Properties and Technologies to Power Electronics Applications

Course Outcomes:

Upon completion of the course, students shall have ability to

C928.1	Understand the Basic Operating Principles and Static Blocking Characteristics of Power BJTs.	[U]
C928.2	Apply the Knowledge of Current Gain and Emitter Current Crowding to Analyze Output and On-State Characteristics.	[AP]
C928.3	Understand the Basic Device Structures and Operation of Power Semiconductor Devices.	[U]
C928.4	Apply the Techniques for Power-Loss Optimization and Latch-Up Suppression in Power Semiconductor Devices.	[AP]
C928.5	Analyze the Switching Characteristics and Performance of Power MOSFETs under Various Conditions	[AN]
C928.6	Apply the Concepts of Silicon Carbide Technology in Real-World Power Electronics Systems	[AP]

Course Contents:

Bipolar Junction Transistors: 15

Power Bipolar Junction Transistor Structure, Basic Operating Principles, Static Blocking Characteristics, Current Gain, Emitter Current Crowding, Output Characteristics, On-State Characteristics, Switching Characteristics, Safe Operating Area, Darlington Configuration. Applications of the basic transistors in real time.

Insulated Gate Bipolar Transistors: 15

Basic Device Structures, Device Operation and Output Characteristics, Device Equivalent Circuits, Blocking Characteristics, On-State Characteristics, Current Saturation Model, Switching Characteristics, Power-Loss Optimization, Complementary (p-Channel) Structure, Latch-Up Suppression, Safe Operating Area, Trench-Gate Structure, Blocking Voltage Scaling, High Temperature Operation, Lifetime Control Techniques, Cell Optimization, Reverse Conducting Structure, Soft Switching.

Power MOSFET Transistors and Silicon Carbide Applications in Power Electronics:15
Power MOSFET Transistors: Power MOSFET technologies, Mechanism of power MOSFET operation, Power MOSFET Main Characteristics, Switching Cycle with an Inductive Load, Characteristics Variations due to MOSFET Temperature changes. Silicon Carbide Applications in Power Electronics: Physical Properties of Silicon Carbide, State of the art technology for Silicon Carbide Power Components, Applications of Silicon Carbide in Power Electronics.

	Total Hours:	45

Text Books:

1	B.JayantBaliga, Fundamentals of Power Semiconductor Devices, Second Edition, Springer Nature, 2013
2	Robert Perret, Power electronics semiconductor devices, John Wiley & Sons, 2009

Reference Books:

1	B.JayantBaliga, Power Semiconductor Devices, PWS Publishing Co., Boston, 1996.
2	B.JayantBaliga, Silicon Carbide Power Devices, World Scientific, 2006.

Web References:

1	https://www.ti.com/design-resources/seminars.html
2	https://ww1.microchip.com/downloads/en/Appnotes/00799b.pdf
3	https://assets.wolfspeed.com/uploads/2023/03/Silicon_Carbide_Module_Performance_in_Electric_Aircraft_Inverters_Report.pdf

Online Resources:

1	https://nptel.ac.in/courses/108105066
2	https://www.coursera.org/specializations/power-electronics

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)
Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Ca-se Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C928.1	Understand	Quiz	20
C928.2	Apply	Assignment	20
C928.3, C928.4	Apply	Seminar	20
C928.5,	Analyse	Group Assignment	20

C928.6			

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1: [60 Marks]	**CIA2: [60 Marks]**	
Remember	20	10	10
Understand	40	40	40
Apply	40	40	30
Analyse		10	20
Evaluate			
Create			

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks			**CA 2 : 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

Course Articulation Matrix														
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
1	3	-	-	2	-	-	-	1	-	-	-	1	-	1
2	-	3	2	1	-	-	2	1	-	-	-	2	2	-
3	3	-	-	2	-	-	-	-	-	-	-	1	-	-
4	-	3	2	1	-	1	2	-	-	-	-	2	1	2
5	-	-	3	2	1	-	-	-	-	-	-	-	3	-
6	3	2	1	-	-	-	2	-	-	-	-	3	-	3
1	Reasonably agreed			2		Moderately agreed			3			Strongly agreed		

22EC929	PHOTONIC INTEGRATED CIRCUITS	3/0/0/3

Nature of Course	: C (Theory Concept)

Course Objectives:

1	To understand the basic principles of biophotonics and its applications in biological systems.
2	To learn about the interaction of light with biological tissues.
3	To understand the principles of optical sensors and their role in biophotonics.
4	To learn about various types of optical sensors and their working mechanisms.
5	To gain knowledge of advanced biophotonic techniques and their applications.

Course Outcomes:
Upon completion of the course, students shall have ability to

C929.1	Summarize the fundamental concept of optical waveguides.	[U]
C929.2	Understand the different types of optical waveguides.	[U]
C929.3	Analyze the couplers, modulators and devices for communication applications.	[AN]
C929.4	Understand the working of nano photonic devices.	[U]
C929.5	Summarize fabrication technologies for design of optical waveguides	[E]
C929.6	Explain the various nonlinear effects in integrated optical waveguides.	[AP]

Course Contents:

FUNDAMANTALS OF OPTICAL WAVEGUIDES	**15**

Brief history of optical communication, Advantages of integrated optics configuration, Guided TE and TM Modes of Symmetric and anti-symmetric planar waveguides: Step-index and graded index waveguides. Strip and channel waveguides, Beam propagation method.

OPTICAL AND NANO DEVICES	**15**

Directional couplers, Applications as power splitters, Y-junction, optical switch; modulators, filters, A/D converters, Mode splitters, Mach-Zehnder interferometer based devices. Acousto-optic waveguide devices. Arrayed waveguide devices, Nano-photonic-devices: Metal/dielectric plasmonic waveguides, Surface Plasmon modes, applications in waveguide polarizers.

OPTICAL FABRICATION PROCESS AND NON LINEAR EFFECTS	**15**

Materials- Glass, lithium niobate, silicon, compound semiconductors. Fabrication of integrated optical waveguides and devices. Lithography, deposition. Waveguide characterisation, prism coupling, grating and tapered couplers, Nonlinear effects in integrated optical waveguides, Types and Applications- case study on applications of non lineareffects .

Total Hours:	**45**

Text Books:

1	H Nishihara, M Haruna and T Suhara, Optical Integrated Circuits; McGraw-Hill Book

	Company, New York, 1989.
2	C. R. Pollock and M Lipson, Integrated photonics,Kluwer Pub, 2003.
3	José Capmany and Daniel Pérez, Photonic Integrated Circuits, Oxford Univversity Press, 2020
Reference Books:	
1	A Ghatak and K Thyagarajan, Optical Electronics, Cambridge University Press, 1989.
2	T. Tamir, Guided wave opto-electronics, Springer Verilag, 1990.
3	K. Okamota, Fundamentals of Optical waveguides, Academic Press, 2006.
Web References:	
1	https://www.photonics.com/
2	https://opg.optica.org/
3	Recent journals and conference proceedings.
4	https://innovationspace.ansys.com/courses/courses/introduction-to-waveguide-design/lessons/photonic-integrated-circuits-and-the-role-of-waveguide-lesson-1/
Online Resources:	
1	https://archive.nptel.ac.in/courses/108/108/108108174/

Continuous Assessment				End Semester Examination	Total
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%)** **[80 Marks]**
C929.1 C929.2	Understand	Quiz	20
C929.3	Analyze	Assignment	20
C929.4,5	Evaluate	Group Assignment	20
C929.6	Apply	Seminar presentation	20
Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment** **[120 Marks]**		**End Semester Examination (60%)** **[100 Marks]**

	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	40	10	10
Understand	60	50	60
Apply		40	30
Analyse			
Evaluate			
Create			

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Course Articulation Matrix														
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	3	2	1	1	-	-	-	1	-	2	-	-	2	2
2	3	2	1	1	-	-	-	-	-	2	-	-	2	2
3	3	2	2	3	-	-	-	-	-	2	-	-	2	2
4	3	2	2	3	1	-	-	-	2	3	-	2	2	2
5	3	3	3	3	1	-	-	-	2	3	-	2	2	2
6	3	2	2	2	1	2	2	-	-	3	-	-	-	-
1	Reasonably agreed		2	Moderately agreed			3	Strongly agreed						

22EC930		BIOPHOTONICS AND OPTICAL SENSORS	3/0/0/3
Nature of Course		: C (Theory Concept)	
Course Objectives:			
1		To understand the basic principles of biophotonics and its applications in biological systems.	
2		To learn about the interaction of light with biological tissues.	
3		To understand the principles of optical sensors and their role in biophotonics.	
4		To learn about various types of optical sensors and their working mechanisms.	
5		To gain knowledge of advanced biophotonic techniques and their applications.	
Course Outcomes:			
Upon completion of the course, students shall have ability to			
C930.1	Demonstrate an understanding of the fundamental concepts of biophotonics.		[U]
C930.2	Explain the interaction of light with biological tissues.		[U]
C930.3	Understand the working principles of various optical sensors.		[U]
C930.4	Understand the working principles of various optical detectors.		[U]
C930.5	Apply advanced biophotonic techniques in research and clinical practice.		[AP]
C930.6	Evaluate the therapeutic applications of biophotonics.		[E]
Course Contents:			

Fundamentals of Biophotonics 15

Overview of biophotonics-spectral window, Principles of light -tissue interaction-reflection and refraction applications, absorption, scattering, scattering with absorption, light tissue interaction mechanisms.

Optical sensors and detection techniques 15

Optical biosensors-overview of biosensors and probes, optical sensors, interferometric sensors-photonic crystals fiber biosensor, fiber Bragg grating sensor, surface plasmon resonance biosensor, optical detectors-PIN-APD-Multichannel detectors.

Advanced biophotonic Techniques and Applications 15

Advanced optical Imaging procedures: Multiphoton Microscopy, Optical Coherence Tomography, Biophotonic Therapeutics- Photodynamic Therapy, Laser Surgery, Applications-optical manipulation-smart phone spectrometers-wearable biophotonic body sensors- robotic surgery, **case studies** on Robotic Surgery Guided by Biophotonic Imaging.

Total Hours:		45
Text Books:		
1	Gerd Keiser " Biophotonics - Concepts to Applications" second edition, Springer publications, 2002.	
2	Paras N.Prasad "Introduction to biophotonics " Wiley Interscience, A JOHN WILEY	

	& SONS, INC., Publication, 2003.

Reference Books:

1	Optical Biosensors: Present & Future" by Frances S. Ligler, Chris A. Rowe Taitt.,1st Edition -, Elsevier Publishing, 2002
2	Optical Sensors: Basics and Applications" by Jary Haus, Wiley publishing, 2010
3	Nanobiophotonics" edited by Hiroshi Masuhara, Satoshi Kawata, Fumio Tokunaga, Elsevier Science, 2007
4	Handbook of Optical Sensors" by José Luis Santos, Faramarz Farahi, Taylor & Francis, 2014.

Web References:

1	https://www.nature.com/nphoton
2	https://opg.optica.org/
3	https://www.mdpi.com/journal/optics/special_issues/Biophotonics_Optical_Microscopy

Online Resources:

1	https://archive.nptel.ac.in/noc/courses/noc21/SEM1/noc21-ph17/
2	https://archive.nptel.ac.in/courses/117/108/117108037/

Continuous Assessment				End Semester Examination	Total
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms' Taxonomy)
Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C930.1 C930.2	Understand	Quiz	20
C930.3	Understand	Assignment	20
C930.4,5	AP	Group Assignment	20
C930.6	Evaluating	Seminar presentation	20

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	40	10	10
Understand	60	50	60
Apply		40	30
Analyse			
Evaluate			
Create			

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Course Articulation Matrix

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	3	2	1	1	-	-	-	1	-	2	-	-	2	2
2	3	2	1	1	-	-	-	-	-	2	-	-	2	2
3	3	2	2	3	-	-	-	-	-	2	-	-	2	2
4	3	2	2	3	1	-	-	-	2	3	-	2	2	2
5	3	3	3	3	1	-	-	-	2	3	-	2	2	2
6	3	2	2	2	1	2	2	-	-	3	-	-	-	-
1	Reasonably agreed			2	Moderately agreed			3	Strongly agreed					

22EC931	**FLEXIBLE AND WEARABLE SENSORS**	**3/0/0/3**

Nature of Course	:C (Theory Concept)

Course Objectives:

1	To provide the overview of flexible electronics technology and the issues with materials processing for thin film electronics.
2	To expose the students for the materials selection and patterning methods for thin film electronics development.
3	To describe the process involved in transferring the flexible electronics from foils to textiles and the challenges, opportunities, and the future of wearable devices.
4	To expose the students to the design, challenges of wearable sensors employed for sensing the physical and biological parameters and the process involved in the conversion of conducting and semiconducting fibres to smart textiles.
5	To impart the importance of smart sensors, sensor interface standards for wearable device applications and to provide a brief overview of the wearable technology and its impact on social life.

Course Outcomes:
Upon completion of the course, students shall have ability to

C931.1	Realize the technology developments in the flexible electronics technology and ability to identify the suitable materials and its processing for the development of thin film electronics.	[U]
C931.2	Realize the process involved in the transformation of electronics from foils to textiles	[U]
C931.3	Acquire the design knowledge for developing wearable sensors for physical and chemical parameters	[AP]
C931.4	Gain the competency in transferring the conducting and semiconducting fibers to smart textiles	[U]
C931.5	Realize the concept of wearable bio, chemical and inertial sensors employed for real life applications and able to conduct experiments on sensors and develop projects based on socio economic needs.	[AN]

Course Contents:

OVERVIEW OF FLEXIBLE ELECTRONICS TECHNOLOGY AND NANO-CRYSTALLINE SILICON MATERIALS 15

History of flexible electronics - Materials for flexible electronics - Fabrication technology for flexible electronics - Fabrication on sheets by batch processing - fabrication on web by Roll-to Roll processing - Additive printing - low temperature amorphous and nano crystalline silicon - characteristics of low temperature dielectric thin film deposition - low temperature silicon nitride and silicon oxide characteristics - Device structures and materials processing - Device performance - Contacts for the device - Device stability.

MATERIALS AND NOVEL PATTERNING METHODS FOR FLEXIBLE ELECTRONICS 15

Materials considerations for flexible electronics: Inorganics semiconductors and dielectrics, organic semiconductors and dielectrics, conductors - Print processing options for device fabrication: Overview, control of feature sizes of jet printed liquids, jet printing for etch mask patterning, methods for minimizing feature size, printing active materials - Thin film transistors -

Review of semiconductors employed in flexible electronics - Thin film transistors based on IGZO - Plastic electronics for smart textiles - Improvements and limitations.

WEARABLE BIO, CHEMICAL AND INERTIAL SENSORS, AND ITS TECHNOLOGY 15

Introduction-Systems design - Challenges in chemical and biochemical sensing - Application areas -Wearable inertial sensors - obtained parameters from inertial sensors - Applications for wearable motion sensors - Practical considerations for wearable inertial sensor - Smart connectivity and Big picture of IoT - Wireless technologies and need for data analysis - Evolution of wearable technology, Wearable IoT use cases - Smart watches, Android wear, Smart glasses, fitness trackers, health care devices, cameras, smart clothing - Case studies – Health care, fitness and sports, defence and security, fashion and apparel.

Total Hours:	45

Text Books:

1	William S. Wong, Alberto Salleo, Flexible Electronics: Materials and Applications, 2021, Springer, New York.
2	Michael J. McGrath, Cliodhna Ni Scanaill, Dawn Nafus, "Sensor Technologies: Healthcare, Wellness and Environmental Applications", 2021, Apress Media LLC, New York.

Reference Books:

1	Ram. K Gupta, "Flexible and Wearable Sensors Materials, Technologies, and Challenges", 2023.
2	Edward Sazonov, Michael R. Newman, "Wearable Sensors: Fundamentals, Implementation and Applications", 2014, 1st Edition, Academic Press, Cambridge.
3	Kate Hartman, "Make: Wearable Electronics: Design, prototype, and wear your own interactive garments", 2014, 1st Edition, Marker Media, Netherlands.

Web References:

1	https://ieeexplore.ieee.org/document/9452111
2	https://ieeexplore.ieee.org/document/7931559

Online Resources:

1	https://www.nature.com/articles/s41528-023-00261-4
2	https://onlinelibrary.wiley.com/doi/abs/10.1002/adma.202400333
3	https://www.sciencedirect.com/science/article/pii/S0924424723008427?casa_token=Ur8xh25W4FUAAAAA:iKLwlRLHzYqbWGe6j-eeaX62VpBHzYbIr4Ld5V-271FcIWfSkV1zbUYiJFGt2WT2uzueTLWwqcc

Continuous Assessment			Total Continuous Assessment	End Semester Examination	Total
Formative Assessment	Summative Assessment	Total			
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C931.1	Understand	Quiz	20
C931.2	Understand	Assignment	20
C931.3	Apply	Group Assignment	20
C931.4	Understand		
C931.5	Analyze	Quiz	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	30	30	30
Apply	20	20	20
Analyse	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks			**CA 2 : 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
						Course Articulation Matrix								
1	1	-	2	1	-	2	2	-	-	-	-	2	-	2
2	1	-	2	1	-	2	2	-	-	-	-	2	-	2
3	1	-	2	1	-	2	2	-	-	-	-	2	-	2
4	1	-	2	2	-	3	3	-	-	-	-	2	-	3
5	1	-	2	2	-	3	3	-	-	-	-	2	-	3
1	Reasonably agreed				2	Moderately agreed			3	Strongly agreed				

22EC932	**SENSOR TECHNOLOGY**		3/0/0/3

Nature of Course	:C (Theory Concept)

Course Objectives:

1	Introduce various developments in sensor technology.
2	Familiarize with the basics of optimal system layout, partitioning and device scaling.
3	Know various thick film and thin film techniques used for sensor development.
4	Study the various sensor technologies and robot guidance for the measurement of Force, Pressure, acceleration, vibration, and Torque.

Course Outcomes:
Upon completion of the course, students shall have ability to

C932.1	Study the basics of sensor technology and the various sensors and to understand the basics of optimal system layout, partitioning and device scaling.	[U]
C932.2	Acquaint with various thick and thin film techniques used in sensor development.	[U]
C932.3	To acquire knowledge on microelectromechanical system sensors that is integrated with electronics on a common silicon substrate through microfabrication technology.	[AP]
C932.4	Identify the sensor for acceleration, vibration and shock measurement and Familiarize with the fabrication techniques for packaging of sensors.	[U]
C932.5	Apply an integrated knowledge on the sensors, work with and interpret the data obtained from various sensor applications.	[AN]

Course Contents:

Developments, design and packaging of sensor in sensor technology   15
Semiconductor sensors, smart sensors, micro sensors, fiber optic sensors, chemical sensors, biosensors, TEDs - Partitioning, Layout, technology constraints, scaling, compatibility study.

Thick and thin film technology   15
Thick-film processing-screen printing, Lasering of substrates, curing, low temperature co-fired ceramic processing, wire bonding. Micro machining, IOC (Integrated Optical circuit) fabrication process - Thin film formation and characterization- sol-gel method, chemical vapour deposition, physical vapour deposition, sputtering, plasma/Ion beam deposition, structural and physical properties, Applications- Thin films for microelectronics, MEMS, optical coatings, photodetectors, smart sensors.

Sensor technologies for various applications   15
Introduction – Sensors in Manufacturing – Temperature Sensors in Process Control – Pressure Sensors – Fibre Optic Pressure Sensors – Displacement Sensors for robotic Applications – Process Control Sensors for measuring and monitoring Liquid Flow – Process Control Sensor for acceleration – An Endoscope as Image Transmission sensor – Sensor Network architecture in Manufacturing – Role of Sensors in flexible manufacturing systems – Robot Control through vision sensors – Robot guidance with vision systems – End effector camera sensor for Edge detection, extraction and detecting partially visible objects – Ultrasonic End effectors – Vision recognition sensors – Multisensor – Controlled robot Assembly.

Total Hours:		45

Text Books:

1	Jon S Wilson, Sensor Technology Handbook, 2021, Elsevier Inc., USA.
2	Sabrie Soloman, Sensors Handbook, Tata Mcgraw Hill, 2019.

Reference Books:

1	B C Nakra& K K Choudhry, Instrumentation Measurement and Analysis, 2019, 3rd ed.,Tata McGrawHill, India.
2	Jacob Fraden, Hand Book of Modern Sensors: Physics, Designs and Applications, 2019, Springer, USA.
3	John G Webster, Measurement, Instrumentation and sensor Handbook, 2014, CRC Press, USA.
4	A Stephen, The Science and Engineering of Microelectronic Fabrication, 2011, Second Edition,, Oxford University Press, 198, Madison Avenue, New York.

Web References:

1	https://r2r.tech/blog/web-guiding-fundamentals-sensors
2	https://www.electrochem.org/world-of-sensors/

Online Resources:

1	https://onlinecourses.nptel.ac.in/noc23_ee95/preview
2	https://iisc.talentsprint.com/sensor-technologies-certification-course/mobile/?utm_source=g_search&utm_medium=paid_google&utm_campaign=iisc-st-g_search-performance-lower_funnel&utm_content=iisc-st-g_search-performance-lower_funnel-audience&utm_term=course%20on%20sensors&placement=&matchtype=b&device=c&network=g&gad_source=1&gclid=Cj0KCQjwkdO0BhDxARIsANkNcrclYiG8CUlde6hTu32pPHKl38AdGLZzfou13iRyg6ffDr_b3ygJTOQaArzrEALw_wcB
3	https://www.coursera.org/learn/sensors-circuit-interface

Continuous Assessment			Total Continuous Assessment	End Semester Examination	Total
Formative Assessment	Summative Assessment	Total			
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C932.1	Understand	Quiz	20
C932.2	Understand	Assignment	20
C932.3	Apply	Group Assignment	20
C932.4	Understand		
C932.5	Analyze	Quiz	20

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	20	20	20
Understand	30	30	30
Apply	20	20	20
Analyse	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Course Articulation Matrix														
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	1	-	2	1	-	2	2	-	-	-	-	2	-	2
2	1	-	2	1	-	2	2	-	-	-	-	2	-	2
3	1	-	2	1	-	2	2	-	-	-	-	2	-	2
4	1	-	2	2	-	3	3	-	-	-	-	2	-	3
5	1	-	2	2	-	3	3	-	-	-	-	2	-	3
1	Reasonably agreed			2	Moderately agreed			3	Strongly agreed					

22EC933	MEDICAL ROBOTICS	3/0/0/3
Nature of Course	: C (Theory Concept)	

Course Objectives:	
1	To gain knowledge on the basic concepts of medical robotics.
2	To study the sensor requirements for localization, control and tracking.
3	To Classify the types of assistive robots.
4	To introduce the various applications of robotics in rehabilitation.
5	To understand the design aspects of medical robots

Course Outcomes:

Upon completion of the course, students shall have ability to

C933.1	Understand the basic concepts of robotics.	[U]
C933.2	Identify the type of medical robots and its functionalities.	[U]
C933.3	Understand the image guided intervention techniques.	[U]
C933.4	Define the applications of surgical robotics.	[AP]
C933.5	Explore the purpose of Rehabilitation interface.	[AP]
C933.6	Analyse the design characteristics, methodology and technological choices for medical robots	[AN]

Course Contents:

Introduction to Medical Robotics: **15**

Introduction to medical robotics: applications and paradigms – Role of AI in medical robotics – Potential impact of medical robots, types of medical robots and level of human intervention – growing healthcare challenges, Surgical, Physical therapy, Bionic prosthetics, Care-Giver, Simulators, Pharmacy, Logistics.

Image-Guided Interventions & Surgical Robotics: **15**

Medical imaging modalities (e.g., MRI, US, X-ray, CT) - Robot compatibility with medical imagers – Image segmentation and modelling - Tracking devices - Frames and transformations - Surgical navigation - Medical robots: History, Characteristics of medical robots, Automation and Navigation Challenges – robotics in surgery: Laparoscopic and Endoscopic Manipulators, Oncology robotics, Physically assistive robotics, Socially assistive robotics Calibration Rigid and non-rigid registration – Radiosurgery

Rehabilitation Robotics: **15**

Physiological basis of neuromotor recovery, Framework for neurorehabilitation robotics: implication and recovery, Actuators and sensors and prosthetic robots, Assistive controllers and modalities, Exoskeletons for upper limb and lower limb rehabilitation, Wearable robotic applications for neurorehabilitation **,** Applications in Biomedical Engineering – Bio Engineering Biologically Inspired Robots, Neural Engineering, Application in Rehabilitation – Interactive Therapy, Bionic Arm, Clinical and Surgical – Gynaecology, Orthopaedics, Neurosurgery, Controversies and outcomes

Case Study Contemporary issues	
Total Hours:	**45**

Text Books:	
1	Robert Schilling, Fundamentals of Robotics-Analysis and control, Prentice Hall, 2022
2	Paula Gomes, "Medical robotics- Minimally Invasive surgery", Woodhead, 2022.
3	Roberto Colombo Vittorio Sanguineti, Rehabilitation Robotics, 1st Edition, Imprint: Academic Press Published Date: 10th March 2018, Springer
Reference Books:	
1	R. D. Howe and Y. Matsuoka, "Robotics for surgery," Annual Review of Biomedical Engineering, vol. 1, pp. 211–240, 1999.View at: Google Scholar
2	A. R. Lanfranco, A. E. Castellanos, J. P. Desai, and W. C. Meyers, "Robotic surgery: a current perspective," Annals of Surgery, vol. 239, no. 1, pp. 14–21, 2004.
3	S. Badaan and D. Stoianovici, "Robotic systems: past, present, and future," in Robotics in Genitourinary Surgery, pp. 655–665, Springer, New York, NY, USA, 2011
Web References:	
1	https://www.sciencedirect.com/topics/engineering/medical-robot
2	https://robotnik.eu/applications-of-robotics-in-medicine/
Online Resources:	
1	https://onlinecourses.nptel.ac.in/noc24_me88/
2	https://onlinecourses.nptel.ac.in/noc21_me49

Continuous Assessment				End Semester Examination	Total
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%)** **[80 Marks]**
C933.1	Remember	Quiz	**20**
C933.2	Understand	Assignment	**20**
C933.3, C933.4	Apply	Class Presentation	**20**

C933.5, C933.6	Understand	Case Study	**20**

Assessment based on Summative and End Semester Examination			

Bloom's Level	**Summative Assessment [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	10	10
Understand	30	40	40
Apply	30	40	30
Analyse	20	10	20
Evaluate			
Create			

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks			**CA 2 : 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

Course Articulation Matrix														
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
1	2	2	2	1	-	-	-	-	-	-	-	1	2	1
2	1	1	2	2	-	-	-	-	-	-	-	2	1	2
3	2	2	1	1	-	-	-	-	-	-	-	1	2	1
4	1	1	2	2	-	-	-	-	2	-	-	2	1	2
5	1	1	2	2	-	-	-	-	-	-	-	2	2	2
6	2	1	2	2	-	-	-	-	-	-	-	2	2	2
1	Reasonably agreed		2	Moderately agreed			3	Strongly agreed						

22EC934	SENSOR FOR INDUSTRIAL APPLICATIONS	3/0/0/3
Nature of Course	:C (Theory Concept)	

Course Objectives:	
1	To obtain a broad understanding of wireless sensor networks
2	To study the challenges and design issues in wireless sensor networks
3	To focus on network architectures and energy efficiency
4	To study the concept of Time Synchronization and Localization
5	To focus on Routing Protocols and Operating Systems

Course Outcomes:

Upon completion of the course, students shall have ability to

C934.1	Learn the basics of wireless sensor networks and its applications.	[R]
C934.2	Understand the architecture and elements of wireless sensor networks	[U]
C934.3	Analyze the MAC protocols for wireless sensor networks.	[AN]
C934.4	Apply the concept of Synchronization and Localization for sensor networks	[AP]
C934.5	Understand the various routing protocols of wireless sensor networks	[U]
C934.6	Understand the basics of operating systems needed to establish sensor networks	[U]

Course Contents:

Overview of Wireless Sensor Networks: **15**

Characteristics-Types of Wireless Sensor Networks-Applications. Challenges for Wireless Sensor Networks - Enabling Technologies for Wireless Sensor Networks - Single-Node Architecture**:** Hardware Components - Energy Consumption of Sensor Nodes - Network Architecture: Sensor Network Scenarios - Optimization Goals and Figures of Merit -Design principles for WSNs - Gateway Concepts - Physical Layer and Transceiver design Considerations

Time Synchronization and Localization: **15**

MAC Protocols for Wireless Sensor Networks - S-MAC - Wakeup radio concepts – Introduction to the time synchronization problem - Protocols based on sender/receiver synchronization - Single-hop localization - Positioning in multi-hop environments - Topology-control: Aspects of topology-control algorithms

Routing Protocols and Operating Systems: **15**

Energy-Efficient unicast - Broadcast and multicast - Geographic Routing-Operating Systems for Wireless Sensor Networks: Operating System Design Issue - Examples of Operating Systems: TinyOS, Mate, MagnetOS and OSPM - Application specific support: Target detection and tracking.

Total Hours:	**45**

Text Books:	
1	Holger Karl and Andreas Willig, "Protocols And Architectures for Wireless Sensor Networks", John Wiley, 2022.
2	KazemSohraby, Daniel Minoli and TaiebZnati, "Wireless Sensor Network-Technology, Protocolsand Applications", John Wiley, 2022

Reference Books:

1	Feng Zhao and Leonidas J. Guibas, "Wireless Sensor Networks - An Information Processing Approach", Elsevier, 1st edition, 2016.
2	WaltenegusDargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks – Theory and Practice", John Wiley, 1st edition, 2017.
3	C.S. Raghavendra, Krishna M. Sivalingam, TaiebZnati,"Wireless Sensor Networks", Springer,1st edition, 2010.

Web References:

1	http://profsite.um.ac.ir/~hyaghmae/ACN/WSNbook.pdf
2	http://ijcttjournal.org/Volume4/issue-8/IJCTT-V4I8P194.pdf
3	*profsite.um.ac.ir/~hyaghmae/ACN/WSNbook.pdf*
4	https://pdfs.semanticscholar.org/e552/059d73eef06be26fd0e1a1e4118d4f4e4b20.pdf

Online Resources:

1	https://www.coursera.org/lecture/internet-of-things-history/sensor-networks
2	https://nptel.ac.in/courses/106105160/21
3	https://nptel.ac.in/courses/114106035/37
4	https://www.edx.org/course/computer-networks-internet-kironx-fhlcnx

Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C934.1	Remember	Quiz	**3**
C934.2	Understand	Quiz	**3**
C934.3	Analyse	Assignment	**5**
C934.4	Apply	Assignment	**5**
C934.5	Understand	Class presentation	**2**
C934.6	Remember	Class presentation	**2**

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [50 Marks]
	CIA1[10 Marks]	CIA2[10 Marks]	CIA3 [10 Marks]	
Remember	50	20	30	30
Understand	50	20	30	30
Apply	-	30	20	20
Analyse	-	30	20	20
Evaluate	-	-	-	-
Create	-	-	-	-
		Summative Assessment		Total

Formative Assessment	Continuous Assessment	End Semester Examination	
20	30	50	100

Course Articulation Matrix														
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	2	2	3	-		-	-	-	-	-	-	-	2	-
2	3	3	2	3		-	-	-	-	-	-	-	2	-
3	3	3	3	2	1	-	-	-	2	-	-	-	3	-
4	3	3	3	3		-	-	-	2	-	-	-	2	-
5	3	2	3	2		-	-	-	2	2	-	-	2	-
6	3	3	3	2	1	-	-	-	2	2	-	1	3	1
1	Reasonably agreed			2	Moderately agreed				3	Strongly agreed				

22EC935	BIOMATERIALS AND ITS APPLICATIONS	3/0/0/3
Nature of Course	:C (Theory Concept)	

Course Objectives:	
1	To study the characteristics of Biomaterials and its reaction in the host
2	To understand Biomaterials degradation mechanism
3	To understand different metals and ceramics used as biomaterials
4	To study the different polymeric materials and their clinical application and role in drug delivery
5	To understand the concept of Biomedical application of polymers outside the body

Course Outcomes:
Upon completion of the course, students shall have ability to

C935.1	Understand the properties of biomaterials and biomaterial- tissue reaction.	[U]
C935.2	To understand Biomaterials degradation mechanism	[U]
C935.3	Apply the metals and ceramic materials used for medical applications	[AP]
C935.4	Compare different polymeric materials, their application in biomedical field and its function in drug delivery	[U]
C935.5	Analyse the concept of Biodegradable polymers for medicinal application	[AN]

Course Contents:

INTRODUCTION TO BIO-MATERIALS   **15**
Definition and classification of bio-materials, Characterization of biomaterials: mechanical properties, surface properties, viscoelasticity. Host reactions to biomaterials: Inflammation, Wound Healing and Foreign Body Response, Failure mechanisms: corrosion, fracture, degradation of Implanted materials in the biological environment.

METALLIC AND CERAMIC MATERIALS   **15**
Metallic implants: Stainless steels, co-based alloys, Ti-based alloys, shape memory alloy, applications. Ceramic implant: bioinert, biodegradable or bio resorbable, bioactive ceramics, applications.

POLYMERIC IMPLANT MATERIALS   **15**
Polymerization, Polyethylene, Clinical study of synthetic polymers, Blood compatible polymers, Bioactive polymers, Hydrogels; Drug incorporation polymer gels, Biomedical application of polymers outside the body and temporary in vivo applications. Case Study: Biodegradable polymers for medicinal application

Total Hours:	**45**

Text Books:	
1	Sujata V. Bhatt, "Biomaterials", Narosa Publishing House, 2022.
2	BD Ratner, AS Hoffmann, FJ Schoen, JE Lemmons, "An Introduction to Materials in Medicine" Academic Press, 2021.

Reference Books:	
1	Park J.B, R.S Lakes "Biomaterials an Introduction", Springer, 2017.
2	Joseph D Bronzino, "Biomedical engineering Fundamentals", CRC press, Third Edition, 2016.
3	A.C Anand, J F Kennedy, M.Miraftab, S.Rajendran, "Woodhead Medical Textiles andBiomaterialsfor Healthcare", Publishing Limited 2016.
Web References:	
1	https://iopscience.iop.org/article/10.1088/1757-899X/1116/1/012178/pdf
2	https://www.intechopen.com/online-first/89304
Online Resources:	
1	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8513057/
2	https://nptel.ac.in/courses/102106057
3	https://www.coursera.org/learn/materials-oral-health

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C935.1	Understand	Quiz	20
C935.2	Understand	Assignment	20
C935.3	Apply	Group Assignment	20
C935.4	Understand		
C935.5	Analyze	Quiz	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	20	20	20

Understand	30	30	30
Apply	20	20	20
Analyse	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Course Articulation Matrix													
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	1	-	2	1	-	2	2	-	-	-	-	2	-	2
2	1	-	2	1	-	2	2	-	-	-	-	2	-	2
3	1	-	2	1	-	2	2	-	-	-	-	2	-	2
4	1	-	2	2	-	3	3	-	-	-	-	2	-	3
5	1	-	2	2	-	3	3	-	-	-	-	2	-	3
1	Reasonably agreed		2	Moderately agreed			3		Strongly agreed				

22EC936	ERGONOMICS	3/0/0/3

Nature of Course	:C (Theory Concept)

Course Objectives:

1	To understand the psychology of human behaviour as it relates to workplace safety.
2	To Identify the ergonomic hazards and recommended appropriate controls.
3	To study the human and workplace factors which contribute to ergonomic hazards.
4	To understand the relationship of human behaviour and ergonomics as applied to workplace
5	To understand the concept of evaluating physical workloads and information ergonomics

Course Outcomes:
Upon completion of the course, students shall have ability to

C936.1	Understand the Foundational Ergonomics and Systems of the Body	[U]
C936.2	Identifying the Environmental Factors in Ergonomics	[U]
C936.3	Analyse the Types of Work and Related Musculoskeletal Disorders	[AP]
C936.4	Understand the Energy Consumption during Heavy Work	[U]
C936.5	Analyse the concept of Information Processing and Mental Workload Measurement	[AN]

Course Contents:

INTRODUCTION TO ERGONOMICS   15
Foundational Ergonomics - Systems of the Body: Respiratory System - Skeletal System - Muscular System - Senses of the Human Body and Measurement: Sensory Functions - Environmental Factors in Ergonomics - Visual Factors Light Levels - Noise Level - Thermal Conditions: Temperature and Humidity - Vibration and the Human Body

DESIGN OF WORKPLACES AND HAND TOOLS   15
Workplace Design Analysis - General Principles of Workplace Design - Workplace Evaluation Tools - Types of Work and Related Musculoskeletal Disorders - Stages of WMSD and Principles of Prevention - Task-Related Risk Factors - Screening Methods and Diagnosis of WMSD - Procedure for Workplace Analysis and Design

EVALUATING PHYSICAL WORKLOADS AND INFORMATION ERGONOMICS   15
Heavy Work: Energy Consumption during Heavy Work - Energy Efficiency of Heavy Work - Effects of Heavy Work and Heat **-** Assessment of Workload for Manual Material Handling Tasks - Information Processing: Perception - Human as Information Processor – Serial Models - Parallel Models - Channel Capacity Theory - Mental Workload Measurement

Total Hours:	45
Text Books:	

1	Pamela McCauley Bush, "ERGONOMICS - Foundational Principles, Applications, and Technologies", CRC Press-Taylor & Francis Group, 2022
2	Kroemer, K.H.E., "Fitting the Human: Introduction to Ergonomics", CRC Press, Taylor & Francis Group, 2020
Reference Books:	
1	Benjamin Niebel and Andris Freivalds, "Neibel's Methods, Standards and Work Design", McGraw Hill, 2020
2	Stephen Pheasant, Christine M. Haslegrave, "Bodyspace - Anthropometry, Ergonomics and the Design of Work", CRC Press-Taylor & Francis Group, 2019
3	Patrick W. Jordan, "An Introduction to Usability", CRC Press-Taylor & Francis Group, 2020
Web References:	
1	https://www.physio-pedia.com/Ergonomics
2	https://osha.oregon.gov/OSHAPubs/ergo/ergoadvantages.pdf
Online Resources:	
1	https://nptel.ac.in/courses/107103004
2	https://www.udemy.com/topic/ergonomics/
3	https://www.coursera.org/learn/anthropometry-biomechanics-and-motorskills-in-user-design

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C936.1	Understand	Quiz	20
C936.2	Understand	Assignment	20
C936.3	Apply	Group Assignment	20
C936.4	Understand		
C936.5	Analyze	Quiz	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	30	30	30
Apply	20	20	20
Analyse	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks			**CA 2 : 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

Course Articulation Matrix														
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
1	1	2	-	1	-	2	1	-	-	-	-	1	-	3
2	1	2	-	1	-	2	1	-	-	-	-	1	-	3
3	1	2	-	1	-	2	1	-	-	-	-	1	-	3
4	1	2	-	2	-	3	1	-	-	-	-	1	-	3
5	1	2	-	2	-	3	1	-	-	-	-	1	-	3
1	Reasonably agreed			2	Moderately agreed			3			Strongly agreed			

MANDATORY COURSE

22MC101	INDUCTION PROGRAMME (FOR ALL BRANCHES OF B.E / B.TECH PROGRAMMES)	1/0/0/0

Nature of Course	Induction Programme
Pre requisites	Nil

Course Objectives:

1	To have broad understanding of society and relationships
2	To nurture the character and fulfil one's responsibility as an engineer, a citizenand a human being
3	To incorporate meta skills and values

Course Outcomes:

Upon completion of the course, students shall have ability to

C101.1	Explore academic interest and activities	[AP]
C101.2	Work for excellence	[AP]
C101.3	Promote bonding and give a broader view of life and character	[AP]

Course Contents:

PHYSICAL ACTIVITY: Research over the past years has shown Yoga to have stress-relieving powers on students, paving the way for improved academic performance with the practice of asanas, meditation and breathing exercises. To prove these words Yoga classes has been planned in this module.(CO mapping: C101.1, C101.2, C101.3)

CREATIVE ARTS (students can select any one of their choice): Cultural development supports students to understand, feel comfortable with, value and appreciate the potential enrichment of cultural diversity. They should challenge discrimination, whether based on cultural or racial difference. Students should experience cultural traditions embedded in arts, crafts, language, literature, theatre, song, music, dance, sport, Science, technology and travel. Students should develop an appreciation of beauty both in experiencing artistic expression and by exploring their own creative powers. To inculcate those skills they are given a chance to exhibit their talents through painting, sculpture, pottery, music, dance, craft making and so on. .(CO mapping: C101.1, C101.2, C101.3)

UNIVERSAL HUMAN VALUES: Moral development involves supporting students to make considered choices around their behaviour and the values that provide a framework for how they choose to live. Moral development is also learning about society's values, understanding the reasons for them, how they are derived and change; and how disagreements are resolved. Students must consider the consequences of personal and societal decisions on the wider community – local and global- and on the environment and future generations. To acquire this the students are exposed to training to enhance their soft skills. .(CO mapping: C101.1, C101.2, C101.3)

LITERARY AND PROFICIENCY MODULES: Social development helps students to work effectively together, developing the inter-personal skills required to relate positively with their peers and people of all ages. Students must also understand how to participate productively in a diverse and plural society and learn about, and how to effectively engage with societal institutions and processes. They should understand that a person may have different roles and responsibilities within society. To reach this the following aspects are given in the form of Reading, writing, speaking – debate, role play etc. Communication and computer skills. (CO mapping: C101.1, C101.2, C101.3)

LECTURES BY EMINENT PEOPLE: Teaching with Lectures. ... It is essential to see lectures as a means of helping students learn to think about the key concepts of a particular subject, rather than primarily as a means of transferring knowledge from instructor to student. During the induction period students will attend to Guest lectures by subject experts.(CO mapping: C101.1, C101.2, C101.3)

VISIT TO LOCAL AREAS: Traveling is in fact a way of learning to learn. You are out of your comfort zone and so you must learn to be able to adapt to a new learning environment in a very short time. It also helps in your overall learning as well. In the induction period students will be taken to different places near

college to learn new things. Eg.Meditation centre/orphanage/Hospital.(CO mapping: C101.1, C101.2, C101.3)

FAMILIARIZATION TO DEPARTMENT/BRANCH INNOVATION: Hod's of different branches will present about their department followed by department visit to view various facilities available at their department, new innovations from students and faculties etc. .(CO mapping: C101.1, C101.2, C101.3)

22MC102	ENVIRONMENTAL SCIENCES	1 /0 /0 /0

Nature of Course	:C (Theory Concept)	

Course Objectives:

1	To learn the integrated themes on various natural resources.
2	To gain knowledge on the type of pollution and its control methods.
3	To have an awareness about the current environmental issues and the social problems.

Course Outcomes:

Upon completion of the course, students shall have ability to

C102.1	Recall and play an important role in transferring a healthy environment for future generation.	[R]
C102.2	Understand the importance of natural resources and conservation of biodiversity.	[U]
C102.3	Understand and analyze the impact of engineering solutions in a global and societal context.	[U]
C102.4	Apply the gained knowledge to overcome pollution problems.	[AP]
C102.5	Apply the gained knowledge in various environmental issues and sustainable development.	[AP]

Course Contents:

Module 1: Natural Resources   **10**

Introduction-Forest resources: Use and abuse, case study-Major activities in forest-Water resources-over utilization of water, dams-benefits and problems. Mineral resources-Use and exploitation, environmental effects of mining- case study–Food resources- World food problems, case study. Energy resources -Renewable and non-renewable energy sources Land resources- Soil erosion and desertification — Role of an individual in conservation of natural resources.

Module 2: Environmental Pollutions   **10**

Definition — causes, effects and control measures of: a. Air pollution-Acid rain - Greenhouse effect-Global warming- Ozone layer depletion — case study- Bhopal gas tragedy. Water pollution c. Solid waste management-Recycling of plastics-Pyrolysis method- causes, effects and control measures of municipal solid wastes d. Noise pollution. e. Nuclear hazards-case study-Chernobyl nuclear disaster-Role of an individual in prevention of pollution.

Module 3: Social issues and the Environment   **10**

Sustainable development-water conservation, rain water harvesting, E-Waste Management – Environmental ethics: 12 Principles of green chemistry-Scheme of labelling of environmental friendly products (Eco mark) – Emission standards – ISO 14001 standard. HIV AIDS.

	Total Hours	**30**

Text Books:

1	Anubha Kaushik and C P Kaushik "Perspectives in Environmental Studies" 4th Edition, Newage International (P) Limited, Publisher Reprint 2014. New Delhi
2	Rajagopalan, R, "Environmental Studies-From Crisis to Cure", Oxford University Press 2015.

Reference Books:

1	Tyler Miller, Jr., "Environmental Science", Brooks/Cole a part of Cengage Learning, 2014.
2	William Cunningham and Mary Cunningham, "Environmental Science", 13th Edition, McGraw Hill, 2015.
3	Gilbert M. Masters, "Introduction to Environmental Engineering and Science", Third Edition, Pearson Education, 2014.

Web References:

1	http://nptel.ac.in/courses/104103020/20
2	http://nptel.ac.in/courses/120108002
3	http://nptel.ac.in/courses/122106030
4	http://nptel.ac.in/courses/120108004/

5	http://nptel.ac.in/courses/122102006/20
Online Resources:	
1	https://www.edx.org/course/subject/environmental-studies
2	www.environmentalscience.org

Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:100)

Course Outcome	Bloom's Level	Assessment Component	Marks
C201.1	Remember	Quiz	10
C201.2	Understand	Case study based on environmental aspect	20
C201.3	Understand	Class presentation	10
C201.4 & C201.5	Apply	Assignment	10

Summative assessment based on Continuous Assessment			
	Continuous Assessment		
Bloom's Level	**CIA-I [0 marks]**	**CIA-II [0 marks]**	**Term End Assessment [50 marks]**
Remember	-	-	30
Understand	-	-	40
Apply	-	-	30
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-

22MC103	SOFT SKILLS	1/0/0/0
Nature of Course	Theory Concept	

Course Objectives:

1.	To develop the students competency level and their capabilities.
2.	To teach the students to be effective in workplace and social environments.
3.	To create self confidence among the students and to resolve stress and conflict within themselves.
4.	To help the students to enhance their career skills by increasing their productivity and performances.
5.	To concentrate more on conversation skills, presentation skills, verbal ability, critical and creative thinking.

Course Outcomes:
Upon completion of the course, students shall have ability to

C103.1	Remember the principles of soft skills required for their profession.	[R]
C103.2	Understand the importance of Interpersonal communication Skills among individuals, groups and cultures.	[U]
C103.3	Apply verbal and non-verbal communication skills in corporate environment.	[AP]
C103.4	Analyze and apply creativity skills, critical thinking skills and problem solving skills.	[A]
C103.5	Articulate oral and written messages in an appropriate and persuasive manner to suit specific purposes, audiences and contexts at work place.	[AP]
C103.6	Apply good teamwork skills and Leadership Skills	[AP]

Course Contents:

Module 1: Professional Communication Skills   **10**
Introduction to the Soft Skills, Performance Evaluation 1 –Significance of Soft Skills- Understanding the basic Communication Principles –Listening Skills- Listening Exercises- Speaking Skills- How to start and Sustain a Conversation- Speaking in Groups- Understanding self and Personal Branding, attitude, types of attitude, Positive Attitude, Self Confidence and Self-Motivation - Personal Application/Action Taken.
Advanced Writing Skills-Principles of Business Writing- E mails- Writing Reports- Types of Reports- Strategies for Report Writing- Personal Application/Action Taken.
Verbal Ability- Analogy- Classification- Odd One Out- Idioms and Phrases- Sentence Correction- Empathy and its importance in career -Personal Application/Action Taken.

Module 2: Interpersonal Communication   **10**
Nonverbal Communication- Individual, Groups and Cultures- Body Language- Attire and Etiquettes- Interpersonal Skills- dealing with diverse People- Networking- Emotional Intelligence and its importance. Personal Application/Action Taken. Developing Creativity- Critical Thinking and Problem Solving Skills- Making the Right Choice- Never Give Up- Begin to Grow- Personal Application/Action Taken.
Interviews- Facing Job Interviews - Planning and Preparing- Effective Resume along with Covering Letter- Planning and Preparing- Personal Application/Action Taken.
Self-Discipline - Self Presentation - Personal Application/Action Taken.

Module 3: Teamwork and Leadership Skills   **10**
Industry Expectations- Universal Hiring Rule- Personal Application/Action Taken.
Importance of Human Values-Importance of Team Work- Developing Key Traits in Motivation, Persuasion, Negotiation and Leadership Skills- Being an Effective Team Player- Personal Application/Action Taken.
Planning- Prioritization – Delegation - Conflict Management - Decision and its necessity in crucial situations- Group Discussion - Personal Application/Action Taken. Essential Skills in working Strategies- Presentation and Interaction Skills- What to Present and How- Being Assertive- Multimedia Presentation-Making Effective Presentations. Interview Skills - Do's and Don'ts - Body Language - Answering the Common Questions of Interview- Performance Evaluation 2 - Mock Interview

		Total Hours	**30**

Text Books:		
1.	Business Communication for managers: An advanced approach, by Penrose, Cengage learning.
2.	Professional Communication in Engineering. by H.E. Sales. Palgrave Macmillan 2009.
3.	Communication for professional engineers by W. P. Scott, Bertil Billing. Thomas Telford, 1998.
Reference Books:	
1.	Reason and professional ethics by Peter Davson-Galle. Ashgate Publishing, Ltd., 2009.
2.	Cross Cultural and Inter Cultural Communication. by William B. Gudykunst. Sage Publications India Pvt Ltd, New Delhi.2003.
3.	Corporate Communications: Theory and Practice. ByJoepCornelissen. Sage Publications India Pvt Ltd, New Delhi.2004.
Web References:	
1	https://onlinecourses.nptel.ac.in/noc16_hs15/preview
2	https://www.getinternship.switchidea.com/NTAT/syllabus/Interpersonal-Communication.
3	https://smude.edu.in/smude/programs/bca/soft-skills.html
Online Resources:	
1	https://swayam.gov.in/course/4047-developing-soft-skills-and-personality
2	https://www.clearias.com/interpersonal-skills-including-communication-skills-for-csat/
3	https://www.bizlibrary.com/soft-skills-training/

Assessment Methods & Levels (based on Revised Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:100)

Course Outcome	Revised Bloom's Level	Assessment Component	Marks
C103.1	Remember	Group Discussion	30
C103.2 & C103.3	Understand	Listening Skills	20
C103.4	Apply	Interview	20
C103.5 & C103.6	Apply	Formal Presentation	30

22MC104		MANAGEMENT ORGANIZATIONAL BEHAVIOUR	1/0/0/0
Nature of Course		Theory Concept	
Course Objectives:			
	1.	The objective of the course is to provide basic knowledge about management tofamiliarize the students with the management principles and organizational behavior.	
	2.	The course is designed to enable the students to adapt & apply theoreticalconcepts in business	
	3.	To know about the role of manager in the area of management.	
	4.	To create and implement team building strategies for organization building.	
Course Outcomes:			
Upon completion of the course, students shall have ability to			
C104.1	Identify and understand different management principles techniques in business environment.		[U]
C104.2	Apply management fundamentals and planning to solve organization problems and make effective decisions.		[AP]
C104.3	Understand and analyze the changes within an individual will changethe group as well as the organization		[AN]
C104.4	Understand and analyze the leadership style and organization theoriesto create a productive environment to workforce.		[AN]
C104.5	Analyze the organizational climate and change management strategiesand tactics		[AN]
C104.6	Apply the empowerment strategy and tactics for productivity		[AP]
Course Contents:			

Module 1: Fundamentals of Management, Planning and Decision Making 10

Introduction to Management- Concept and functions- Thought Managerial roles and styles- Principles of Management - Levels of Management- Theories of Management - Classical, Scientific, Administrative, Behavioral, Management Sciences Theories. Organizational planning - Vision, Mission and goals, Types of plans, steps in planning process, Approaches to planning,Planning in Dynamic Environment. Decision making process, types of decisions, decision making styles, Behavioural influences on decision making - Group decision making - Vroom's Participative decision-making model.

Module 2: Individual, interpersonal and group behavior 10

Definition, need and importance of Organizational behavior –Learning-Nature -Importance of Learning- Introduction and theories Motivation: Content and process theories-Leadership: Styles and Theories - Perception-Personality — Attitudes- Definition, need and importance - Nature and scope-Importance of Groups and Teams- Role relationships and conflict-Group dynamics- Work values. Organization Theories: Maslow's needs hierarchy theory, two factor theory of motivation, McGregor's theory, ERG theory, McClelland's needs theory, Valance Theory.

Module 3: Organizational Development 10

Organizational culture: Elements - Organizational climate– Factors affecting organizational climate- Organizational Commitment, Organizational change- Importance- Stability Vs Change- Proactive Vs Reaction change- Change process– Resistance to change- Managing changes- Managing International Workforce - Productivity- Alternative change management approaches and cultural contingencies - power to manage effectively; Empowerment and Participation strategies and tactics.

	Total Hours:	**30 Hrs**
Text Books:		
1.	Nelson, Quick, Khandelwal, "Organizational Behavior", 2nd edition, Cengage Learning,2016.	
2.	Williams, Tripathy, "Principles of Management", Cengage Learning, 2016.	
3.	Aswathappa, K, "Organizational Behavior", 12th Edition, Himalaya Publication, 2016.	
4.	Stephen Robbins, Timothy A. Judge, "Organizational Behavior", 16th edition, PrenticeHall India Pvt. Ltd, 2014.	

	Reference Books:	
1.	Chandrani Singh, Aditi Khatri, "Principles and Practices of Management andOrganizational Behavior", Sage Publications, 2016.	
2.	Richard L. Daft, "Understanding the Theory and Design of Organizations", 11th edition, Cengage Learning, 2013.	
3.	John M Ivancevich and Robert Konopaske, "Organizational Behavior and Management", McGraw-Hill Education, 2013.	
4.	UdaiPareek, Sushama Khanna, "Organization Behavior", 3rd edition, Oxford Publishing, 2012.	

	Web References:
1.	https://iedunote.com/fundamental-concepts-of-organizational-behavior
2.	https://nscpolteksby.ac.id/ebook/
3.	https://ebooks.lpude.in/management/mba/term_1/DMGT402_MANAGEMENT PRACTICES_AND_ORGANIZATIONAL_BEHAVIOUR.pdf
4.	https://www.studocu.com/in/document/vellore-institute-of-technology/organizational-behaviour/lecture-notes/ob-notes/3208134/view

	Online Resources:
1.	https://nptel.ac.in/syllabus/110105034/
2.	https://nptel.ac.in/courses/110/105/110105033/
3.	https://freevideolectures.com/course/3502/organizational-behaviour-i
4.	https://nptel.ac.in/courses/110/106/110106145/

Tentative Assessment Methods & Levels (based on Revised Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:100)

Course Outcome	Revised Bloom's Level	Assessment Component	Marks
C104.1	Understand	Quiz	30
C104.2 C104.6	Apply	Listening Skills	20
C104.3	Analyze	Group Discussion	20
C104.4 C104.5	Apply	Formal Presentation	30

22MC105		GENERAL APTITUDE	1 /0 /0 /0
Nature of Course		Theory Concept	
Pre requisites		NIL	

Course Objectives:

1	To improve the verbal ability.
2	To improve the mathematical skills.
3	To develop problem solving skills.
4	To equip them to face interview & Group Discussion.
5	To inculcate critical thinking process.

Course Outcomes:

Upon completion of the course, students shall have ability to

C105.1	To teach the basics of Quantitative Techniques in a graded manner	[R]
C105.2	Understand the verbal and non-verbal nature of problems in reality and now the shortcut methods of solving it.	[U]
C105.3	Solve problems using their general mental ability	[AP]
C105.4	To give intense focus on improving and increasing the ability of solving real problems	[AP]
C105.5	Think critically about mathematical models for relating different quantities to reach conclusion	[AP]
C105.6	Enable effective use of data interpretation, formulas, graphs and assumptions	[AP]

Course Contents:

Module 1: Number Theory and Statistics	**14**

Number Systems– HCF and LCM of Numbers – Decimal Fractions – Simplification – Square Root and Cube Root of a number – Surds and Indices – Problems on numbers – Percentage– Ratio and Proportion – Divisibility – Mixtures – Averages- Polynomials – Solving Equations and Inequalities – Discard's rule of signs – Problems on ages – Chain rule – Time and Work –Time and Distance – Problems on Trains – Problems on Boats and Streams- Measures of central tendency – Mean, Median and Mode – Variance and Standard deviation Logarithms – Profit and Loss – Simple Interest – Compound Interest.

Module 2: Logic and Decision Making	**8**

Analogy – Classification – Series completion – Coding and Decoding – Blood Relations –Puzzle Test – Direction Sense test – Logical Venn Diagrams - Number Ranking and Time Sequence Test – Decision Making – Assertion and Reason– Inserting the missing one –Logical Sequence of words – Syllogisms.

Module 3: Reasoning	**8**

Logic – Statement and Arguments – Statements and Assumptions – Statements and Course of Action – Statements and Conclusions – Deriving conclusions from passages – Functions –Different kinds of functions – Miscellaneous sets- Series – Analogy – Classifications –Analytical Reasoning – Problems on Cubes and Dice – Mirror Images – Water Images – Rule Detection.

	Total Hours:	**30**

Text Books:

1	Aggarwal R. S. "Quantitative Aptitude" Revised Edition, S. Chand Publication.
2	Abhijit Guha "Quantitative Aptitude" 5th Edition, McGraw Hill Education.

Reference Books:

1	Edgar Thorpe "Mental Ability & Quantitative Aptitude" 3rd Edition, McGraw HillEducation.

Web References:

1	https://www.wiziq.com/tutorial/815468-quantitative-aptitude-reasoning-data- interpretation-video-lectures
2	https://learningpundits.com/contest?referrer=harsh.cse15@nituk.ac.in
3	https://nptel.ac.in/courses/114106041/8
4	https://nptel.ac.in/courses/111103020/2

Online Resources:

1	http://aptitudetraining.in/home/index.php
2	https://www.udemy.com/vedicmaths/

3	https://www.youtube.com/channel/UCtmn-DsF4BhPug- ff9LiDAA?disable_polymer=true

Reference Books:

1	R.S. Aggarwal,"Quantitative Aptitude", S.Chand Publishers
2	R.S. Aggarwal,"A Modern Approach to Verbal & Non-verbal reasoning", S.ChandPublishers
3	Face Aptipedia - Aptitude Encyclopedia - Wiley
4	Dinesh Khattar, "The pearson guide to Quantitative Aptitude for Competitive examinations, Pearson Education

Web References:

1	https://www.geeksforgeeks.org/placements-gq/
2	https://www.indiabix.com/aptitude/questions-and-answers/

Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:100)

Course Outcome	Bloom's Level	Assessment Component	Marks
C105.1	Remember	Quiz	30
C105.2 & C105.3	Understand	Formal presentation	20
C105.4, C105.5 & C105.6	Apply	Formal interview tests	50

22MC106		**LIFE SKILLS AND ETHICS**	1 /0 /0 /0
Nature of Course		Theory Concept	
Pre requisites		NIL	

Course Objectives:

1	To develop communication competence in prospective engineers.
2	To enable them to convey thoughts and ideas with clarity and focus.
3	To develop report writing skills.
4	To equip them to face interview & Group Discussion.
5	To inculcate critical thinking process.
6	To prepare them on problem solving skills.
7	To provide symbolic, verbal, and graphical interpretations of statements in a problem description.

Course Outcomes:

Upon completion of the course, students shall have ability to

C106.1	Define and Identify different life skills required in personal and professionallife.	[U]
C106.2	Develop an awareness of the self and apply well-defined techniques to cope with emotions and stress.	[AP]
C106.3	Explain the basic mechanics of effective communication and demonstratethese through presentations.	[AN]
C106.4	Use appropriate thinking and problem solving techniques to solve new problems.	[AP]
C106.5	Understand the basics of teamwork and leadership	[U]

Course Contents:

Module 1   **10**
Communication Skill: Introduction to Communication, The Process of Communication, Barriers to Communication, Listening Skills, Writing Skills, Technical Writing, Letter Writing, Job Application, Report Writing, Non-verbal Communication and Body Language, Interview Skills, Group Discussion, Presentation Skills, Technology-based Communication.

Module 2   **10**
Critical Thinking & Problem Solving: Creativity, Lateral thinking, Critical thinking, Multiple Intelligence, Problem Solving, Six thinking hats Mind Mapping & Analytical Thinking. Teamwork: Groups, Teams, Group Vs Teams, Team formation process, Stages of Group, Group Dynamics, Managing Team Performance & Team Conflicts.

Module 3   **10**
Ethics, Moral & Professional Values: Human Values, Civic Rights, Engineering Ethics, Engineering as Social Experimentation, Environmental Ethics, Global Issues, Code of Ethics like ASME, ASCE, IEEE. **Leadership Skills:** Leadership, Levels of Leadership, Making of a leader, Types of leadership, Transactions Vs Transformational Leadership, VUCA Leaders, DART Leadership, Leadership Grid & leadership Formulation

	Total Hours	**30**

Reference Books:

1	Barun K. Mitra; (2011), "Personality Development & Soft Skills", First Edition; OxfordPublishers.
2	Kalyana; (2015) "Soft Skill for Managers"; First Edition; Wiley Publishing Ltd.
3	Larry James (2016); "The First Book of Life Skills"; First Edition; Embassy Books.
4	ShaliniVerma (2014); "Development of Life Skills and Professional Practice"; FirstEdition; Sultan Chand (G/L) & Company
5	John C. Maxwell (2014); "The 5 Levels of Leadership", Centre Street, A division ofHachette Book Group Inc

Web References:

1	https://www.coursera.org/courses?query=ethics

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:100)			
Course Outcome	Bloom's Level	Assessment Component	Marks
C106.1	Remember	Quiz	20
C106.2	Understand	Assignment	20
C106.3	Understand	Presentation	30
C106.4 C106.5	Apply	Group Discussion	30

22MC107	STRESS MANAGEMENT	1 /0 /0 /0
Nature of Course	Theory Concept	
Pre requisites	NIL	

Course Objectives:		
1	Understand the basic principles of stress management	
2	Recognize your stress triggers and how to manage them	
3	Develop proactive responses to stressful situations	
4	Use coping tips for managing stress both on and off the job	
5	Learn to manage stress through diet, sleep and other lifestyle factors	
6	Develop a long term action plan to minimize and better manage stress	
7	Understand the basic principles of stress management	

Course Outcomes:
Upon completion of the course, students shall have ability to

C107.1	Understand the basic principles of stress management	[U]
C107.2	Apply the concept of recognizing your stress triggers and find was tomanage them.	[AP]
C107.3	Develop proactive responses to stressful situations	[AN]
C107.4	Develop a long term action plan to minimize and better manage stress	[AP]

Course Contents:

Module 1   **10**
Scientific Foundations of Stress: What is stress? – Sources of Stress – Types of Stress – Personality Factors and stress – Stress and the college student. Stress Psychophysiology: Stress and nervous system – Hypothalamic – Pituitary – Adrenal (HPA) Axis – Effect of Stress on Immune system – Health risk associated with chronic stress – Stress and Major Psychiatric disorders.

Module 2   **10**
Developing Resilience to Stress: Understanding you stress level – Role of personality pattern, Self-esteem, Locus of control – Role of Thoughts Beliefs and Emotions – I & II – Life situation Intrapersonal: (Assertiveness, Time Management).

Module 3   **10**
Strategies for Relieving Stress: Developing cognitive coping skills – Autogenic training, imagery and progressive relaxation – Other relaxation techniques – Exercise and Health – DIY strategies stress management.

	Total Hours	**30**

Reference Books:	
1	Jonathan C. Smith; (2011), "Stress Management: A Comprehensive Handbook of Techniques and Strategies", First Edition; Springer Publishing Company.
2	Bob Stahl, Elisha Goldstein, Jon Kabat-Zinn (2019); "A mindfulness–based stress reduction workbook"; Second Edition; New Harbinger Publications.
3	Ryan M. Niemiec (2019), " The Strengths-based workbook for stress relief", First edition, New Harbinger Publications.

Web References:	
1	https://thiswayup.org.au/courses/coping-with-stress-course/
2	https://www.classcentral.com/course/swayam-stress-management-14309

Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:100)

Course Outcome	Bloom's Level	Assessment Component	Marks
C107.1	Remember	Quiz	**20**
C107.2	Apply	Group Discussion	**30**
C107.3	Apply	Class Presentation	**30**
C107.4	Understand	Assignment	**20**

22MC108	CONSTITUTION OF INDIA	1/0/0/0

Nature of Course	Theory
Pre Requisites	NIL

Course Objectives:

1	To familiarize with basic information about Indian constitution
2	To understand the fundamental rights and duties as citizens of India

Course Outcomes:
Upon completion of the course, students shall have ability to

C108.1	Explain the objectives of the Constitution of India and its formation	[U]
C108.2	Recall state and central policies (Union and State Executive), fundamentalRights and their duties.	[R]
C108.3	Make use of legal directions in developing solutions to societal issues	[AP]
C108.4	Utilized for competitive exams that requires knowledge of Indian Constitution	[AP]

Course Contents:

Module 1   **10**
Historical perspective, The making of the Constitution, The Role of the Constituent Assembly - Preamble and Salient features of the Constitution of India. Fundamental Rights, Directive Principles of State Policy, Fundamental Duties, Citizenship Article 5-11.

Module 2   **10**
Federal structure, Powers of the Union and the states, Centre-State Relations, Union Executive - President, Prime Minister, Union Cabinet, Parliament, Supreme Court of India, State Executives - Governor, Chief Minister, State Cabinet, State Legislature, High Court and Subordinate Courts, Elections, Electoral Process, and Election Commission of India, Election Laws. Powers and Functions of Municipalities and Panchayat

Module 3   **10**
Amendments - Methods, Emergency Provisions, National Emergency, President Rule, Financial Emergency, Provisions for SC & ST, OBC, women, children and backward classes, Right to Property, Freedom of Trade and Commerce. Agricultural Law

	Total Hours:	**30**

Text Books:

1	Dr.D.D.Basu, "Introduction to the Constitution of India", LexisNexis, New Delhi, 22ndEdition, 2016.
2	"Bare act-constitution of India", The universal Publications, LexisNexis 2020, New Delhi,India.

Reference Books:

1	Subhash.C.Kashyap, "Our Constitution: An Introduction to India's Constitution and Constitutional Law", National Book Trust, India, 5th edition, 2019.
2	M. Laxmikanth, "Constitution of India", Cengage Learning India. 1st edition 2018.

Web References:

1	https://unacademy.com/course/the-indian-constitution/NSKQ8XXQ
2	https://unacademy.com/goal/upsc-civil-services-examination-ias-preparation/KSCGY

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:100)

Course Outcome	Bloom'sLevel	Assessment Component	Marks
C108.1	Remember	Test	**20**
C108.4	Understand	Quiz	**40**
C108.3	Apply	Presentation	**20**
C108.2	Apply	Group Assignment	**20**

22MC109		**ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE**	**1/0/0/0**
Nature of Course	Theory Concept		
Pre Requisites	NIL		

Course Objectives:

1	To make understand the contribution of Indian mind in various fields.
2	To cultivate critical appreciation of the thought content and provide insightsrelevant for promoting cognitive ability, health, good governance, aesthetic appreciation and right values.

Course Outcomes:

Upon completion of the course, students shall have ability to

C109.1	Relate classical Indian traditions with contemporary traditions and culture.	[R]
C109.2	Outline the thoughts of Indians in different disciplines.	[U]
C109.3	Apply the knowledge to the present context.	[AP]
C109.4	Develop a better appreciation and understanding of Indian traditions.	[C]

Course Contents:

Module 1   **10**

Indian Ethics: Individual and Social – Society state and Polity (Survey) - Education systems – Agriculture (Survey) – Early & Classical Architecture – Medieval & Colonial Architecture.

Module 2   **10**

Astronomy in India — Martial Arts Traditions (Survey) - Indian Literatures - Indian Philosophical Systems - Indian Traditional Knowledge on Environmental Conservation

Module 3   **10**

Ayurveda for Life, Health and Well-being - The Historical Evolution of Medical Tradition inAncient India- Music in India - Classical & Folk

	Total hours	**30**

Text Books:

1	Kapil Kapoor and Michel Danino, Textbook of "Knowledge Traditions and Practicesof India", Central Board of Secondary Education, 2017.
2	Yogesh Atal, "Indian Society: Continuity and Change", Pearson EducationIndia, 2016.

Reference Books:

1	Douglas Osto, "An Indian Tantric Tradition and Its Modern Global Revival", Routledge publications, 2020.
2	Rao C.N. Shankar, "Sociology: Principles of Sociology with an Introduction toSocial Thoughts", S Chand Publisher, 2019.

Web References:

1	http://nopr.niscair.res.in/handle/123456789/43
2	https://nptel.ac.in/courses/109/104/109104102/

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:100)

Course Outcome	Bloom's Level	Assessment Component	Marks
C109.1	Remember	Quiz	**20**
C109.2	Understand	Group Assignment	**20**
C109.3	Apply	Presentation	**20**
C109.4	Create	Survey	**40**

VALUE ADDED COURSE

22VA401	ANTENNA DESIGN USING ANSYS HFSS TOOL FLOW	1/0/0/1

Nature of Course	:G (Theory & Analytical)

Course Objectives:

1	To learn fundamental concepts of computational electromagnetics
2	To understand the principle of operation of radio frequency devices
3	Togainknowledge on antenna radiation characteristics
4	To study about different types of antenna design using HFSS
5	To understand the concepts of wireless communication systems
6	To exposethe RF technologies used in various applications

Course Outcomes:

Upon completion of the course, students shall have ability to

C401.1	Understand the fundamental computational electromagnetic concepts.
C401.2	Understand the basic mathematical tools required for analysing RF Systems
C401.3	Understand the Antenna Radiation Parameters and Characteristics
C401.4	Able to design special antennas and analyze their Performance
C401.5	Able to comprehend system level parameters in RF Systems
C401.6	Able to apply RF system design concepts for Wireless Technologies

Course Contents:

Introduction to Computational Electromagnetics & HFSS- Design–Simulation and Characterization of a Horn fed Reflector Antenna –Introduction to Antenna Array, Designer RF-HFSS Dynamic linking –Meta Materials concepts and applications-Radar Cross Section analysis using HFSS.

	Total Hours:	15

Reference Books:

1	Anders Bondeson, Thomas Rylander,ParIngelstrom, "Computational Electromagnetics", Springer, 2005.
2	Ecole Polytechnique De Montŕ Eal, Tatsuo Itoh, "ElectromagneticMetamaterials: Transmission Line Theory andMicrowaveApplications -The Engineering Approach",A John Wiley & Sons, 2006.
3	David B Davidson, "Computational Electromagnetics for RF and Microwave Engineering", CAMBRIDGE University press,2005

Web References:

1	https://www.ansys.com/training-center/course-catalog/electromagnetics/ansys-hfss-for-antenna-design
2	https://www.udemy.com/course/basic-microstrip-antenna-design-using-hfss-software/
3	https://www.cadfem.net/in/en/shop/professional-development/training-elearning/introduction-to-hf-simulation-with-ansys-hfss-12173.html

22VA402		**MASTERING IN MATLAB - MATH AND OPTIMIZATION**	**1/0/0/1**
Nature of Course		:Theory& Analytical	

Course Objectives:

1	To Provide a working introduction to MATLAB
2	Learn fundamental computer programming concepts such as variables, control structures, functions and many others.
3	Study about various data types and how to handle them in MATLAB.
4	Gain knowledge on basic MATLAB commands.
5	Understand the fundamental Simulink techniques
6	Formulate and define the environmental problems in a realizable manner.

Course Outcomes:
Upon completion of the course, students shall have ability to

C402.1	Understand the fundamental programming concepts.
C402.2	Break a complex problem into smaller as well as simpler.
C402.3	Discuss the various data types and scripts.
C402.4	Implement programming loops and conditional statements to science and engineering applications
C402.5	Apply fundamental Simulink techniques for real-life systems through modelling.
C402.6	Investigate and solve optimization problems.

Course Contents:

The MATLAB Environment, Matrices and Operators, Functions, Selection, Loops, Data Types, MATLAB Scripts, Programmings Loops & Conditional Statements, User Defined Functions, Simulink, Simulink Features, Example Simulink Projects, numerical optimization, key aspects of the optimization workflow, add basic constraints to your optimization problem.

		Total Hours:	**15**

Reference Books:

1	Amos Gilat, "Matlab, An Introduction With Applications",Wiley 2012.
2	William Palm, "MATLAB for Engineering Applications", McGraw Hill Education, 2019.

Web References:

1	https://www.coursera.org/learn/matlab#about
2	https://matlabacademy.mathworks.com/details/optimization-onramp/optim
3	https://www.udemy.com/course/learn-matlab-and-simulink-programming/

22VA403	THE AGRICULTURE INDUSTRY IN INDUSTRY 4.0	1/0/0/1

Nature of Course	:G (Theory & Analytical)

Course Objectives:

1	Introduce the basics of Agricultural Industry
2	Impart the challenges and opportunities of Agriculture Industry
3	Gain knowledge on Industry 4.0
4	Knowledge on Cyber Physical system and limitations
5	Imparting the knowledge on barriers and drives of implementing Industry 4.0.

Course Outcomes:

Upon completion of the course, students shall have ability to

C403.1	Understand the basics Agricultural Industry.
C403.2	Analyzing various challenges and opportunities of Agricultural Industry
C403.3	Understanding the concept of Industry 4.0.
C403.4	Understand Cyber Physical Systems with its limitations
C403.5	Analyze the barriers of implementing Industry 4.0

Course Contents:

Agriculture – Industry 4.0

Understand the Agriculture Industry and its role in Society, Challenges of the Agriculture Industry , Opportunities for Innovation in the Agriculture Industry, Industry 4.0 and the Industry 4.0 Environment, Cyber Physical Systems (CPS) and its benefits and drawbacks of CPS, Impact of Industry 4.0 on the Agriculture Industry, Barriers for Implementing Industry 4.0, Drivers of Implementing Industry 4.0.

	Total Hours:	**15**

Reference Books:

1	Alasdair Gilchrist , "Industry 4.0: The Industrial Internet of Things" Apress, 2017.
2	Stella Despoudi, Konstantina Spanaki, Oscar Rodriguez-Espindola and Efpraxia D. Zamani, "Agricultural Supply Chains and Industry 4.0" : Technological Advance for Sustainability Springer , 2021.
3	Vítor João Pereira DominguesMartinho, "Trends of the Agricultural Sector in Era 4.0" Springer Cham,2022

Web References:

1	https://www.newfoodmagazine.com/article/162994/food-industry-automation-a-silver-lining-of-the-pandemic/
2	https://new.siemens.com/in/en/company/topic-areas/digital-enterprise.html?gclid=CjwKCAjwuYWSBhByEiwAKd_n_i5lwcG_Xsq_hys_f3G0cb6I-jVjuY4WQHE7Jh_oFjMO2063y_vgfxoC5joQAvD_BwE
3	https://prepr.org/resource-hub/webinar/ifc-workshop/manufacturing-request/?gclid=CjwKCAjwuYWSBhByEiwAKd_n_m3jXktk_Yf0VEn6ju5jcYpccR6-UGGaGeHJMX0pLnZ4SciHbWZo9hoCiMcQAvD_BwE
4	https://ati.ec.europa.eu/sites/default/files/202007/Industry%204.0%20in%20Agriculture%20-%20Focus%20on%20IoT%20aspects%20%28v1%29.pdf

22VA404	CONNECTING TECHNOLOGIES WITH REAL WORLD	1/0/0/1

Nature of Course	:Theory

Course Objectives:

1	Introduce the basics of connectivity technologies
2	Familiarize the basics of modern technologies for realistic applications
3	Gain knowledge of various sensors interface
4	Impart knowledge on different user interface assistant devices
5	Introduce concepts on behavioural analysis of connecting technologies

Course Outcomes:

Upon completion of the course, students shall have ability to

C404.1	Understand the basics of connectivity Technologies
C404.2	Analyze the various connectivity technologies in the real world
C404.3	Analyze the different sensors suitable for real time applications.
C404.4	Design the real time system which connect the modern connecting technology
C404.5	Construction of IoT based design which is realistic and feasible for application
C404.6	Analyzing the various user interface assistant devices for realtime applications

Course Contents:

Introduction to connectivity technologies-6LoWPAN-wireless HART-Z-wave –Mobile sensor Networks-UAV Networks, connectivity of different sensors- behavioural analysis of connecting technologies- user interface assistant devices. Connectivity of sensors modules with IoT

	Total Hours:	15

Reference Books:

1	Zach Shelby andCarsten Bormann, "6LoWPAN: The Wireless Embedded Internet", Publisher: John Wiley & Sons, 1st edition,2019.
2	Feng Zhao and Leonidas J. Guibas, "Wireless Sensor Networks - An Information Processing Approach", Elsevier, 2nd edition, 2018.
3	Holger Karl and Andreas Willig, "Protocols And Architectures for Wireless Sensor Networks", John Wiley, 3rd edition, 2019.

Web References:

1	https://onlinecourses.nptel.ac.in/noc22_ee50
2	https://alison.com/course/introduction-to-connectivity-technologies-and-sensornetworks
3	www.ist.hokudai.ac.jp/eng/divisions/mednet/

22VA405	**ARDUINO PROGRAMMING MODEL**	**1/0/0/1**

Nature of Course	Theory & Practical

Course Objectives:

1	Introduce the hardware of Arduino board and the development of software in Integrated Development Environment
2	Familiarize with Arduino Coding
3	Gain knowledge on Arduino shields and libraries
4	To learn the interfacing of Arduino with Input/Output devices
5	Introduce concepts of real time interfacing using Arduino

Course Outcomes:

Upon completion of the course, students shall have ability to

C405.1	Understand various hardware features of the Arduino UNO board
C405.2	Understand various features of Integrated Development Environment (IDE) software used for the development of software
C405.3	Understand how to download and use the Arduino IDE for the development of software
C405.4	Understand the structure and functions of the Arduino program
C405.5	Demonstrate the interfacing and programming of Temperature Sensor (LM35), Humidity and Temperature Sensor (DHT11), Light Dependent Register, Touch Sensor, Optical Sensor with Arduino UNO board
C405.6	Demonstrate the interfacing and programming of Switch, Keypad Matrix, and Potentiometer with Arduino UNO board.

Course Contents:

Introduction to Arduino platform board, IDE, Sheilds and libraries, Arduino sketches, sketch structure, basic program flow and control, analog and digital, basic serial communication, variables and memory and inputs, outputs. Integration of sensors and actuators, memory with Arduino.

	Total Hours:	**15**

Reference Books:

1	Simon Monk, "Programming Arduino: Getting started with sketches", Publisher: Mcgrawhill , 2nd edition, 2016.
2	Brain Evans, " Beginning Programming Arduino" Publisher: Technologyin action , 2nd edition, 2012
3	Ryan Turner, "Arduino Programming " Publisher: KDS print, 1nd edition, 2019

Web References:

1	https://www.halvorsen.blog/documents/technology/resources/resources/Arduino/Programming%20with%20Arduino.pdf
2	https://bastiaanvanhengel.files.wordpress.com/2016/06/arduino_projects_book.pdf
3	https://www.coursera.org/learn/interface-with-arduino
4	https://www.tutorialspoint.com/arduino/arduino_tutorial.pdf

22VA406		**PCB DESIGN FOR ELECTRONIC CIRCUITS**	**1/0/0/1**
Nature of Course:		~~G~~(Theory + Practical)	
Course Objectives:			
1		Introduce the basics of PCB design	
2		Impart the knowledge on types of PCB packages	
3		Gain knowledge on tool usage	
4		Familiarize the rules for PCB design	
5		Gain the skills of designing PCB through CAD packages and documentation.	

Course Outcomes:

Upon completion of the course, students shall have ability to

C406.1	Acquire the basic level knowledge.
C406.2	Understand the packages of Electronic components.
C406.3	Know the types of PCBs.
C406.4	Understand different tool usage.
C406.5	Understand the rules before PCB Designing.
C406.6	Understandthe flow of computer aided design packages and will Acquire the importance of manufacturing documents.

Course Contents:

What is PCB - Types of PCBs: Single Sided (Single Layer),Multi-Layer (Double Layer) - PCB Materials, Brief History of EDA - Latest Trends in Market - Different EDA tools - Introduction to SPICE and PSPICE Environment.Through Hole Packages - Axial lead - Radial Lead - Single Inline Package (SIP) - Dual Inline Package(DIP) - Transistor Outline(TO) - Pin Grid Array(PGA) - Through Hole Packages - Metal ElectrodeFace(MELF) - Leadless Chip Carrier(LCC) - Small Outline Integrated Circuit(SOIC) - Quad FlatPack(QPF) and Thin QFP (TQFP) - Ball Grid Array(BGA) - Plastic Leaded Chip Carrier(PLCC).Designing Flow Chart - Schematic Entry - Net listing - PCB Layout Designing – PrototypeDesigning - Design Rule Check(DRC) - Design For Manufacturing(DFM) - PCB Making - Printing,Etching - Drilling - Assembly of components, Description of PCB Layers - Electrical Layers – TopLayer - Mid Layer - Bottom Layer - Mechanical Layers - Board Outlines and Cutouts - Drill Details -Documentation Layers - Components Outlines - Reference Designation – Text.

	Total Hours:	**15**

Reference Books:

1	Walter C Bosshart, "Printed Circuit Boards: Design and Technology", Tata McGraw-hill
2	R S Khandpur, "Printed Circuit Boards: Design, Fabrication, Assembly & Testing", Tata McGraw-hill
3	Ronals A. Reis, "Electronics Project Design And Fabrication", Merrill Publishing
4	Darryl Lindsey," The Design & Drafting of Printed Circuits", The Design & Drafting of Printed Circuits

Web References:

1	https://componentsearchengine.com/
2	https://upverter.com/
3	https://nptel.ac.in/courses/108108031

22VA407	ENERGY HARVESTING AND SECURITY ISSUES IN COGNITIVE NETWORKS	1/0/0/1

Nature of Course:	G(Theory)	

Course Objectives:

1	Introduce the basics and architecture of cognitive radio networks
2	Impart the knowledge on spectrum management and it's challenges
3	Gain knowledge on Energy Harvesting and it's Techniques
4	Familiarize the concept of cooperative relay
5	Impart the knowledge on energy efficient Techniques in Next generation networks.

Course Outcomes:
Upon completion of the course, students shall have ability to

C407.1	Understand the basics of cognitive radio networks and its architecture.
C407.2	Analyze the various spectrum management framework.
C407.3	Understand the Energy Harvesting and it's Techniques.
C407.4	Apply the cooperative relay in Cognitive Radio Network
C407.5	Analyze the SWIPT based CoR protocol.
C407.6	Understand the energy efficient Techniques in Next generation networks.

Course Contents:

Cognitive Networks, Cognitive Radio Network Architecture, Cognitive Wireless Sensor Networks, Cooperative Cognitive Wireless Communication Networks, Spectrum Management,Cognitive Radio Paradigms and Challenges - Security Measures of Cooperative Cognitive Wireless Communication Networks, Energy Harvesting, Power Management Schemes - Two-phase Method, Energy Harvesting Models and Constraints, RF-EH Network, Energy Supply and Demand of Cellular Systems, Energy cooperation, Communication cooperation, Cooperative Relay, Benefits of CoR, SWIPT Procedure, Architecture of SWIPT, SWIPT based CoR protocol, SWIPT CoR based CRN, 5G Technology, 5G Architecture, SWIPT and Cognitive Radio in 5G, Massive MIMO systems in EH CRNs.

	Total Hours:	15

Reference Books:

1	Prabhat Thakur, Ghanshyam singh, "Spectrum Sharing in Cognitive Radio Networks – Towards Highly Connected Environment", John Wiley and Sons.
2	Chuan Huang, Sheng zhou, Jie Xu, ZhixengNiu, Rui Zhang, Shuguang Cui, "Energy Harvesting Wireless Communications", IEEE Press, Wiley
3	Dushantha Nalin K.Jayakody, John Thompson, SymeonChatzinotas, Salman Durrani, "Wireless Information and Power Transfer: A new paradigm for Green Communications", Springer

Web References:

1	https://ieeexplore.ieee.org/document/8628978
2	https://www.coursera.org/learn/smart-device-mobile-emerging-technologies
3	https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1093&context

22VA161	SOFT SKILLS FOR CORPORATE WORKPLACE	1/0/0/1

Nature of Course:	G (Theory)

Course Objectives:

1	To prepare learners for placement and a successful career.
2	To develop students' ability to understand the companies and its process.
3	To facilitate learners to acquire some Essential skills.
4	To train the students to face the corporate Companies.
5	To improve their leadership quality.

Course Outcomes:
Upon completion of the course, students shall have ability to

C161.1	Remember the principles of soft skills required for their profession.
C161.2	Understand the importance of Interpersonal communication Skills among individuals, groups and cultures.
C161.3	Apply verbal and non verbal communication skills in corporate environment.
C161.4	Analyse and apply creativity skills, critical thinking skills and problem solving skills.
C161.5	Articulate oral and written messages in an appropriate and persuasive manner to suit specific purposes, audiences and contexts at work place.
C161.6	Apply good teamwork skills and Leadership Skills

Course Contents:

How things work overall: Types of companies and typical organization - Who does What, Understanding companies - Domain, Offering, Customers, Strategy, Company Culture & What does it mean, Moving from Campus to Corporate - Some Essential skills and areas of understanding: Continuous learning and improvement - An essential skill - Analyzing ones career path and making educated judgements - Effective Articulation and Collaboration- Ownership and Leadership - Understanding how companies make or not make money and why - Problem breakdown and resolving model - Time management and multi tasking model - Being a effective Mentee and Mentor - Effective project and program management - Mind Mapping - A powerful technique to learn - Being Inquisitive: Why asking questions is more difficult than giving answers? Hands on exercise - Innovation: A Buzzword only meant for a few? - Must have tips to succeed in any career.

	Total Hours:	**15**

Reference Books:

1	Reason and professional ethics by Peter Davson-Galle. Ashgate Publishing, Ltd., 2009.
2	Cross Cultural and Inter Cultural Communication. by William B. Gudykunst. Sage Publications India Pvt Ltd, New Delhi.2003
3	Corporate Communications: Theory and Practice. byJoepCornelissen. Sage Publications India Pvt Ltd, New Delhi.2004.

Web References:

1	https://onlinecourses.nptel.ac.in/noc22_hs77/preview
2	https://onlinecourses.nptel.ac.in/noc22_mg105/preview
3	https://onlinecourses.nptel.ac.in/noc22_hs76/preview