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 2020

(Batch: 2021 – 2025)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

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 2020 – Batch 2021-25

YEAR	SEM	COURSE	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	-	-	-	1	1	-	2	2	1
		ENGINEERING MATHEMATICS I	3	3	2	-	-	-	-	-	-	-	-	-	2	2
		PHYSICS FOR ELECTRONICS	3	2	1	1	-	-	-	-	-	-	-	2	2	2
		PROBLEM SOLVING USING C PROGRAMMING	3	3	3	2	1	-	-	-	2	-	-	2	2	1
		CIRCUIT THEORY	3	3	3	2	2	-	-	-	-	-	-	2	2	1
		ENGINEERING PRACTICES LABORATORY	2	2	2	2	1	-	-	-	-	-	-	2	2	2
	II	UNIVERSAL HUMAN VALUES	-	-	-	-	-	3	3	3	3	-	2	-	-	3
		TECHNICAL COMMUNICATION SKILLS	-	-	-	-	-	-	-	2	-	3	2	3	-	2
		ENGINEERING MATHEMATICS II	3	3	2	-	-	-	-	-	-	-	-	-	2	2
		ENGINEERING CHEMISTRY	3	3	2	1	1	-	-	-	-	-	-	1	-	1
		ELECTRON DEVICES	2	2	2	1	-	-	-	-	-	-	-	1	3	1
		ENGINEERING GRAPHICS	2	2	3	-	3	-	-	1	-	-	-	-	2	-
		MANDATORY COURSE II (ENVIRONMENTAL SCIENCES)	-	-	-	-	-	3	3	-	-	-	-	-	2	2
II	III	DIGITAL ELECTRONICS	3	2	2	1	-	-	-	-	1	-	-	-	2	-
		ELECTRONIC CIRCUITS	3	3	2	2	2	-	-	-	1	1	-	-	2	-
		ELECTROMAGNETICS	3	3	3	2	-	-	-	-	-	-	-	-	2	-
		TRANSFORMS AND NUMERICAL METHODS	3	3	2	-	-	-	-	-	-	-	-	-	2	-
		MANAGING DATA USING RDBMS	3	3	3	2	2	-	-	-	2	2	2	3	3	2
		PROBLEM SOLVING USING C++ AND DATA STRUCTURES	3	3	2	2	2	-	-	-	2	-	-	3	3	2
		DIGITAL ELECTRONICS LABORATORY	3	3	1	2	1	-	-	-	1	1	-	-	3	-
	IV	ANALOG INTEGRATED CIRCUITS	1	2	2	2	1	2	-	-	1	1	-	-	2	-
		SIGNALS AND SYSTEMS	3	3	3	3	2	-	-	-	2	-	-	1	3	1
		ANALOG AND DIGITAL COMMUNICATION	3	3	3	2	3	-	-	-	-	-	-	-	2	1
		PROBABILITY AND RANDOM PROCESSES	2	2	2	3	-	-	-	-	-	-	-	-	3	-

		JAVA PROGRAMMING	3	3	2	2	2	-	-	-	2	-	-	3	3	2
		WEB DEVELOPMENT USING REACT	3	3	3	3	3	-	-	-	3	2	3	2	3	3
		CIRCUITS LABORATORY	3	2	3	3	2	-	-	-	1	-	-	1	3	1
		ANALOG AND DIGITAL COMMUNICATION LABORATORY	1	2	3	3	2	-	-	-	-	-	-	1	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
		VLSI DESIGN	3	3	3	2	1	-	-	-	2	1	2	-	3	-
		DIGITAL SIGNAL PROCESSING LABORATORY	3	3	3	2	2	-	-	-	-	1	1	1	3	1
		VLSI LABORATORY	3	3	3	2	2	-	-	-	1	1	1	1	3	1
	VI	ANTENNAS AND WAVE PROPAGATION	3	2	2	2	-	-	-	-	2	2	-	2	-	2
		EMBEDDED SYSTEMS AND ITS APPLICATIONS	2	3	3	2	1	-	-	-	-	-	-	3	3	2
		CONTROL ENGINEERING	3	3	2	2	3	-	-	-	-	-	-	1	3	1
		MICROCONTROLLERS & EMBEDDED SYSTEMS LABORATORY	2	1	2	2	2	-	-	-	3	-	-	1	2	1
		BUSINESS COMMUNICATION SKILLS LABORATORY	-	-	-	-	-	-	-	2	3	3	-	2	-	2
IV	VII	MICROWAVE AND OPTICAL COMMUNICATION	3	3	3	2	-	-	-	-	1	-	-	1	3	1
		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 2020 (Batch: 2021 – 2025)

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.**
THEORY							
1	21SB101	Engineering Biology	3/0/0	3	3	60/40	BSC
THEORY CUM PRACTICAL							
2	21MA101	Engineering Mathematics I	2/1/2	5	4	50/50	BSC
3	21PH101	Physics for Electronics	3/0/3	6	4.5	50/50	BSC
4	21CS111	Problem Solving Using C Programming	3/0/2	5	4	50/50	ESC
5	21EC101	Circuit Theory	3/0/3	6	4.5	50/50	ESC
LABORATORY COURSE							
6	21ME103	Engineering Practices Laboratory	0/0/3	3	1.5	40/60	ESC
MANDATORY COURSE							
7	21MC101	Mandatory Course I (Induction Programme)	3 weeks		0	0/100	MC
		TOTAL	14/1/13	**28**	**21.5**	**700**	

SEMESTER II							
SL. No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs./wk.**	**C**	**Ext./Int.**	**Cat.**
THEORY							
1	21GE201	Universal Human Values	3/0/0	3	3	60/40	HSMC
THEORY CUM PRACTICAL							
2	21EN101	Technical Communication Skills	2/0/2	4	3	50/50	HSMC
3	21MA201	Engineering Mathematics II	2/1/2	5	4	50/50	BSC
4	21CH101	Engineering Chemistry	3/0/3	6	4.5	50/50	BSC
5	21EC201	Electron Devices	3/0/3	6	4.5	50/50	ESC
LABORATORY COURSE							
6	21ME111	Engineering Graphics	1/0/3	4	2.5	40/60	ESC
MANDATORY COURSE							
7	21MC102	Mandatory Course II (Environmental Sciences)	2/0/0	2	0	0/100	MC
		TOTAL	16/1/13	**30**	**21.5**	**700**	

SEMESTER III							
SL. No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs./wk.**	**C**	**Ext./Int.**	**Cat.**
THEORY							
1	21EC301	Digital Electronics	3/0/0	3	3	60/40	PCC
2	21EC302	Electronic Circuits	3/0/0	3	3	60/40	PCC
3	21EC303	Electromagnetics	3/0/0	3	3	60/40	PCC
4	21MA303	Transforms and Numerical Methods	3/0/0	3	3	60/40	BSC
THEORY CUM PRACTICAL							
5	21CS303	Managing Data using RDBMS	3/0/2	5	4	50/50	ESC
6	21CS304	Problem solving using C++ and Data Structures	3/0/2	5	4	50/50	ESC
LABORATORY COURSE							
7	21EC304	Digital Electronics Laboratory	0/0/2	2	1	40/60	PCC
TOTAL			18/0/6	**24**	**21**	**700**	

SEMESTER IV							
SL. No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs./wk.**	**C**	**Ext./Int.**	**Cat.**
THEORY							
1	21EC401	Analog Integrated Circuits	3/0/0	3	3	60/40	PCC
2	21EC402	Signals and Systems	3/0/0	3	3	60/40	PCC
3	21EC403	Analog and Digital Communication	3/0/0	3	3	60/40	PCC
4	21MA402	Probability and Random Processes	3/0/0	3	3	60/40	BSC
THEORY CUM PRACTICAL							
5	21CS302	Java Programming	3/0/2	5	4	50/50	ESC
6	21IT301	Web Development using REACT	3/0/2	5	4	50/50	ESC
LABORATORY COURSE							
7	21EC404	Circuits Laboratory	0/0/2	2	1	40/60	PCC
8	21EC405	Analog and Digital Communication Laboratory	0/0/2	2	1	40/60	PCC
TOTAL			18/0/8	**26**	**22**	**800**	

SEMESTER V							
SL. No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs./wk.**	**C**	**Ext./Int.**	**Cat.**
THEORY							
1	21EC501	Microcontrollers and Interfacing	3/0/0	3	3	60/40	PCC
2	21EC502	Data and Wireless Networks	3/0/0	3	3	60/40	PCC
3	21EC503	Digital Signal Processing	4/0/0	4	4	60/40	PCC
4	21EC504	VLSI Design	3/0/0	3	3	60/40	PCC
5	21XXXXX	Emerging Elective-1	3/0/0	3	3	60/40	EEC
6	21XXXX	Open Elective-1	3/0/0	3	3	60/40	OEC
LABORATORY COURSE							
7	21EC505	Digital Signal Processing Laboratory	0/0/2	2	1	40/60	PCC
8	21EC506	VLSI Laboratory	0/0/2	2	1	40/60	PCC
MANDATORY COURSE							
9	21MCXXX	Mandatory Course III	2/0/0	2	0	0/100	MC
TOTAL			21/0/4	**25**	**21**	**900**	

SEMESTER VI							
SL. No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs./wk.**	**C**	**Ext./Int.**	**Cat.**
THEORY							
1	21EC601	Antennas and Wave Propagation	3/0/0	3	3	60/40	PCC
2	21EC602	Embedded Systems and its Applications	3/0/0	3	3	60/40	PCC
3	21EC9XX	Professional Elective-1	3/0/0	3	3	60/40	PEC
4	21EE611	Control Engineering	3/0/0	3	3	60/40	ESC
5	21XXXXX	Emerging Elective -2	3/0/0	3	3	60/40	EEC
6	21XXXXX	Open Elective-2	3/0/0	3	3	60/40	OEC
LABORATORY COURSE							
7	21EC603	Microcontrollers & Embedded Systems Laboratory	0/0/2	2	1	40/60	PCC
8	21EN601	Business Communication skills Laboratory	1/0/2	3	2	40/60	HSMC
TOTAL			**19/0/4**	**23**	**21**	**800**	

SEMESTER VII							
SL. No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs./wk.**	**C**	**Ext./Int.**	**Cat.**
THEORY							
1	21EC701	Microwave and Optical Communication	3/0/0	3	3	60/40	PCC
2	21EC9XX	Professional Elective-2	3/0/0	3	3	60/40	PEC
3	21EC9XX	Professional Elective-3	3/0/0	3	3	60/40	PEC
4	21EC9XX	Professional Elective-4	3/0/0	3	3	60/40	PEC
5	21EC9XX	Professional Elective-5	3/0/0	3	3	60/40	PEC
6	21EC9XX	Professional Elective-6	3/0/0	3	3	60/40	PEC
LABORATORY COURSE							
7	21EC702	Microwave and Optical Communication Laboratory	0/0/2	2	1	40/60	PCC
PROJECT							
8	21EC703	Mini Project	-	-	2	0/100	PROJ
EMPLOYABILITY ENHANCEMENT SKILLS							
9	21EES01	Employability Enhancement Skills (Summer Internship/Summer Training – 4 weeks)			2	40/60	
TOTAL			18/0/2	**20**	**23**	**900**	

SEMESTER VIII							
SL. No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs./wk.**	**C**	**Ext./Int.**	**Cat.**
PROJECT							
1.	21EC801	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)		6				2			12*	8	**4.9**
2	Basic Sciences (BSC)	11.5	8.5	3	3					25*	26	15.96
3	Engineering Sciences (ESC)	10	7	8	8		3			24*	36	22.09
4	Professional Core (PCC)			10	11	15	7	4		48*	47	28.83
5	Professional Electives (PEC)						3	15		18*	18	11.04
6	Open Electives/ Emerging Electives (OEC/EEC))					6	6			18*	12	7.36
7	Project Work (PROJ)							2	12	15*	14	8.59
8	Mandatory Course (MC)									Non-Credit	Non-Credit	-
9	Employability Enhancement Skills							2		-	2	1.23
Total		**21.5**	**21.5**	**21**	**22**	**21**	**21**	**23**	**12**	**160***	**163**	**100**

HUMANITIES & SOCIAL SCIENCES INCLUDING MANAGEMENT (8 Credits)

SL. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Cat.
1.	21GE201	Universal Human Values	3/0/0	3	3	HSMC
2.	21EN101	Technical Communication Skills	2/0/2	4	3	HSMC
3.	21EN601	Business Communication skills Laboratory	1/0/2	3	2	HSMC

BASIC SCIENCE COURSES (26 Credits)

SL. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Cat.
1	21SB101	Engineering Biology	3/0/0	3	3	BSC
2	21MA101	Engineering Mathematics I	2/1/2	5	4	BSC
3	21PH101	Physics for Electronics	3/0/3	6	4.5	BSC
4	21MA201	Engineering Mathematics II	2/1/2	5	4	BSC
5	21CH101	Engineering Chemistry	3/0/3	6	4.5	BSC
6	21MA303	Transforms and Numerical Methods	3/0/0	3	3	BSC
7	21MA402	Probability and Random Processes	3/0/0	3	3	BSC

ENGINEERING SCIENCE COURSES (36 Credits)

SL. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Cat.
1.	21CS111	Problem Solving Using C Programming	3/0/2	5	4	ESC
2.	21EC101	Circuit Theory	3/0/3	6	4.5	ESC
3.	21ME103	Engineering Practices Laboratory	0/0/3	3	1.5	ESC
4.	21EC201	Electron Devices	3/0/3	6	4.5	ESC
5.	21ME111	Engineering Graphics	1/0/3	4	2.5	ESC
6.	21CS303	Managing Data using RDBMS	3/0/2	5	4	ESC
7.	21CS304	Programming solving using C++ and Data Structures	3/0/2	5	4	ESC
8.	21CS302	Java Programming	3/0/2	5	4	ESC

9.	21IT301	Web Development using REACT	3/0/2	5	4	ESC
10.	21IEE611	Control Engineering	3/0/0	3	3	ESC

PROFESSIONAL CORE COURSES (47 Credits)

SL. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Cat.
1.	21EC301	Digital Electronics	3/0/0	3	3	PCC
2.	21EC302	Electronic Circuits	3/0/0	3	3	PCC
3.	21EC303	Electromagnetics	3/0/0	3	3	PCC
4	21EC304	Digital Electronics Laboratory	0/0/2	2	1	PCC
5.	21EC401	Analog Integrated Circuits	3/0/0	3	3	PCC
6.	21EC402	Signals and Systems	3/0/0	3	3	PCC
7.	21EC403	Analog and Digital Communication	3/0/0	3	3	PCC
8.	21EC404	Circuits Laboratory	0/0/2	2	1	PCC
9.	21EC405	Analog and Digital Communication Laboratory	0/0/2	2	1	PCC
10.	21EC501	Microcontrollers and Interfacing	3/0/0	3	3	PCC
11	21EC502	Data and Wireless Networks	3/0/0	3	3	PCC
12.	21EC503	Digital Signal Processing	4/0/0	4	4	PCC
13.	21EC504	VLSI Design	3/0/0	3	3	PCC
14.	21EC505	Digital Signal Processing laboratory	0/0/2	2	1	PCC
15.	21EC506	VLSI Laboratory	0/0/2	2	1	PCC
16.	21EC601	Antennas and Wave Propagation	3/0/0	3	3	PCC
17.	21EC602	Embedded Systems and its Applications	3/0/0	3	3	PCC
18.	21EC603	Microcontrollers & Embedded Systems Laboratory	0/0/2	2	1	PCC
19.	21EC701	Microwave and Optical Communication	3/0/0	3	3	PCC
20.	21EC702	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 & VLSI Design						
1.	21EC901	High Speed Digital Design	3/0/0	3	3	PEC
2.	21EC902	Hardware Description Languages	3/0/0	3	3	PEC
3.	21EC903	ASIC Design	3/0/0	3	3	PEC
4.	21EC904	System on Chip Design	3/0/0	3	3	PEC
5.	21EC905	Electronic Design Automation Tools	3/0/0	3	3	PEC
6.	21EC906	Embedded Processors	3/0/0	3	3	PEC
7.	21EC907	ARM Processor Architecture and Programming	3/0/0	3	3	PEC
8.	21EC908	Internet of Medical Things	3/0/0	3	3	PEC
9.	21EC909	Internet of Things and its Applications	3/0/0	3	3	PEC
Elective Stream II: Communication Engineering						
1	21EC911	Advanced Wireless Technologies	3/0/0	3	3	PEC

2	21EC912	Satellite Communication and GPS	3/0/0	3	3	PEC
3	21EC913	Long Term Evolution Technology	3/0/0	3	3	PEC
4	21EC914	MEMS	3/0/0	3	3	PEC
5	21EC915	Smart Antennas	3/0/0	3	3	PEC
6	21EC916	RF System Design	3/0/0	3	3	PEC
7	21EC917	Cognitive Radio Communication	3/0/0	3	3	PEC
8	21EC918	MIMO and Multi Carrier Systems	3/0/0	3	3	PEC
9	21EC919	Millimeter Wave Communication Systems	3/0/0	3	3	PEC
Elective Stream III – Networks, Image and Video Processing						
1	21EC921	Wireless Sensor Networks	3/0/0	3	3	PEC
2	21EC922	Soft Computing	3/0/0	3	3	PEC
3	21EC923	Digital Image and Video Processing	3/0/0	3	3	PEC
4	21EC924	Convergent Networks	3/0/0	3	3	PEC
5	21EC925	Information Security	3/0/0	3	3	PEC
6	21EC926	Pattern Recognition Techniques	3/0/0	3	3	PEC
7	21EC927	High Speed Networks	3/0/0	3	3	PEC
8	21EC928	Advanced Wireless Networks	3/0/0	3	3	PEC
9	21EC929	Neural Networks and Deep Learning	3/0/0	3	3	PEC

OPEN ELECTIVE COURSES (6 Credits)
(Offered to Other Branches)

SL. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Cat.
1.	21EC001	Principles of Cyber Physical Systems	3/0/0	3	3	OEC
2.	21EC002	Introduction to Raspberry Pi and Arduino	3/0/0	3	3	OEC
3.	21EC003	IT Workshop SCILAB/MATLAB	3/0/0	3	3	OEC
4.	21EC004	Brain Computer Interface and its Applications	3/0/0	3	3	OEC
5.	21EC005	Wireless wearable Sensors	3/0/0	3	3	OEC
6.	21EC006	Organizational Behaviour	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.	21EC007	Robotics	3/0/0	3	3	EEC
2.	21EC008	Augmented and Virtual Reality	3/0/0	3	3	EEC
3.	21EC009	Computer Vision	3/0/0	3	3	EEC
4.	21EC010	Bio – inspired Human Machine Interface	3/0/0	3	3	EEC

PROJECT WORK (14 Credits)

SL. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Cat.
1.	21EC703	Mini Project	-	-	2	PROJ
2	21EC801	Project Work	0/0/24	24	12	PROJ

MANDATORY COURSES

S.No	CourseCode	Course Title	L/T/P	Contact Hrs/Wk	C	Cat.
1.	21MC101	Induction Program	3 weeks		0	MC
2.	21MC102	Environmental Sciences	2/0/0	2	0	MC
3.	21MC103	Soft Skills	2/0/0	2	0	MC
4.	21MC104	Management Organizational Behavior	2/0/0	2	0	MC
5.	21MC105	General Aptitude	2/0/0	2	0	MC
6.	21MC106	Life Skills and Ethics	2/0/0	2	0	MC
7.	21MC107	Stress Management	2/0/0	2	0	MC
8.	21MC108	Constitution of India	2/0/0	2	0	MC
9.	21MC109	Essence of Indian Traditional Knowledge	2/0/0	2	0	MC
11.	21MC110	Design and Analysis of Algorithm	2/0/0	2	0	MC

VALUE ADDED COURSES OFFERED BY ECE

SL. No.	Course Code	Course Title	Credits
1.	21VA401	Antenna Design using ANSYS HFSS Tool Flow	1
2.	21VA402	Mastering in MATLAB - Math and Optimization	1
3.	21VA403	The Agriculture Industry in Industry 4.0	1
4.	21VA404	Connecting Technologies with Real World	1
5.	21VA405	Arduino Programming model	1
6.	21VA406	PCB Design for Electronic Circuits	1
7.	21VA407	Energy Harvesting and Security Issues in Cognitive Networks	1

VALUE ADDED COURSES OFFERED BY OTHER DEPARTMENTS

SL. No.	Course Code	Course Title	Credits
1.	21VA160	Agile Product Development in Web Application	2
2.	21VA161	Soft Skills for Corporate Workplace	1
3.	21VA162	Web Framework Technologies	2

SEMESTER WISE CREDIT DISTRIBUTION:-

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	21.5	21.5	21	22	21	21	23	12	163

Total Credits: 163

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

21SB101	ENGINEERING BIOLOGY	3/0/0/3

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: 15

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-Artificial Liver-Artificial heart valves.

BCI: **15**

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:
15

Introduction to Nanobiology, Bioremediation- removal of bacteria and microbes – Nanomaterials for antimicrobial coatings- medical implants–medical and defence textiles. Biosensors- biodevices and implantable devices. Nanomaterials for diagnosis and therapy-Implications of Drug delivery- various forms of nanocarriers -Polymeric Nanoparticles as drug carriers - Drug release mechanism- Targeted drug delivery. Point-of-care and Personalized medicine.

Total Hours:	**45**

Text Books:

1	Leslie Cromwell. Biomedical Instrumentation and measurements-Prentice Hall,2011
2	Bernhard Graimann, Brenden Allison,Gert Pfurtscheller, 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 Neuroanatomyll, Mc. Graw hill Edition, 1996.
2	Biology for Engineers, Arthur T. Johnson, CRC Press, Taylor and Francis, 2011
3	Matews G.G.,Neurobiology, Second Edition,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**		
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	20	20	10
Understand	20	20	20
Apply	30	30	35
Analyse	30	30	35
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			

21MA101	ENGINEERING MATHEMATICS I (COMMON TO MECH, MCT,CIVIL,ECE,EEE,CSE,IT,AIDS)	2/1/2/4

Nature of Course	B (100% Analytical)

Course Objectives:

1	To develop the skill to use matrix algebra techniques that is needed by engineers for practical applications.
2	To know about system of linear equations and its solution set and how to write down the coefficient matrix and augmented matrix of a linear system
3	To familiarize with functions of several variables applicable in many branches of engineering.
4	To find the solution of ordinary differential equations as most of the engineering problems are characterized in this form.

Course Outcomes:

Upon completion of the course, students shall have ability to

C101.1	Recall the concepts of matrices, ordinary and partial derivatives.	[R]
C101.2	Express square matrix in the diagonal form.	[U]
C101.3	Solve systems of linear equations numerically and to find inverse matrices.	[AP]
C101.4	Apply numerical techniques effectively to analyse and visualize data to solve basic engineering-related problems.	[AP]
C101.5	Find the extreme values of the given functions to solve the engineering problems.	[AP]
C101.6	Find the solution of second and higher order differential equations connected with electric circuits and simple harmonic motion.	[AP]

Course Contents:

MODULE I - MATRICES (15 Hrs)

Definition – Types of matrices – Characteristic equation – Eigenvalues and eigenvectors of a real matrices and their properties (statement only) – Cayley-Hamilton theorem (statement only) – Verification and application to find inverse and powers of real matrices – Orthogonal transformation of a real symmetric matrix to diagonal form – Reduction of quadratic form to canonical form by Orthogonal transformation.

MODULE II - SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS (15 Hrs)

Newton-Raphson method – Fixed point iteration method – Gauss-Elimination method – Gauss-Jordan method – Iterative methods of Gauss-Jacobi and Gauss-Seidel – Matrix Inversion by Gauss-Jordan method – Eigenvalue of a matrix by Power method and Jacobi method.

MODULE III - CALCULUS (15 Hrs)

Concepts of limits and continuity – Functions of several variables – Total derivatives – Differentiation of implicit functions – Jacobians – Taylor series expansion – Maxima and Minima – Method of Lagrangian multipliers – Ordinary differential equations – Higher order linear differential equations with constant coefficients –Euler Cauchy's equations – Applications of ODE: Solving electrical circuits and simple harmonic motion.

Lab Component

1. Entering row vector, column vector, accessing blocks of elements in MATLAB.
2. Entering matrices, to locate matrix elements and Correcting any entry through indexing in MATLAB.
3. Sum, product, transpose, inverse, determinant and rank of a matrices using MATLAB.
4. Eigenvalues and eigenvectors of a matrix using MATLAB.
5. System of linear equations in MATLAB using Gaussian elimination.
6. System of linear equations in MATLAB using matrix inverse method.
7. System of linear equations in MATLAB using linsolve.
8. First and second derivative of single variable functions using MATLAB.
9. Maxima and Minima of a function using MATLAB.
10. Higher Order Equations of constant coefficients using MATLAB.

Total Hours:(45+15)	**60**

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" Tenth Edition, John Wiley and Sons (Asia) Limited, Singapore 2018.
3	Grewal. B.S, "Higher Engineering Mathematics", 43rd edition, Khanna Publications, Delhi, 2018.
Reference Books:	
1	Veerarajan. T, "Engineering Mathematics I", 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.Manish Goyal,"A Text book of Engineering Mathematics" 9th edition, Laxmi publications ltd, 2014.
Web References:	
1	http://www.nptel.ac.in/courses/111105035
2	http://www.nptel.ac.in/courses/122104017
3	http://nptel.ac.in/courses/122102009
4	http://nptel.ac.in/courses/111107063
Online Resources:	
1	https://www.coursera.org/learn/linearalgebra2
2	https://www.coursera.org/learn/differentiation-calculus
3	https://www.coursera.org/learn/single-variable-calculus
4	https://alison.com/courses/Algebra-Functions-Expressions-and-Equations

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]**
C101.1	Remember	Quiz	20
C101.2	Understand	Seminar	20
C101.3 – C101.6	Apply	Tutorial	20
C101.3 – C101.6	Apply	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	10	10	10
Understand	40	40	40
Apply	50	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	10	10
Understand	30	30	30
Apply	60	60	60
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

<table>
<tr><th colspan="8">Assessment based on Continuous and End Semester Examination</th></tr>
<tr><th colspan="7">Continuous Assessment (50%)</th><th>End Semester Examination (50%)</th></tr>
<tr><th colspan="3">CA 1
(100 Marks)</th><th colspan="3">CA 2
(100 Marks)</th><th colspan="2">Practical Exam
(100 Marks)</th><th>Theory Examination
(35%)
Practical Examination
(15%)</th></tr>
<tr><th rowspan="2">SA 1
(60M)</th><th colspan="2">FA 1</th><th rowspan="2">SA 2
(60 M)</th><th colspan="2">FA 2</th><th rowspan="2">FA
(75M)</th><th rowspan="2">SA
(25M)</th><th rowspan="2"></th></tr>
<tr><th>Component-I
(20 Marks)</th><th>Component-II
(20 Marks)</th><th>Component-I
(20 Marks)</th><th>Component-II
(20 Marks)</th></tr>
</table>

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

21PH101	PHYSICS FOR ELECTRONICS (ECE)	3/0/3/4.5

Nature ofCourse	: E (Theory skill based)

Course Objectives:

1	To introduce the basics of oscillations and resonance.
2	To enable the students in understanding the importance of quantum physics.
3	To equip the students on the knowledge of Electrostatics.
4	To make the students understand the concepts of Magnetism.
5	To inculcate an idea of the significance of Smart materials, nanomaterials and ensuing nanodevice applications.
6	To introduce the basics of Fiber optics.

Course Outcomes:

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

C101.1	Describe the basic concepts of simple harmonic and damped oscillations.	[U]
C101.2	Solve Schrodinger's equations on finite and infinite potential well problems.	[AP]
C101.3	Interrelate electric and magnetic fields behaviour of electrostatics and electrodynamics.	[U]
C101.4	Infer changes in the properties of smart materials and their applications in engineering field.	[AP]
C101.5	Recall the fundamental concepts of lasers and various types of optical fibers for different Engineering applications.	[R]
C101.6	Apply the gained knowledge to solve the problems 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: heavy, critical and light damping and energy decay in a damped harmonic oscillator. **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 – Electron microscope: SEM and TEM.

ELECTROSTATICS AND MAGNETISM **15**

Electrostatics: Coulomb's law – Gauss's law, applications of Gauss's law: Electric field around a plane, sheet of conductor and charged sphere – Electric field in matter: dielectric, polarization, susceptibility, types of polarization – Internal field - Claussius- Mosotti equation – Capacitors. **Magnetism:** Definitions of fundamental terms – Magnetic field around a current carrying conductor – Direction of magnetic field and current–Biot-Savart law and its applications: Magnetic field due to circularcurrent Loop– Ampere's law and its applications: magnetic field due to a solenoid and a

toroid –Magnetic Lorentz force: force experienced by a current carrying conductor in a magnetic field – Force between two long parallel current carrying conductors – Electromagnetic induction Faraday's law of induction, Lenz law – Expression for induced emf in a conductor – Time varying magnetic fields. Maxwell's equations (equations only) – Propagation of electromagnetic waves in dielectric medium.

SMART MATERIALS, LASER AND FIBER OPTICS **15**

Smart materials: Metallic Glass: properties, preparation and applications–Shape memory alloys(SMA): characteristics, properties of Ni-Ti alloy and applications–Nano materials:properties, Moore's law, Quantum confinement, Quantum well, wire and dot. (definitions)-Synthesis: chemical vapor deposition and ball milling –Applications. Carbon nanotubes (CNT): structure, properties and applications**. 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 - CO_2laser, **Fiber optics**: principle and propagation of light in optical fibers– Numerical aperture and acceptance angle – Light detector: PIN photo diode– Applications: optical fiber communication system.

Lab Component **30 Hours**

1	Determination of Moment of Inertia of disc and rigidity modulus of a wire – Torsional oscillation.	[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 Time constant of RC circuits.	[E]
6	Determination of Magnetic field along the axis of current carrying coil – Stewart and Gee method.	[E]
7	Determine the characteristics of LCR circuits.	[E]
8	Determination of Faraday's electromagnetic induction law – Simulation lab	[E]
9	Determination of Characteristics of solar cell/photo diode	[E]
10	Determination of Laser and optical fiber parameters.	[E]
Life Skills Experiments		
1.	Determination of pressure required to shut off the fuel pump nozzle.	[E]
2.	Determination of capacitance required to shut off the circuit in a circuit breaker.	[E]
3.	Determination of earth, neutral and phase line in a circuit.	[E]
	Total Hours:	**75**

Text Books:

1	Rajendran, V "Engineering Physics" Mc Graw Hill Publications ltd, New Delhi, 2016.

2	David Halliday, Robert Resnick, Jearl Walker "Fundamentals of Physics" Wileyplus.2018
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	David Griffiths "Introduction to Electrodynamics' 4th Edition, Cambridge University Press 2017.
5	Dieter Vollath " Nanomaterials: An Introduction to Synthesis,Properties and Applications, 2nd Edition,2013
6	Karl F. Renk "Basics of Laser Physics" Springer International Publishing, 2017.
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	http://www.eas.uccs.edu/~mwickert/ece3110/lecture_notes/N3110_4.pdf
5	https://www.tcd.ie/Physics/research/groups/magnetism/files/lectures/5006/5006-2.pdf
6	https://nptel.ac.in/courses/118/104/118104008/
7	https://nptel.ac.in/courses/113/105/113105081/
8	http://webdocs.cs.ualberta.ca/~database/MEMS/sma_mems/sma.html
9	https://www.eatm.in/upload/srit__unit_i_laser.pdf
10	http://www.crectirupati.com/sites/default/files/lecture_notes/OFC%20NOTES.pdf

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]**
C101.1	Understand	Online Quiz - I	**20**
C101.2	Apply	Assignment - I	**20**
C101.3	Understand	Online Quiz - II	**20**
C101.4 & C101.5, C101.6	Remember, Apply	Assignment - II	**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	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%) 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**
C101.1	3	2	-	1	-	-	-	-	-	-	-	1	1	1
C101.2	2	1	-	1	-	-	-	-	-	-	-	1	1	1
C101.3	3	2	-	1	-	-	-	-	-	-	-	2	2	2
C101.4	3	2	1	1	-	-	-	-	-	-	-	2	2	2
C101.5	3	2	1	1	-	-	-	-	-	-	-	1	1	1
C101.6	3	2	1	1	-	-	-	-	-	-	-	1	1	1

21CS111	PROBLEM SOLVING USING C PROGRAMMING	3/0/2/4
Nature of Course	F (Theory Programming)	
Course Objectives:		
1.	To understand problem solving using structured programming language	
2.	To gain knowledge about the control structures in C.	
3.	To develop logics and write C programs using arrays	
4.	To gain familiarity ininbuilt functions, structures and unions in C.	
5.	Apply concept and techniques for implementation in respective domain	
Course Outcomes		
Upon completion of the course, students shall have ability to		
C111.1	Apply problem solving techniques to solve real world problems	[AP]
C111.2	Understand C fundamental constructs and control structures	[U]
C111.3	Use the concept of pointers and arrays in designing programs	[AP]
C111.4	Design C programs using the concepts of strings and functions	[C]
C111.5	Developprograms using structures and Unions in C	[AP]
C111.6	Apply the suitable programming concept for the given computational problem	[AP]

Course Contents:

PROBLEM SOLVING TECHNIQUES AND C FUNDAMENTALS **15**

Problem Solving Techniques:Algorithm, Pseudo-code and Flowchart. Creative Thinking and Problem solving skills in everyday life. Understanding Compiler and interpreter. Program Development LifeCycle. C Fundamentals: Structure of C program, Character Set – Identifiers and Keywords – Data Types – Constants - Variables and Arrays – Declarations - Operators and Expressions –Precedence of operators and associativity. Data input and output - Preparing and running a Complete C Program

CONTROL STRUCTURES, ARRAYS, STRINGS **15**

Control Structures: Branching: if-else- Looping – while - do while – for - Nested control structures –switch – break – continue – comma - goto. Arrays - Defining an array - Processing an array - Multi dimensional arrays - Strings: Defining a string - Null character -initialization of strings – reading and writing a string - processing the string

POINTERS, FUNCTIONS, STRUCTURES AND UNIONS **15**

Pointers: fundamentals – Pointer Declaration & Usage – Dynamic Memory Allocation. Functions: Defining a Function – Accessing a function – Function Prototype Functions - Pointer to Function - Functions Returning Pointers. - Pointers and Strings - Passing arguments to a function – Recursion. Structures and Unions: The Type Definition (type def) – Enumerated types – Structure - Type Definition – Initialization – Accessing Structures - Unions.

Total Hours	**45**

Laboratory Component:

S. No	List of Experiments
1.	Formulate simple algorithm and flowchart using Raptor Tool for simple and complex problem
2.	Program to process data types, format input and output and to evaluate an expression
3.	Program using decision making statements

4.	Program using looping statements
5.	Program using single and two dimensional arrays
6.	Program with Strings
7.	Program using Pointers.
8.	Program using Recursion
9.	Program using structures
10.	Branch specific application program
	Total Hours **30 Hrs**

Text Books:	
1.	SprankleM,"Problem Solving and Programming Concepts", 9th Edition, Pearson Education, New Delhi, 2013
2.	YashavantKanetkar, "Let Us C", 16th Edition, BPB Publication, 2017.
3.	Byron, S. Gottfreid, "Programming with C", McGraw Hill, Schaum's outlines, 4thEdition, 2018.
4.	ReemaThareja Computer Fundamentals and Programming in C, 2nd edition, OXFORD publications, 2016
5.	Brian W. Kernighan, Dennis Ritchie, " The C Programming Language", 2ndEdition Pearson Publicaitons, 2015
Reference Books:	
1.	YashavantKanetkar, "101 Challenges in C Programming" Edition, BPB Publication, 2017
2.	Herbert Schildt, "The Complete Reference C", 4th Edition , McGraw Hill , 2015
3.	Venugopal K R and SudeepR.Prasad , "Mastering C", 2nd Edition, McGraw Hill, 2017
4.	Jeri.RHanly, and Elliot B Koffman, "Problem solving and programming Design in C",8th Edition, Pearson 2016
Web References:	
1.	http://raptor.martincarlisle.com/
Online Resources:	
1.	https://nptel.ac.in/courses/106/104/106104128/
2.	https://nptel.ac.in/courses/106/105/106105171/
3.	https://www.coursera.org/specializations/c-programming

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]**
C111.1	Remember	Quiz	**20**
C111.2 & C111.3	Understand	Assignment	**20**
C111.4	Analyse	Group Assignment	**20**
C111.5 & C111.6	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	20	15	20
Understand	30	35	30
Apply	50	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	20	20	20
Understand	30	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 Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
C111.1	3	3	2	2	1	-	-	-	2	-	-	1	2	1
C111.2	3	3	2	1	1	-	-	-	2	-	-	1	1	-
C111.3	3	3	2	1	1	-	-	-	2	-	-	1	1	-
C111.4	3	3	2	1	1	-	-	-	2	-	-	1	1	-
C111.5	3	3	2	1	1	-	-	-	2	-	-	1	1	-
C111.6	3	3	3	2	1	-	-	-	2	-	-	2	2	1

21EC101	CIRCUIT THEORY	3/0/3/4.5

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 of graph theory

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	[R]
C101.2	Understand the basic principles of network theorems	[U]
C101.3	Understand the concepts and performance of transients, resonance and coupling	[U]
C101.4	Identify component of Graph topology, understand and apply for simplification of electrical networks.	[U]
C101.5	Apply network theorems and analyse the possibilities of deriving the equivalent circuits	[AP]
C101.6	Design RLC circuits and analyse 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 –delta wye conversion- -Thevenin and Norton theorem, Maximum power transfer, Superposition theorem, Reciprocity theorem, Compensation theorem. Millman and Tellegans Theorem. (Both AC and DC)

TRANSIENTS AND NETWORK TOPOLOGY: **15**

Capacitor–Inductor–energy storage– Introduction to Laplace Transform - DC Response of an RL circuits using Laplace Transforms - DC Response of an RC circuits using Laplace Transforms - DC Response of an RLC circuits using Laplace Transforms, Concept of duality, dual network, Graphs of a network, trees, chords and branches, tie set and cutset of a Graph.

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 - mutual inductance – coupling Coefficient.

Lab Component		**30 hours**
1	Verification of ohm's laws and kirchoff's laws	[E]
2	Verification of Thevenin's and Norton's Theorem	[E]
3	Verification of superposition Theorem	[E]
4	Verification of maximum power transfer theorem	[E]
5	Verification of reciprocity theorem	[E]
6	Verification of mesh and nodal analysis	[E]
7	Analysis of Frequency response of RL,RC and RLC circuits	[E]
8	Q factor extraction in Tank circuits	[E]
	Total Hours:	**75**

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									**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]**
CO 101.1, CO 101.2	Remember, Understand	Quiz	20
CO 101.3, CO 101.4	Understand	Assignment	20
CO 101.5	Apply	Group assignment	20
CO 101.6	Analyse	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	20	20	10
Understand	20	20	20
Apply	30	30	35
Analyse	30	30	35
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	20	20
Understand	30	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 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			

21ME103	ENGINEERING PRACTICES LABORATORY	0/0/3/1.5
Nature of Course	Practical application	

Course Objectives:

1	To learn the use of basic hand tools and to know the need for safety in work place and to gain hands on experience in Carpentry, Sheet metal, Plumbing, Welding and Foundry.
2	To learn about basic electrical devices, meters and electronics devices and to gain knowledge about the fundamentals of various electrical and electronic gadgets their working and trouble shooting.

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

C103.1	Identify and solve the basic engineering problems at home and in workplace.	[AP]
C103.2	Develop the surfaces and make simple components like tray and funnel.	[C]
C103.3	Make simple metal joints using welding equipment and wooden joints using carpentry tools.	[AP]
C103.4	Prepare pipe connections and sand moulds.	[AP]
C103.5	Understand the fundamentals of hot forging and injection moulding	[U]
C103.6	Examine and troubleshoot electrical and electronic circuits	[A]

Course Contents:

GROUP A (CIVIL & MECHANICAL)

Manufacturing Methods –Sheet metal operations - Welding - arc welding, gas welding,Study of TIG & MIG welding. Study of foundry, Demonstration of Smithy and Injection moulding - Carpentry work using power tools - Plumbing components and pipelines

List of Experiments:

S.No	List of Experiments	CO Mapping	RBT
1	Preparation of butt joints and lap joints using arc welding	C103.3	[AP]
2	Sheet metal Forming and Bending, Model making – Trays and funnels.	C103.2	[AP]
3	Preparation of wooden joints by sawing, planning and cutting.	C103.3	[AP]
4	Making basic pipe connections involving the fittings like valves, taps, coupling, unions, reducers, elbows and other components used in household fittings.	C103.4	[AP]
5	Demonstration of foundry operations like mould preparation for solid and split piece pattern.	C103.4	[U]
6	Demonstration of Smithy operations	C103.5	[AP]
7	Demonstration of assembly of pump / Demonstration of Injection moulding	C103.5	[AP]

GROUP B (ELECTRICAL AND ELECTRONICS ENGINEERING)

List of Experiments:

Basic Circuit Elements: Resistor, inductor, capacitor. Introduction to measuring equipments: Moving iron meter, moving coil meter, Wattmeter, Energy meter, CRO, Multi-meter. Digital logic circuits, PCB design, fuse, relay, circuit breaker, wire, Earthing, fan, fluorescent lamp, iron box, mixer grinder, study of FM radio and mobile phone.

S.No	List of Experiments	CO Mapping	RBT
1	Study and identification of electronic components with specification.	C103.6	[A]
2	Testing of CRO and Electronic components using Multimeter.	C103.6	[A]
3	Generation and measurement of signals using CRO.	C103.6	[A]
4	Familiarisation of digital basic gate IC's.	C103.6	[A]
5	Soldering practice-components devices and circuits- using general purpose PCB.	C103.6	[A]
6	Demonstration of meters and electrical components.	C103.6	[A]
7	Safety precautions with electrical components.	C103.6	[A]
8	Residential house wiring.	C103.6	[A]
9	Measurement of power and energy.	C103.6	[A]
10	Trouble shooting of electrical equipments.	C103.6	[A]
	Total Hours:	**45**	

Reference Books:

1	SeropeKalpakjian and Steven R. Schmid, "Manufacturing Engineering and Technology", Pearson Education, Inc. 2009 (Second Indian Reprint).
2	Hajra Choudhury, "Elements of Workshop Technology", Vol. I & II, Media Promotors Pvt Ltd., 2014.
3	Suyambazhagan S, 'Engineering practices' PHI Learning private limited, New Delhi,2012.
4	D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
5	E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.

Web References:

1	www.nptel.ac.in
2	www.sme.org
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	2	2	2	1	1	-	-	-	-	-	-	-	-	-
2	2	2	1	-	1	-	-	-	-	-	-	-	-	-
3	2	2	1	-	1	-	-	-	-	-	-	1	-	1
4	2	1	1	-	1	-	-	-	-	-	-	1	-	1
5	1	1	-	1	1	-	-	-	-	-	-	2	1	2
6	1	1	1	2	1	-	-	-	-	-	-	2	2	2
1	Reasonably agreed			2	Moderately agreed					3	Strongly agreed			

21GE201	UNIVERSAL HUMAN VALUES (All Branches)	3 /0 /0 /3

Nature of Course	C (Theory Concept)

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

Course Outcomes:

Upon completion of the course, students shall have ability to

C201.1	Understand and take responsibilities in life and handle problems to att sustainable solutions while keeping human relationships and human r 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]

Course Contents:

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

Purpose and motivation for the course. Self-Exploration–Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration. Continuous Happiness and Prosperity- A look at basic Human Aspirations. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario. Method to fulfil the above human aspirations: understanding and living in harmony at various levels. Understanding human being as a co-existence of the sentient 'I' and the 'Material Body'. Understanding the needs of Self ('I') and 'Body' - happiness and physical Facility. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer). Understanding the characteristics and activities of 'I' and harmony in 'I'. Understanding the harmony of 'I' with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail-Programs to

ensure Sanyam and Health.

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

Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship. Understanding the meaning of Trust; Difference between intention and Competence. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family. Understanding the harmony in the Nature. Interconnectedness and mutual fulfilment among the four orders of nature recyclability and self regulation in nature. Understanding Existence as Co-existence of mutually interacting units in all- pervasive space. Holistic perception of harmony at all levels of existence.

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

Natural acceptance of human values. Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for the above production systems. Case studies of typical holistic technologies, management models and eco-friendly production systems. Strategy for transition from the present state to Universal Human Order: a. Individual level: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations. Sum up.

Total Hours:	**45**
Text Books:	
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.
Reference Books:	
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	India Wins Freedom - Maulana Abdul Kalam Azad.
Web References:	
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
Online Resources:	
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	Understand	Presentation	20
C201.4	Apply		
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)**	

Course Articulation Matrix														
Course Outcomes (CO)	**Programme Outcomes (PO)**												**Programme Specific Outcomes (PSO)**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
C201.1	-	-	-	-	-	3	-	-	-	-	-	-	-	-
C201.2	-	-	-	-	-	3	-	-	3	-	-	-	-	-
C201.3	-	-	-	-	-	3	-	3	-	-	-	-	-	3
C201.4	-	-	-	-	-	3	3	3	-	-	2	-	-	3
C201.5	-	-	-	-	-	3	3	-	-	-	-	-	-	-

21MA201	ENGINEERING MATHEMATICS II (COMMON TO MECH,MCT,CIVIL,ECE,EEE,CSE,IT,AIDS)	2/1/2/4
Nature of Course	B (100% Analytical)	
Course Objectives:		
1	To gain knowledge in integrals, which are needed in engineering applications.	
2	To develop logical thinking and analytical skills in evaluating multiple integrals.	
3	To acquaint with the concepts of vector calculus needed for problems in all engineering disciplines.	
4	To impart the knowledge of Laplace transform, to find solutions of initial value problems for linear ordinary differential equations.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C201.1	Determine the area and volume by applying the techniques of double and triple integrals.	[R]
C201.2	Finding the values of integrals through different numerical methods.	[U]
C201.3	Differentiate and integrate a vector-valued functions to solve real world applications.	[AP]
C201.4	Calculate grad, div, curl and use Gauss, Stokes and Greens theorem to simplify the calculations of integrals.	[AP]
C201.5	Apply Laplace transform techniques in system modelling, digital signal processing, process control, solving boundary value problems.	[AP]
C201.6	Apply Laplace transform methods for solving linear differential equations.	[AP]

Course Contents:

INTEGRAL CALCULUS **18**

Definite integrals: Evaluation of definite integrals using Bernoulli's formula –Multiple Integrals: Double integration in Cartesian coordinates –Area as double integral –Change of order of Integration – Triple integration in Cartesian co-ordinates –Volume as triple integral –Beta and Gamma functions – Relation between Beta and Gamma Functions – Evaluation of Integrals using Beta and Gamma Functions –Numerical integration:Trapezoidal rule and Simpson's rule for single and double integrals.

VECTOR CALCULUS **14**

Vector differential operator – Gradient of a scalar point function - Directional derivatives – Divergence and Curl of a vector point function – Irrotational and solenoidal vector fields – Simple problems – Vector integration – Green's theorem in a plane, Gauss divergence theorem and Stoke's theorem (theorems statements only)– Simple applications involving cubes and rectangular parallelepipeds.

LAPLACE TRANSFORM **16**

Convergence of Laplace transform – Transform of some standard functions –Unit step function – Unit Impulse function – Properties – Initial and final value theorem – Inverse

Laplace transform – Partial fraction method – Convolution theorem – Application of Laplace transform for solving second orderordinary differential equation.

Lab Components:

1. Double integrals evaluation in cartesian coordinates using MATLAB.
2. Triple integral calculations using MATLAB in cartesian and cylindrical coordinates.
3. Double integral evaluation in MATLAB by Trapezoidal rule.
4. Evaluation of gradient, curl and divergence in MATLAB.
5. Line integral over a vector field using MATLAB
6. Applying Green's theorem to solve integrals in MATLAB.
7. Relation between Laplace transform of function and its derivative using MATLAB.
8. Laplace transform of Dirac delta and Heaviside functions in MATLAB.
9. Solving Differential Equations in MATLAB using Laplace Transform.
10. Inverse Laplace Transformof symbolic expressions using MATLAB.

Total Hours:(48+15)	**60**

Text Books:	
1	G.B.Thomas and R.L.Finney, Calculus and Analytic Geometry, 14thEdition, Pearson, Reprint,2018.
2	Kreyszig. E, "Advanced Engineering Mathematics" Tenth Edition, John Wiley and Sons (Asia) Limited, Singapore 2018.
3	Grewal. B.S, "Higher Engineering Mathematics", 43rd edition, Khanna Publications, Delhi, 2014.
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 Text book of Engineering Mathematics" 9th edition, Laxmi publications ltd, 2014.
Web References:	
1	http://nptel.ac.in/video.php?subjectId=122107037
2	http://nptel.ac.in/courses/122107036/
3	http://nptel.ac.in/video.php?subjectId=117102060
Online Resources:	
1	https://www.coursera.org/learn/pre-calculus
2	https://www.coursera.org/learn/linearalgebra1
3	https://alison.com/courses/Advanced-Mathematics-1
4	https://www.edx.org/course/algebra-lineal-mexicox-acf-0903-1x.

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]
C201.1	Remember	Quiz	20
C201.2	Understand	Seminar	20
C201.3, C201.6	Apply	Tutorial	20
C201.3, C201.6	Apply	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	10	10	10
Understand	40	40	40
Apply	50	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	10	10
Understand	30	30	30
Apply	60	60	60
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 Articulation Matrix														
Course Outcomes (CO)	**Programme Outcomes (PO)**												**ProgrammeSpecificOutcomes (PSO)**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
C201.1	2	2	1	-	-	-	-	-	-	-	-	-	1	1
C201.2	2	2	2	-	-	-	-	-	-	-	-	-	2	2
C201.3	3	3	3	-	-	-	-	-	-	-	-	-	3	3
C201.4	2	2	2	-	-	-	-	-	-	-	-	-	1	2
C201.5	2	2	2	-	-	-	-	-	-	-	-	-	2	2
C201.6	2	2	2	-	-	-	-	-	-	-	-	-	1	2

21CH101	ENGINEERING CHEMISTRY (Common to all I Year B.E. / B.Tech)	3 /0 /3 /4.5

Nature of Course	: E (Theory skill based)

Course Objectives:

1	To make the students conversant with water treatment, boiler feed water techniques.
2	To learn the effect of corrosion in materials and the methods for prevention of corrosion.
3	To understand the principles and applications of electrochemistry and to learn electro analytical methods.
4	To understand the basic concepts, synthesis, and applications of
5	nanomaterials.
	To explore the synthesis and properties of important engineering plastics,
6	energy sources and drug molecules.
	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 requirements of water treatment procedures and boiler feed water for industries.	[R]
C101.2	Apply the various corrosion control techniques in real time industrial environments.	[AP]
C101.3	Understand the principle and working of reference electrodes and conductivity meters as an analyzer.	[U]
C101.4	Understand the basic concepts and applications of Nanochemistry.	[U]
C101.5	Use the knowledge of polymers, various energy sources and storage devices in engineering field.	[AP]
C101.6	Understand the principle and working of certain analytical techniques, and synthesis of some common drug molecules.	[U]

Course Contents:

Water chemistry and Corrosion: Water treatment-characteristics of water-hardness-types and estimation of hardness by EDTA method with numerical problems. Boiler feed water–requirements-disadvantages of hard water. Domestic water treatment-disinfection methods (chlorination, Ozonation, UV treatment)-demineralization process–desalination-reverse osmosis. Corrosion-types–mechanism of dry and wet corrosion-galvanic corrosion-differential aeration corrosion-protective coatings-electroplating of gold-electroless plating of nickel.

Electrochemistry and Energy sources: Electrochemical cells-electrolytic cell-reversible and irreversible cells - Free energy and emf, cell potentials, Nernst equation and applications. Oxidation and reduction potentials-standard hydrogen electrode, saturated calomel electrode, glass electrode-pH measurement. Nanochemistry-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 (H_2-O_2). Storage Devices-Batteries- Alkaline-Lead acid, Nickel cadmium and Lithium-ion batteries.

Polymer chemistry, Spectroscopic techniques and Synthesis of drug molecules: Introduction-monomers and polymers-classification of polymers-Polymerization-types. 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). Synthesis of a commonly used drug molecule-Asprin, p-nitroaniline from acetanilide.

Field work:

Industrial visit- Water treatment plant / Sewage treatment plant / Reverse osmosis plant

Lab Components:		
1	Estimation of hardness of water by EDTA method	[E]
2	Estimation of alkalinity of water sample	[E]
3	Determination of chloride content in bleaching powder	[E]
4	Estimation of dissolved oxygen in water	[E]
5	Potentiometry- determination of redox potentials and emf's	[E]
6	Conductometric titration-mixture of acids vs NaOH	[E]
7	Determination of strength of strong acid by pH metry	[E]
8	Corrosion rate of mild steel in acid medium	[E]
9	Electroplating of nickel over copper	[E]
10	Spectrophotometry-Estimation of iron in water	[E]
11	Separation of mixture of amino acids by thin layer chromatography	[E]
12	Synthesis of Nylon 66	[E]
	Total Hours:	**75**

Understanding the concepts by simple Demonstrations/Experiments:	
1	To observe the hardness of given water sample by soap solution test
2	To view the colour of the different medium of given water sample using litmus paper test
3	To detect the chlorine content in tap water using simple chemical method
4	To know the presence of dissolved oxygen in given water sample using glucose by redox principle
5	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, Dhanpat Rai 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	Physical Chemistry, 11th Edition by P. W. Atkins Publishing Oxford University Press (P) Ltd, United Kingdom, 2018.
5	Nanochemistry, 2nd Edition by K. Klabunde, G. Sergeev Springer Publisher, 2013.
6	N.Krishna Murthy, Vallinayagam D.,"Engineering Chemistry" 3rd Edition by PHI Learning Pvt Ltd.,2014
7	Sunita Rattan, A Text Book of Engineering Chemistry, Student Edition by SK Kataria Publishers, 2013.
8	R.V.Gadag, A.Nithyananda Shetty "Engineering Chemistry" 3rd Edition PHI Learning Pvt Ltd., 2014.
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	Perez, Nestor,"Electrochemistry and Corrosion Science", Springer, 2016.
6	Introduction to Nano: basics to Nanoscience and Nanotechnology, by Sengupta, Amretashis, Sarkar, Chandan Kumar, Springer Publisher, 2015.
7	Ghazi A.Karim. "Fuels, Energy and the Environment", CRC Press, Taylor and Francis group, 2012.
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 2 3 4 5 6	nptel.ac.in/courses/105104102/hardness.htm https://ocw.mit.edu/courses/chemistry nptel.ac.in/courses/105106112/1_introduction/5_corrosion.pdf https://alison.com - Spectroscopic technique, Colorimetry https://ocw.mit.edu/courses/chemistry nptel.ac.in/courses/113108051

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]
C101.1	Remember	Online Quiz-I	20
C101.2, C101.3	Apply, Understand	Assignment-I	20
C101.4	Understand	Online Quiz-II	20
C101.5 & C101.6	Apply, Understand	Assignment-II	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	35	35	35
Apply	45	45	45
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%) 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
6	3	2	2	1	1	-	-	-	-	-	-	1	-	1
1	Reasonably agreed			2	Moderately agreed					3	Strongly agreed			

21EC201	ELECTRON DEVICES	3/0/3/4.5
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, thyristors, rectifiers and filters

Course Outcomes:

Upon completion of the course, students shall have ability to

C201.1	Understand the basic Semiconductor Theory concepts	[U]
C201.2	Construct circuits by applying the theoretical knowledge gained in electron devices	[AP]
C201.3	Analyse the electrical characteristics of unipolar and bipolar devices with the constructed circuits	[AN]
C201.4	Observe and analyse the operation of wave shaping circuits.	[AN]
C201.5	Observe and analyse the operation of half wave rectifier, full wave rectifier with and without capacitive filters	[AN]
C201.6	Design and analyze circuits involving electronic components.	[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. – carrier concentration–continuity equation - Hall effect.

DIODES AND THEIR APPLICATIONS **15**

Formation of P-N junction, forward and reverse biased P-N junction - 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 AND THYRISTORS **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. Thyristors: SCR -– TRIAC – DIAC - UJT operation – characteristics

Lab Component		
1	Characteristic analysis of PN Junction Diode	[E]
2	Characteristic analysis of Zener Diode	[E]
3	Characteristic analysis of BJT	[E]
4	Characteristic analysis of JFET devices	[E]
5	Negative resistance characteristics of UJT	[E]
6	Characteristic analysis of Thyristors	[E]
7	Analysis of wave shaping circuits	[E]
8	Design and analysis of Rectifiers with and without filter	[E]
	Total Hours:	**75**
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**
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]**
C201.1,	Understand	Quiz	**20**
C201.2	Apply	Seminar	**20**
C201.3, C201.4	Analyse	Assignment	**20**
C201.5, C201.6	Analyse	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	20	20	10
Understand	20	20	20
Apply	30	30	35
Analyse	30	30	35
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	10	**-**	10
Apply	50	90	40
Analyse	40	10	50
Evaluate	**-**	**-**	**-**
Create	**-**	**-**	**-**

<table>
<tr><th colspan="8">Assessment based on Continuous and End Semester Examination</th></tr>
<tr><th colspan="7">Continuous Assessment (50%)</th><th>End Semester Examination (50%)</th></tr>
<tr><th colspan="2">CA 1
(100 Marks)</th><th colspan="3">CA 2
(100 Marks)</th><th colspan="2">Practical Exam
(100 Marks)</th><th rowspan="3">Theory Examination
(35%)
Practical Examination
(15%)</th></tr>
<tr><th rowspan="2">SA 1
(60M)</th><th colspan="2">FA 1</th><th rowspan="2">SA 2
(60M)</th><th colspan="2">FA 2</th><th rowspan="2">FA
(75M)</th><th rowspan="2">SA
(25M)</th></tr>
<tr><th>Component-I
(20 Marks)</th><th>Component-II
(20 Marks)</th><th>Component-I
(20 Marks)</th><th>Component-II
(20 Marks)</th></tr>
</table>

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			

21EN101	TECHNICAL COMMUNICATION SKILLS (COMMON TO ALL BRANCHES)	2/0/2/3

Nature of Course	:E(Theory Skill Based)

Course Objectives:

1	To enhance learners' LSRW skills.
2	To develop effective communication skills.
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:

Course Contents:

Module I **10 Hours**

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 Hours**

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 Hours**

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]
	Total Hours:	**15**
	Total Hours:	**30+15=45 Hours**

Text Books:

1	Practical English Usage. Michael Swan. OUP. 1995.
2	Remedial English Grammar. F.T. Wood. Macmillan.2007
3	On Writing Well. William Zinsser. Harper Resource Book. 2001
4	Dr Sumanth S, English for Engineers, Vijay Nicole Imprints Private Limited

	2015.
Reference Books:	
1	Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
2	Communication Skills. Sanjay Kumar and Pushp Lata. Oxford University Press. 2011.
3	Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press
Web References:	
1	http://www.academiccourses.com/Courses/English/Business-English
2	https://**steptest**.in
Online Resources:	
1 2	https://www.coursera.org/specializations/business-english http://www.academiccourses.com/Courses/English/Business-English

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]**
C101.1 C101.2	Understand	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%)**

	CIA1: (60 Marks)	CIA2: (60 Marks)	[100 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	-	-	-

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 (25%) Practical Examination (25%)
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
C101.1	-	-	-	-	-	-	-	-	-	3	-	-	-	-
C101.2	-	-	-	-	-	-	-	2	-	3	-	-	-	2
C101.3	-	-	-	-	-	-	-	2	-	3	2	-	-	2
C101.4	-	-	-	-	-	-	-	-	-	3	-	-	-	-
C101.5	-	-	-	-	-	-	-	-	-	3	-	3	-	-

21ME111	ENGINEERING GRAPHICS	1/0/3/2.5
Nature of Course	Practical application	
Course Objectives:		
1	To know the method to construct the conic curves used in engineering applications.	
2	To develop an understanding of Isometric to orthographic views and vice versa.	
3	To learn the basic projection of straight lines and plane surfaces.	
4	To develop the imagination of solids inclined to one reference plane.	
5	To know the development of surfaces used in various fields.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C111.1	Understand the basic concepts of Engineering Graphics.	[U]
C111.2	Sketch isometric, orthographic projections and projection of lines and planes	[AP]
C111.3	Develop lateral surfaces of solids including prisms and pyramids	[AP]
C111.4	Construct projections of lines, planes, solids and isometric views using modelling software.	[A]

Course Contents:

Conic curves and special curves – Isometric projections, Isometric to orthographic projection-Orthographic to Isometric projection-Projection of lines and plane surfaces-Projection of solids-Development of surfaces-Introduction to perspective projection.

S.No	List of Experiments	CO Mapping	RBT
1	Introduction to drafting software.	C111.1	U
2	Construction of conic curves (Ellipse, Parabola and Hyperbola)	C111.1	U
3	Construction of special curves (Cycloid and Involutes)	C111.1	U
4	Isometric to orthographic projections – manual sketches	C111.2	AP
5	Isometric to orthographic projections – software sketches	C111.4	A
6	Projection of lines - inclined to HP, VP and Both HP & VP	C111.4	A
7	Projection of plane surfaces (Hexagon, Pentagon and circle) – inclined to any one of the principle planes	C111.4	A
8	Projection of solids (Prism and Pyramid) – inclined to HP	C111.3	AP
9	Projection of solids (Cone and Cylinder) – inclined to VP	C111.3	AP
10	Development of surfaces (Prism, Pyramid, Cone and Cylinder)	C111.4	A
11	Introduction to perspective projection	C111.2	U

Total Hours: 45

Reference Books:

1	Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 50th Edition, 2014.
2	K. V. Natarajan, “A Text Book of Engineering Graphics", Dhanalakshmi Publishers, 2018.
3	Gopalakrishna K.R., “Engineering Drawing” (Vol. I&II combined), Subhas Stores, Bangalore, 2011.
4	Venugopal K. and Prabhu Raja V., “Engineering Graphics”, New Age International (P)

	Limited, 2013.
Web References:	
1	http://nptel.ac.in/courses/112102101/
2	www.solidworks.com

Summative assessment based on Continuous and End Semester Examination			
Bloom's Level	**Continuous Assessment (60%)**		**End Semester Examination (40%)**
	FA (45 Marks)	**SA (15 Marks)**	**Practical Examination (40 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	1	1	-	-	-	-	-	-	-	-	-	1	-
2	2	2	3	-	2	-	-	1	-	-	-	-	2	-
3	2	2	3	-	2	-	-	-	-	-	-	-	2	-
4	2	2	3	-	3	-	-	1	-	-	-	-	3	-

1	Reasonably agreed	2	Moderately agreed	3	Strongly agreed

21EC301	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**		
C301.1	Demonstrate knowledge on canonical forms and their realization using logic gates	[U]
C301.2	Applying K- Map and Tabulation method to minimize the Boolean functions.	[AP]
C301.3	Understand various combinational logic and sequential logic circuits and their implementation	[AP]
C301.4	Apply synchronous sequential logic for reducing state reduction.	[AP]
C301.5	Understanding Programmable logic devices and applying for logical function implementation.	[AP]
C301.6	Apply verilog code for realization of combinational logical circuits.	[AP]

Course Contents:

Canonical Forms and Minimization **15**

Minterms, Maxterms, 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 , Code converters – Binary to Gray, BCD to Excess-3, Odd Parity generator and Checker. **Sequential logic circuits:** Latches and flip flops, Realization of one flip flop using other flip flops, Asynchronous Up counter, Shift registers –SISO,SIPO,PISO,PIPO, Case Study: DTMF Decoder.

Synchronous Sequential logic: **15**

Analysis of Synchronous Sequential Circuits using D and T Flip flops, Design of 3 bit sequence

generator, State transition diagrams and state transition tables using Mealy model.PLD's - PLA, PAL, Modelling basic combinational circuits using Verilog**.**	
Total Hours:	**45**
Text Books:	
1	M. Morris Mano, Michael D.Ciletti., "Digital Design",5th Edition, Pearson education, 2018
2	Donald D. Givone, "Digital principles and Design", 2004, McGraw Hill Education India Private Ltd., 29th Reprint, 2017
3	Samir Palnitkar,"Verilog HDL: A Guide to Digital Design and Synthesis" Prentice Hall, Second Edition, 2009
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	http://www.electrical4u.com/digital-electronics.htm
2	http://www.technologystudent.com/elec1/dig1.htm
3	*https://thinkelectronics.org › Electronics › Basics of Digital Electronics*
4	*https://www.geeksforgeeks.org/basic/digital-electronics-logic-design*
Online Resources:	
1	http://www.nesoacademy.org/electronics-engineering/digital-electronics/digital
2	https://www.electronics-tutorials.com/basics/digital-basics.htm
3	https://www.university.youth4work.com › ... › Lectures
4	*https://lecturenotes.in/subject/14/digital-electronics-circuit-dec*

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]**
C301.1	Understand	Quiz	20
C301.2, C301.3	Apply	Assignment	20
C301.4, C301.5	Apply	Case Study	20
C301.6	Apply	Simulation using Logisim	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	-	-	-	-	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			

21EC302	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 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 enable students to design circuits based on amplifiers

Course Outcomes:

Upon completion of the course, students shall have ability to

C302.1	Understand the biasing of BJT & the Basic Concepts of BJT Amplifiers	[U]
C302.2	Understand the biasing of MOSFET & the Basic Concepts of MOSFET Amplifiers	[U]
C302.3	Analyze & Understand the small signal analysis of BJT amplifiers	[AN]
C302.4	Illustrate the operation of various types of Power Amplifiers	[AN]
C302.5	Apply the concepts of negative feedback and positive feedback in amplifiers	[AP]
C302.6	Design and develop a circuit based on the concepts of oscillators	[AN]

Course Contents:

Transistor biasing & Amplifiers:Biasing : 15

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)

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.

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”, 9th 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 ndEdition,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, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C302.1	Understand	Quiz	20
C302.2	Understand	Assignment	20

C302.3, C302.4	Apply	Tutorial	20
C302.5, C302.6	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	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			

21EC303	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, Definition of Inductance and inductors-Inductance due to Solenoid and Toroid, Boundary conditions, Time Varying Field-Maxwells equations.

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, 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 (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	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			

21MA303	TRANSFORMS AND NUMERICAL METHODS ECE / EEE	3/0/0/3

Nature of Course	B (100% Analytical)

Course Objectives:

1	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 variety of engineering fields.
3	To study the concept of mathematical formulation of certain practical problems in terms of partial differential equations and solving for physical interpretation.
4	To find the numerical solution for partial differential equations.

Course Outcomes:

Upon completion of the course, students shall have ability to

C303.1	Recall the basic integration concepts and partial derivatives	[R]
C303.2	Interpret Fourier series solutions to the engineering problems	[U]
C303.3	Apply continuous transforms techniques to evaluate definite integrals	[AP]
C303.4	Apply the Z transform techniques in discrete sequences	[AP]
C303.5	Apply analytical methods to solve the partial differential equations	[AP]
C303.6	Apply numerical methods to solve wave and heat equation with boundary conditions	[AP]

Course Contents:

Module 1: Fourier Series **15 Hrs**

Dirichlet's conditions-General Fourier Series-Odd and Even Functions- Half range sine series and cosine series - Parseval's Identity-Harmonic analysis

Module 2: Fourier Transform and Z Transform **15 Hrs**

Fourier Transform: Complex form of Fourier Transforms – Fourier sine and cosine transforms – Properties – Transforms of simple functions – 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)-Partial fraction method - Formation of difference equations - Solution of difference equations using Z-transform Techniques.

Module 3: Partial Differential Equations **15 Hrs**

Introduction to PDE – Formation of PDE - Solving PDE by Lagrange's linear equations-Linear homogeneous partial differential equations of second order with constant coefficients-Classifications-Numerical Solution to Partial differential Equation-Elliptic equations- Laplace equation - Liebmann's Iteration Process -Poisson equation -Parabolic Equation (one dimensional heat equation) - Bender-Schmidt's Difference Scheme – Crank-Nicholson's Difference Scheme-Hyperbolic Equation (one dimensional wave equation).

Total Hours:	**45 Hrs**

Text Books:	
1	Erwin Kreyszig., “Advanced Engineering Mathematics”,John Wiley and Sons (Asia) Limited, Hoboken,2020.
2	Grewal. B.S, “Higher Engineering Mathematics”, 44th edition, Khanna Publications, Delhi, 2018.
3	Jain M.K. Iyengar, K & Jain R.K., Numerical Methods for Scientific and Engineering Computation, New Age International (P) Ltd, Publishers,6th edition, 2016.
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.
4	P. Kandasamy, K. Thilagavathy and K. Gunavathy, “Numerical Methods”,S.Chand Co. Ltd., New Delhi, 2015.
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]**
C303.1	Remember	Quiz	20
C303.2	Understand	Seminar	20
C303.3 – C303.6	Apply	Tutorial	20
C303.3 – C303.6	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
C303.1	2	2	1	-	-	-	-	-	-	-	-	-	1	-
C303.2	2	2	2	-	-	-	-	-	-	-	-	-	2	-
C303.3	3	3	3	-	-	-	-	-	-	-	-	-	3	-
C303.4	2	2	2	-	-	-	-	-	-	-	-	-	1	-
C303.5	2	2	2	-	-	-	-	-	-	-	-	-	2	-
C303.6	2	2	2	-	-	-	-	-	-	-	-	-	1	-
1	Reasonably agreed				2	Moderately agreed				3	Strongly agreed			

21CS303	MANAGING DATA USING RDBMS	3/0/2/4
Nature of Course:	D (Theory Applications)	

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:

C303.1	Conceptualize data using the data models.	[U]
C303.2	Improve the database design through normalization.	[U]
C303.3	Manipulate a database using SQL.	[AP]
C303.4	Implement advanced SQL concepts on database.	[AP]
C303.5	Infer the transactions management and storage structures 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.

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 Hours**

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

Continuous Assessment									**End Semester Examination**	**Total**
Theory				**Practical**			**Total (A+B)**	**Total Continuous**		
Formative Assessment	**Summative Assessment**	**Total**	**Total (A)**	**Formative Assessment**	**Summative Assessment**	**Total (B)**				

								Assessment		
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]**
C303.1	Understand	Quiz	**20**
C303.2	Understand	Assignment	**20**
C303.3 C303.4	Apply	Group Assignment	**20**
C303.5	Analyze	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	30	40	40
Analyse	20	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%) 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)			

CO – PO & PSO Mapping

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			

21CS304	Problem solving using C++ and Data Structures (Common to ECE and EEE)	3/0/2/4
Nature of Course	F (Theory Programming)	
Course Objectives:		
1	To learn basics of OOPS programming and its basics.	
2	To analyze different types of constructor, Inheritance, polymorphism and File concepts.	
3	To Study the design and applications of linear structures and its applications	
4	To understand the various non-linear data structures like Trees and Graphs along with its applications.	
Course Outcomes		
Upon completion of the course, students shall have ability to		
C304.1	Design, develop and test C++ programs using classes, conditionals, loops and branching statements	[AP]
C304.2	Demonstrate the fundamental concepts of object oriented programming such as constructor, Inheritance and polymorphism	[AP]
C304.3	Discuss the basis of Abstract Classes, interface and Files.	[U]
C304.4	Explore the concepts of Linear structures and apply to any real time applications.	[AP]
C304.5	Implement the concepts of Trees and Graph in real time examples.	[AP]

Course Contents:

Module 1 Beginning with C++ **15 Hours**

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 2 Inheritance and Polymorphism **15 Hours**

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

Module 3 Linear and Non-Linear Data Structure **15 Hours**

Order complexity analysis, Time complexity analysis of iterative and recursive algorithms, Space complexity analysis & its notations, Euclidean algorithm, Sieve of Eratosthenes, Prime factorization, Modular arithmetic, Euler totient function Linked List - Array vs Linked list, Types of linked list - Singly, Doubly and Circular Linked list, Applications of linked list, Problems on Linked list Stack & Queue - Array implementation, Linked list implementation, Expression Evaluation - Infix, Prefix and Postfix, Evaluation of Postfix expression and Problems on Stack, Array implementation, Linked list implementation, Priority Queue and Problems on Queue Trees - Binary Tree, Binary Search Tree - Insertion, Deletion, Traversal - Inorder, Preorder and Postorder, Level order traversal and Problems on Trees Graphs - Matrix and list implementation, Traversal - BFS & DFS, Weighted and Directed graphs, Cycle, Detection in graphs, Problems on Graphs.

Total Hours	**45**

Laboratory Component:

S. No	List of Experiments
1.	Write a C++ program to demonstrate the Looping and Functions.
2.	Write a C++ program to demonstrate constructor and this pointer.
3.	Write a C++ program to implement the Inheritance concepts.
4.	Write a C++program to implement the Compile time and Runtime polymorphism.
5.	Write a C++program to implement the abstract Class, interfaces and File Stream classes.
6.	Write a C++ program to implement the Singly Linked List and Doubly Linked List.
7.	Write a C++ program to implement the Conversion of Infix to Postfix Expression.
8.	Write a C++ program to implement Priority Queue.
9.	Write a C++ program to implement Binary Search tree traversal using integer and Character.
10.	Write a C++ program to implementBreadth first traversal and Depth first traversal.
Total Hours	**30**

Text Books:	
1.	E. Balagurusamy , “Object Oriented Programming with C++”, 6th Edition, Tata Mc Graw HillPublication, 2013.
2.	Mark Allen Weiss, “Data Structures and Algorithm Analysis in C++”, Third Edition, Addison-Wesley, 2007.
3.	A. V. Aho, J. E. Hopcroft, and J. D. Ullman, “Data Structures and Algorithms”, PearsonEducation, 2009.
Reference Books:	
1.	B. Trivedi, “Programming with ANSI C++”, Oxford University Press, 2007.
2.	Rohit Khurana, “Object Oriented Programming with C++”,Vikas Publishing, 2edition, 2014.
3.	Goodrich, Michael T., Roberto Tamassia, David Mount, “Data Structures and Algorithms in C++”, 7th Edition, Wiley. 2004.
4.	Ellis Horowitz, Sartaj Sahni and Dinesh Mehta, “Fundamentals of Data Structures inC++”, GalgotiaPublications , 2007.
5.	Y. Langsam, M. J. Augenstein and A. M. Tenenbaum, “Data Structures using C andC++”, 2nd ed, Prentice- Hall of India, 2009.
Web References:	
1.	https://www.geeksforgeeks.org/c-plus-plus/
2.	https://www.codezclub.com/cpp-solved-programs-problems-solutions/
3.	https://www.javatpoint.com/data-structure-tutorial
4.	https://www.geeksforgeeks.org/data-structures/
Online Resources:	
1.	https://onlinecourses.swayam2.ac.in/cec22_cs19/preview
2.	https://www.coursera.org/learn/data-structures#syllabus

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]**
C304.1	Apply	Quiz & Assignment	**20**
C304.2	Apply	Assignment	**20**
C304.3	Understand	Case study	**20**
C304.4 & C304.5	Apply	Group Assignment	**20**

Assessment based on Summative and End Semester Examination - Theory

Bloom's Level	**Summative Assessment (15%) [120 Marks]**		**End Semester Examination (35%) [100 Marks]**
	CIA1: (60 Marks)	**CIA2: (60 Marks)**	
Remember	10	10	20
Understand	40	30	30
Apply	30	40	40
Analyse	20	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%) 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 Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C304.1	3	3	2	2	2	-	-	-	2	-	-	2	3	2	-
C304.2	3	3	2	2	2	-	-	-	2	-	-	2	3	2	-
C304.3	3	3	2	2	2	-	-	-	2	-	-	2	3	2	-
C304.4	3	3	2	2	2	-	-	-	2	-	-	2	3	2	-
C304.5	3	3	2	2	2	-	-	-	2	-	-	3	3	2	-

21EC304	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 (Full adder & Full Subtractor)	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 (Binary to Octal & Vice versa)	C304.2	[AN]
4	Analysis and Synthesis of Boolean Relations using 2 Digital Comparator	C304.2	[AN]
5	Analysis and Synthesis of Multi-bit Sequential Circuits using Shift Registers (SISO,SIPO,PIPO)	C304.3	[AN]
6	Design a seven segment Electronic clock / Name display.	C304.4	[AN]
7	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			

21EC401	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 familiarizethe linear and non-linear applications of IC 741 operational amplifiers	
3	To sense theconcepts 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**		
C401.1	Understand the functional blocks of Linear IC and conceive the Linear application based on Operation amplifier	[U]
C401.2	Understand the operations and characteristics and application areas of operational amplifiers	[U]
C401.3	Enumeratethe concept of VCO and PLL	[AP]
C401.4	Apply the properties of operational amplifier in designing ADC's, DAC's for real time signal analysis.	[AP]
C401.5	Apply the concept of Integrated circuitsto design Voltage Regulator	[AP]
C401.6	Perform simulation based analysisof 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–current mirror-characteristics of Op –Amp –Wilson Current –Mirror Circuit and Widlar Current –Mirror Circuit, OP-AMP design**,** inverting and non-inverting amplifiers, instrumentation amplifier, integrator and differentiator, voltage-to-current converter, Precision rectifier, Schmitt trigger, Active filtersButterworth 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, 4th edition, 2016. (Reprint)
2	D.Roy Choudhry, Shail Jain, “Linear Integrated Circuits”, New Age International Pvt. Ltd.,2010 (Reprint)
Reference Books:	
1	S.Salivahanan, V S KanchanaBhaaskaran, “Linear Integrated Circuits”, McGraw-Hill, 2nd edition,2015
2	WilliamD.Stanely, “Operational Amplifiers with Linear Integrated Circuits”, Pearson Education, 2004
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 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	Understand	Quiz	20
C401.2	Understand	Assignment	20
C401.3, C401.4,C401.5	Apply	Quiz	20
C401.6	Analyse	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	1	2	1	-	-	-	-	-	-	-	-	-	1	-
2	1	2	2	1	-	-	-	-	-	1	-	-	2	-
3	1	1	2	1	-	-	-	-	1	-	-	-	1	-
4	1	2	3	2	-	-	-	-	-	-	-	-	2	-
5	1	3	2	2	-	-	-	-	-	-	-	-	3	-
6	1	2	1	-	1	2	-	-	-	-	-	-	1	-
1	Reasonably agreed				2	Moderately agreed				3	Strongly agreed			

21EC402	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 signals and systems in terms of both time and frequency domains.	
3	Developing Expertise in time domain and frequency domain approaches to the analysis of Continuous and Discrete systems	
4	Development of the mathematical skills to solve problems involving convolution and filtering	
5	Imparting knowledge of Bio medical signals	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C402.1	Acquire the knowledge of signal, system and its classifications	[R]
C402.2	Analyze the spectral characteristics of continuous-time periodic and aperiodic signals using Fourier Transform.	[AN]
C402.3	Analyze the response of LTI system using convolution integral and LSI system using convolution.	[AN]
C402.4	Analyze system properties based on impulse response and Frequency Response	[AN]
C402.5	Apply Laplace transform for the analysis of continuous-time systems and Z-transform for the analysis of discrete-time signals and systems.	[AP]
C402.6	Understand the fundamental characteristic of Biomedical signals	[U]
Course Contents:		

SIGNALS AND SYSTEMS15

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 AND INTRODUCTION TO BIOMEDICAL SIGNALS 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, Introduction to Biomedical Signals–Electrocardiogram (ECG) –Electroencephalogram (EEG)

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	Leslie Cromwell, "Biomedical Instrumentation and Measurement", Prentice Hall of India, New Delhi, 2/E ,2011
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]**
C402.1 and C402.6	Remember, Understand	Quiz	20
C402.2	Analyze	Assignment	20
C402.3	Analyze	Assignment	20
C402.4 and C402.5	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	-
6	2	2	3	3	2	-	-	-	-	-	-	1	3	1
1	Reasonably agreed			2	Moderately agreed				3	Strongly agreed				

21EC403	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**		
C403.1	Obtain knowledge about modulation concepts and the blocks of analog and pulse communication systems.	R
C403.2	Analyze and design of various modulation and demodulation techniques of analog and pulse communication systems.	AN
C403.3	Apply wave shaping techniques to minimize ISI and analyze modulation techniques with respect to generation, bandwidth and probability of error	AN
C403.4	Acquire knowledge in channel capacity.	U
C403.5	Know the concepts of Source Coding and Error control coding used in Digital Communication	U
C403.6	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, FM broadcasting Systems.

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 - 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, 2009.
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, 2018.

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				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]**
C403.1	Remember	Quiz	20
C403.2, C403.3	Analyze	Assignment	20
C403.4	Understand	Seminar	20
C403.5, C403.6	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)	

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	3	2	2	2	-	-	-	-	-	-	-	2	-
3	2	2	2	2	2	-	-	-	-	-	-	-	2	1
4	3	2	2	1	2	-	-	-	-	-	-	-	2	1
5	3	3	2	2	2	-	-	-	-	-	-	-	2	-
6	3	2	3	2	3	-	-	-	-	-	-	-	2	-
1	Reasonably agreed				2	Moderately agreed				3	Strongly agreed			

21MA402	PROBABILITY AND RANDOM PROCESSES ECE	3/0/0/3

Nature of Course	B (100% Analytical)

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

C402.1	Understand the concept of probability and its features	[R]
C402.2	Understand to handle situations involving random variables and Standard distributions.	[U]
C402.3	Apply skills to handle situations involving single and two dimensional random variables	[AP]
C402.4	Predict the correlation and regression between the random variables	[AP]
C402.5	Use the concepts of random processes in signals and systems	[AP]
C402.6	Apply the concepts of Correlation and spectral density analysis.	[AP]

Course Contents

MODULE I - RANDOM VARIABLE (15 Hrs)

Probability concepts – Addition and Multiplication law of probability – Conditional probability – Total probability theorem, Bayes 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 – Simple problems.

MODULE II - RANDOM PROCESS (15 Hrs)

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 – Limiting distributions.

MODULE III - CORRELATION AND SPECTRAL DENSITIES (15 Hrs)

Auto correlation – Cross correlation – Properties – Power spectral density – Cross

spectral density – Properties – Relationship between cross correlation and cross spectral densities.	
	45 Hrs
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.	Gupta, S.C., &Kapoor, V.K., "Fundamentals of Mathematical Statistics", Sultan Chand &sons, 2000,Reprint 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.	Holly Moore, "MATLAB for Engineers" Fifth Edition , Pearson Publications, 2018.
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]**
C402.1	Remember	Quiz	20
C402.2	Understand	Seminar	20
C402.3 – C402.6	Apply	Tutorial	20
C402.3 – C402.6	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
C402.1	2	1	1	1	-	-	-	-	-	-	-	-	1	2
C402.2	1	2	2	1	-	-	-	-	-	-	-	-	2	1
C402.3	2	2	2	3	-	-	-	-	-	-	-	-	2	2
C402.4	1	1	2	2	-	-	-	-	-	-	-	-	2	1
C402.5	2	3	2	3	-	-	-	-	-	-	-	-	3	2
C402.6	2	3	2	3	-	-	-	-	-	-	-	-	3	2
1	Reasonably agreed				2	Moderately agreed				3	Strongly agreed			

21CS302	JAVA PROGRAMMING	3/0/2/4
Nature of Course	F (Theory Programming)	
Pre requisites	Nil	
Course Objectives:		
1	To learn the object oriented concepts using java programming	
2	To analyze the types of constructor, inheritance and polymorphism	
3	To apply the concepts of package, abstract class and interface	
4	To apply the concepts of exception handling mechanisms in real time problems	
Course Outcomes		
Upon completion of the course, students shall have ability to		
C302.1	Construct the Java programs using class, access modifiers, condition and looping statements	[AP]
C302.2	Implement the java programs using string class, files and serialization concepts	[AP]
C302.3	Develop the programs using objectoriented concepts such as inheritance, abstraction, interface and packages	[AP]
C302.4	Classify the usage of different keywords based on its functionality and use the concepts of association, composition and aggregation for programming	[A]
C302.5	Construct the program using polymorphism and exception handling mechanisms to solve real time problems.	[AP]

Course Contents:

Module 1: 15 Hours

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. if and switch Statements, if-else Branching, switch Statements, Loops and Iterators, usingwhile Loops, Using do Loops, Using for Loops, using break and continue, Unlabelled Statements, Labelled Statements.

Module 2: 15 Hours

tring, StringBuilder, and StringBuffer, The String Class, Important Facts About Strings and Memory,Important Methods in the String Class, The StringBuffer and StringBuilder Classes, Important Methods in the StringBuffer and StringBuilder Classes, File Navigation and I/O, 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.Class and Object, Encapsulation and Abstraction, Inheritance, Polymorphism, Message Passing, ClassSyntax, Access Modifiers, class, class Name, extends, implements keywords, Possible, syntaxes ofClasses, Procedure to use classes in Java, Internal flow in Class Utilization, More than one class inSingle Java Appl, Concrete Methods Vs Abstract Methods. Abstract Classes, Interfaces, MethodSyntax.

Module 3:15 Hours

User defined Immutable Class, Object and Instance Constructors : Introduction, Default Constructor,User Defined Constructors, Constructor Overloading, Instance Block and Instance Flow Of Execution,'this' keyword, 'static' keyword, Class.forName() method internal functionality, newInstance() methodinternal functionality, Utilizations of Class.forName() and newInstance() methods, Factory Methods,Singleton classes, final keyword, 'public static final' Convension for constant variables, enumkeyword,main() method, Introduction To Relationships, Association, Composition and Aggregation.Inheritance: Introduction, Types of Inheritance, Static Context in Inheritance, Instance Context inInheritance, Method Overloading, Rules and Regulations for Method Overriding, Abstract Methodsand Abstract classes Introduction, Concrete Method and Abstract Method, Concreate class andAbstract Class, Abstract Class, Interfaces, Syntaxes between classes, abstract classes and Interfaces. Exception - Call Stack Mechanism the try catch block, The Finally Block, Exception Hierarchy,Multiple Exceptions In a Catch Block, Parameterized Try Block, Overriding Methods And Exception.Creating Your Own Exception, The Assert Keyword.

Total Hours	**45**

Laboratory Component:

S. No	List of Experiments
1.	Write a Java program to demonstrate the Methods, Classes and Constructors.
2.	Write a Java program to demonstrate String concepts.
3.	Write a Java program to implement the Inheritance concepts.
4.	Write a Java program to implement the Polymorphism.
5.	Write a Java program to implement the abstract Class and interfaces.
6.	Write a Java program to demonstrate the concept of File handling.
7.	Write a Java program to demonstrate serialization.
8.	Write a Java program to demonstrate the Java Packages.
9.	Write a Java program to implement Exception Handling Mechanism.
Total Hours	**30**

Text Books:	
1.	Herbert Schildt, “Java: The Complete Reference”, 11th Edition, Oracle Press, 2021
2.	Paul Deitel, Harvey Deitel, “Java How to Program, Late Objects”,11th Edition, Pearson Education,2018
Reference Books:	
1.	Cay S. Horstmann, “Core Java Volume I - Fundamentals”, 11th Edition, Pearson Education, 2020
2.	Y. Daniel Liang, “Introduction to Java Programming”,9th Edition, Prentice Hall Publications ,2015
3.	Robert W Sebesta, “Programming the World Wide Web”, 7th Edition, Pearson Education Inc., 2014.
4.	Steven Holzner, “Java 2 Black book”, Dreamtech Press, 2011.
5.	Timothy Budd, “Understanding Object-oriented programming with Java”, Updated Edition, Pearson Education, 2000
Web References:	
1.	https://docs.oracle.com/javase/tutorial/
2.	https://onlinecourses.nptel.ac.in/noc20_cs58/preview
3.	http://www.javatpoint.com
4.	https://www.geeksforgeeks.org/functional-programming-in-java-with-examples/
Online Resources:	
1.	https://www.coursera.org/learn/object-oriented-java
2.	https://www.coursera.org/specializations/java-object-oriented

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]**
C302.1	Apply	Quiz	**20**
C302.2	Apply	Assignment	**20**
C302.3	Apply	Case Study	**20**
C302.4, C302.5	Analyze	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	10	10	10
Understand	40	40	40
Apply	40	40	40
Analyse	10	10	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	10	10	10
Understand	30	10	10
Apply	40	60	60
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%) 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
C302.1	3	3	2	2	2	-	-	-	2	-	-	2	3	2
C302.2	3	3	2	2	2	-	-	-	2	-	-	2	3	2
C302.3	3	3	2	2	2	-	-	-	2	-	-	2	3	2
C302.4	3	3	2	2	2	-	-	-	2	-	-	2	3	2
C302.5	3	3	2	2	2	-	-	-	2	-	-	3	3	2
1	Reasonably agreed				2	Moderately agreed				3	Strongly agreed			

21IT301	WEB DEVELOPMENT USING REACT	3/0/2/4
Natureof Course	F (Theory programming)	
Pre requisites	Nil	

Course Objectives:

1.	To discuss the essence of front-end development skills.
2.	Ability to understand and use JavaScript in client-side web applications.
3.	To impart the knowledge of React components used in web application development platforms.
4.	To deploy and test the React App used in Web Applications.

Course Outcomes

Upon completion of the course, students shall have ability to

C301.1	Demonstrate the client-side JavaScript application development and the React library.	[U]
C301.2	Illustrate the single page applications in React.	[U]
C301.3	Utilize the various React features including components and forms.	[AP]
C301.4	Show the functionality of front-end UI applications using React.	[R]
C301.5	Apply CSS for designing responsive React applications.	[AP]
C301.6	Identify the use Redux-Redux and Axios package.	[AP]

Course Contents:

Module - I: **15 Hours**

JavaScript Essentials, How JavaScript works, Event loop, Stack, Heap and Queue, Node.js Fundamentals, Introduction to Node.js, Why Node.js?, Traditional Programming Limitations, React Introduction, Overview of frameworks, libraries for client side Web applications, Understanding “what” and “why” React, React Component Demonstration using code pen, Environment Setup for React Application. Understanding NPM commands, Using VS Code, VS Code extensions for ES6, React(formatting and check styles), Hello world app in React, React Essential Features and Syntax, React App Project Directory Structure, Overview of Webpack, Babel, React Component Basic, Create React Component, Understanding JSX, Limitations of JSX, Working with Components and Reusing Components.

Module - II: **15 Hours**

React Components - Props and State, Understanding and using Props and State, Handling Events with methods, Manipulating the State, Two way data-binding, Functional (Stateless) VS Class (Stateful) Components, Parent – Child Communication, Dynamically rendering contents, Showing Lists, List and keys, Styling Components, CSS Styling,

Scoping Styles using Inline Styles, Limitations of inline styles, Inline Styles with Radium, Google Material UI, Installing Material UI, Material UI AppBar, Material UI's Toolbar, Custom React NavBar. CSS - Material UI Buttons, Using Material UI - Rendering a Button, Material UI Card, Material UI Checkbox, Material UI Grid Component, Material UI IconButton, Material UI Paper Component, Style Material UI Components with my own CSS, UI Templates for Business, Typography Usage, Debugging React Apps, Understanding React Error Messages, Handling Logical Errors, Debugging React apps using google developer tools and React DevTool. Understanding Error Boundaries, React Component life cycle, Updating life cycle hooks, Pure Components, React's DOM Updating Strategy, Returning adjacent elements, Fragments, React Component in Details, Higher Order Components, Passing unknown Props, Validating Props, Using References, React Context API, Updated LifeCycle hooks (16.3)

Module – III: **15 Hours**

React Projects, Demo apps, HTTP Requests/Ajax Calls, HTTP Requests in React, Introduction of Axios package, HTTP GET Request, fetching & transforming data, HTTP POST, DELETE, UPDATE, Handing Errors, Adding/Removing Interceptors, Creating/Using Axios instances, Redux, React Thunk, Difference between Thunk& other, React hooks, Application Using React & Redux , React Routing, Routing and SPAs, Setting Up the Router Package, react-router vs react-router-dom, Preparing the Project For Routing, Switching Between Pages. Routing-Related Props, The "withRouter" HOC & Route Props, Passing & extracting route/query parameters, Using Switch to Load a Single Route, Navigating Programmatically. React Forms and Form Validation, Creating a Custom Dynamic Input Component, Setting Up a JS Config for the Form, Dynamically Create Inputs based on JS Config, Adding a Dropdown Component. Handling User Input, Handling Form Submission, Adding Custom Form Validation, Fixing a Common Validation, Adding Validation Feedback, Showing Error Messages, Handling Overall Form Validity, Deploying React App to the Web, Testing React apps with Jasmine & implementing JEST.

Total Hours	**45**

Lab Component:

S. No.	List of Experiments
1	Create a Stateless Functional Component
2	Create a Stateful Class Component
3	Implementation of Conditional Rendering using Class Component
4	Implementation of Communication (Parent-child) between Components
5	Create material UI Card using React
6	Design a Custom Navigation bar using React
7	Implementation of React component to handle HTTP requests

8	Implementation of a Dropdown component using React
9	Implementation of Routing in React
10	Implementation of FORM validation in React
	Total Hours: 30

Text Books:	
1.	Robin Wieruch , “The Road to React”, 2022 Kindle Edition.
2.	Alex Banks,Eve Porcello. “Learning React: Modern Patterns for Developing React Apps”,O'Reilly Media,2020.
3.	Adam Bouch, “React and React Native”,Packt Publishing,3rd Edition, 2020.
4.	KirupaChinnathambi , “Learning React : A Hands-On Guide to Building Web Applications Using React and Redux”,Pearson Education, Second Edition,2018.
Reference Books:	
1.	Adam Boduch, Roy Derks “React and React Native: A Complete Hands-on Guide to Modern Web and Mobile Development with React.js”,Packt Publishing, 2020.
2.	Carlos Santana Roldan, “React Cookbook”,Packt Publishing,2018.
3.	Lionel Lopez, “React: Quickstart Step-by-step Guide to Learning React Javascript Library (React.js, Reactjs, Learning React Js, React Javascript, React Programming)”,CreateSpace Independent Publishing Platform,2017.
Web References:	
1.	https://www.coursera.org/learn/front-end-react
2.	https://www.geeksforgeeks.org/full-stack-development-with-react-node-js-live/
3.	https://www.edx.org/learn/front-end-web-development
4.	https://www.w3schools.com/REACT/DEFAULT.ASP
Online Resources:	
1.	https://reactjs.org/
2.	https://www.youtube.com/watch?v=3HMtarQAt3A
3.	https://frontendmasters.com/guides/front-end-handbook/2018/what-is-a-FD.html
4.	https://www.youtube.com/watch?v=HT82p_re-EY

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]**
C301.1	Understand	Assignment - 1	**20**
C301.2,	Understand	Quiz	**20**
C301.3 C301.4	Apply, Remember	Assignment - 2	**20**
C301.5, C301.6	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	10	10
Understand	10	10	15
Apply	70	80	75
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	10	10
Understand	20	10	10
Apply	70	80	80
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 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
C301.1	3	3	3	2	2	-	-	-	2	2	2	2	3	3
C301.2	3	3	3	2	2	-	-	-	2	2	2	2	3	2
C301.3	3	3	3	3	2	-	-	-	3	2	2	2	3	2
C301.4	3	3	3	2	3	-	-	-	2	2	2	2	3	3
C301.5	3	3	3	2	3	-	-	-	2	2	2	2	3	3
C301.6	3	3	3	2	3	-	-	-	3	2	3	2	2	2
1	Reasonably agreed				2	Moderately agreed				3	Strongly agreed			

21EC404	CIRCUITS LABORATORY	0/0/2/1

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	[AN]
C404.4	Construct different circuits to generate sinusoidal and non-sinusoidal waveforms	[AP]
C404.5	Observe the Applications of operational amplifiers	[AP]
C404.6	Analyse the performance of the various 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	C404.4	[AP]
5.	Inverting and Non Inverting Op – amp.	C404.5	[U]
6.	Applications of Op-Amp (Adder, Subtractor, adder-subtractor, Instrumentation Amplifier).	C404.5	[U]
7.	**Using Multisim /OrcadPspice Tool:** Simulation of Common Source MOSFET Amplifier and its input & output characteristics.	C404.6	[AP]
8.	Cascade Amplifiers using Darlington Pair of Transistors	C404.6	[AP]
9.	Simulation of Wein Bridge Oscillator and RC Phase shift oscillator	C404.6	[AP]
10.	Simulation of Multivibrator.	C404.6	[AP]

11.	Simulation of Analog to Digital Converter and Digital to Analog Converter	C404.6	[AP]
		Total Hours:	**30**

Reference Books:	
1	Millman J and Halkias .C, “Integrated Electronics”, Second Edition, TMH, 2012
2	Salivhanan, ‘Electron Devices and Circuits’, 4th edition, McGraw Hill Education (India) Private Ltd., 2016
3	D.Roy Choudhry, Shail Jain, “Linear Integrated Circuits”, New Age International Pvt. Ltd.,2010
4	S.Salivahanan, V S KanchanaBhaaskaran, Linear Integrated Circuits, McGraw-Hill, 2nd edition,2015
5	PoornachandraRao.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**	**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	2	1		-	-	-	-	-	-	1	2	1
2	3	2	2	1		-	-	-	-	-	-	-	2	-
3	3	1	2	2		-	-	-	-	-	-	1	2	1
4	3	2	3	3		-	-	-	-	-	-	-	3	-
5	3	2	3	3		-	-	-	-	-	-	1	3	1
1	Reasonably agreed				2	Moderately agreed				3	Strongly agreed			

21EC405	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	Design, construct and analyse the performance of various continuous modulation and demodulation circuits.	[AN]
C405.2	Design 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	Design an amplitude modulation system with envelope detection and study its (a) signal handling and (b) frequency response characteristics.	C405.1	[AN]
2	Design Frequency modulation.	C405.1	[AN]
3	Design and test a mixer stage for translating AM signal to IF frequency stage.	C405.2	[AN]
4	Design PAM, PPM and PWM.	C405.2	[AN]
5	Simulation of AM, FM, Sampling Process	C405.3	[AP]
6	Design 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, 2009.

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.
5. Behrouz Forouzan and FirouzMosharraf, Computer Networks: A Topdown approach, SIE, McGraw-Hill, 2012.

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	1	1	3	3	2	-	-	-	-	-	-	1	2	-
2	-	1	2	2	1	-	-	-	-	-	-	-	2	-
3	-	1	2	2	3	-	-	-	-	-	-	-	2	-
4	-	2	2	2	1	-	-	-	-	-	-	-	3	-
5	-	-	3	3	1	-	-	-	-	-	-	-	3	-
1	Reasonably agreed				2	Moderately agreed				3	Strongly agreed			

21EC501	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, Instruction set, Addressing modes, Interrupts, Power down operation, Memory organization, Programming 8051, Micro controller based system designs-LCD – temperature and gas sensors-Stepper motor -RTC-I2C. Memory Interfacing and I/O interfacing - Serial communication interface – Timer – 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 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**	**PO**	**PO**	**PO**	**PO**	**PO**	**PO**	**PO**	**PO**	**PO**	**PO**	**PO**	**PSO**	**PSO**
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**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			

21EC502	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				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
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	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PSO	PSO
	1	2	3	4	5	6	7	8	9	10	11	12	1	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			

21EC503	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	Explore their acquired knowledge for the applications of discrete Fourier Transform and Multirate signal processing.	[AP]
C503.3	Analyze the transformation techniques for analog to digital IIR filter design.	[AN]
C503.4	Analyze various techniques for design of FIR filters.	[AN]
C503.5	Understand the concepts of quantization effects and the behavioral changes in filter response	[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) – Multirate 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, 4th Edition, 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//digital signal processing/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	Apply	Group 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	10	10
Understand	20	20	30
Apply	40	20	20
Analyse	20	40	30
Evaluate		10	10
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	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PSO	PSO
	1	2	3	4	5	6	7	8	9	10	11	12	1	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
C503.1	3	3	3	2	2	-	-	-	-	-	-	1	2	1
1	Reasonably agreed				2	Moderately agreed				3	Strongly agreed			

21EC504	VLSI DESIGN	3/0/0/3
Nature of Course	:G (Theory & Analytical)	
Course Objectives:		
1	Introduce the basics of Integrated Circuits and fabrication process.	
2	Familiarize the basics of CMOS transistors and its characteristics	
3	Gain knowledge on CMOS logic structures for various combinational and sequential circuits at logic design level	
4	Introduce concepts on clock design and programming using HDL and simulate basic combinational and sequential logic circuits using HDL language	
5	Implementing logical circuits of sequential and combinational circuits using FPGA for real time applications	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C504.1	Understand the basics of VLSI circuits and Fabrication methods from Industry perspective	[U]
C504.2	Analyze the various CMOS structures at transistor level with suitable layout diagrams	[AP]
C504.3	Analyze the MOS transistor equation and parasitic component parameters	[AN]
C504.4	Analyze the basic logic gates and expressions based on various CMOS logic structures and their characteristics	[AN]
C504.5	Design and construct the combinational and sequential logic circuits using Verilog HDL programming	[AP]
C504.6	Understand the clock phase designs on sequential logic circuits	[U]

Course Contents:

Issues and Challenges in Digital IC Design: 15

Design hierarchy, Layers of abstraction - Behaviour level, Structural level, Logical Level. Integration density and Moore's law, VLSI design flow - Cell Design – Front end Tools and Back end Tools, MOS Transistor - Review of NMOS - Ids vs Vds relationship, PMOS, CMOS Transistor, Second Order effects, CMOS Logic: Basic gates, Complex Gates, MOSFET fabrication: NMOS Fabrication, CMOS P-well and N-well process, Silicon on Insulator, Stick Diagram, Layout Diagram – NOT –NAND - NOR - Layout Design rules.

Circuit Characterization: 15

MOS Device Equations, CMOS Inverter- DC Characteristics - Estimation of Resistance and Capacitance - Elmore Constant - RC Equivalent circuit - RC Arrays - Logical Effort, Switching characteristics, Power dissipation - Delays - CMOS Logic structures: Pseudo-nMOS, Dynamic CMOS, Clocked CMOS, Domino Logic - Design of Boolean function using Logic structures - Power dissipation in logic structures - Noise margin - Combinational Logic Design**:** Static CMOS, Ratioed Circuits, Pass Transistor, Transmission gate, Cascade Voltage Switch Logic, Dynamic Logic Circuits, Implementation of Boolean functions.

Sequential Circuits Design: Classification, Parameters, Static Latches and Register, Race Condition, Dynamic Latches and Registers, Two Phase vs. Single Phase clock designs, Verilog HDL modeling for combinational and sequential circuits - Adders, Subtractors, Multiplexer, Demultiplexer, Multiplier, Comparator, Encoders and Decoders, Registers, Counters, FIFOs, RAMs,Test benches. Pre Validation & Post Validation Techniques.	**15**
	45

Text Books:	
1.	N.Weste, K.Eshraghian, “Principles of CMOS VLSI Design”, Second Edition, Addision Wesley, 2016
2.	J.M. Rabaey, A. Chandrakasan and B. Nikolic, Digital Integrated Circuits- A Design Perspective, Third Edition,Prentice Hall of India, 2016
3.	A. Pucknell, Kamran Eshraghian, “BASIC VLSI Design”, Third Edition, Prentice Hall of India, 2007.
4.	Samir Palnitkar,Verilog HDL: A Guide to Digital Design and Synthesis, Second Edition, Prentice Hall PTR, 2003
Reference Books:	
1.	J. P. Uyemura, Introduction to VLSI Circuits and Systems, John Wiley & Sons (Asia), 2015.
2.	Muhammed H Rashid, SPICE for circuits and Electronics using PSPICE, Pearson Education,1994.
3.	Gordon Roberts, Adel Sedra, SPICE, The Oxford Series in Electrical and Computer Engineering, 2nd edition,1996
4.	W. Wolf, “Modern VLSI Design - System on Chip design”, Third Edition, Pearson Education, 2015.
5.	D. A. Hodges, H. G. Jackson, R. Saleh, “Analysis and Design of Digital Integrated Circuits in Deep submicron Technology” Third Edition, McGraw Hill, 2005.
Web References:	
1.	https://www.tutorialspoint.com/vlsi_design/
2.	https://electronicsforu.com/resources/learn-electronics/vlsi-developments-ic-fabrication
3.	http://www.vlsi-expert.com/p/vlsi-basic.html
4.	https://www.engineersgarage.com/articles/vlsi-design-future
5.	www.vlsi-expert.com/p/vlsi-basic.html
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]**
C504.1	Understand	Quiz	20
C504.2, C504.3	Apply	Assignment	20
C504.4, C504.5	Apply	Simulation using Modelsim	20
C504.6	Understand	Case Study in Clock design	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	20	30
Apply	30	30	30
Analyse	10	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**	**PO**	**PO**	**PO**	**PO**	**PO**	**PO**	**PO**	**PO**	**PO**	**PO**	**PO**	**PSO**	**PSO**
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	**3**	**2**	**2**	**3**	**-**		**-**	**-**	**1**	**1**	**-**	**-**	**3**	**-**
2	**3**	**3**	**3**	**2**	**-**		**-**	**-**	**1**	**1**	**-**	**-**	**3**	**-**
3	**3**	**3**	**2**	**2**	**1**		**-**	**-**	**1**	**1**	**-**	**-**	**2**	**-**
4	**3**	**2**	**2**	**2**	**1**		**-**	**-**	**1**	**1**	**-**	**-**	**2**	**-**
5	**3**	**2**	**2**	**2**	**1**		**-**	**-**	**1**	**1**	**-**	**-**	**2**	**-**
6	**3**	**3**	**2**	**1**	**-**		**-**	**-**	**2**	**1**	**2**	**-**	**2**	**-**
1	Reasonably agreed				2	Moderately agreed				3	Strongly agreed			

21EC505	DIGITAL SIGNAL PROCESSING LABORATORY	0/0/2/1

Nature of Course: M (Practical application)

Course Objectives:

1. To simulate basic signals, convolution and analyze system using MATLAB code
2. To design, constructing Discrete Fourier Transform techniques and Multirate signal processing.
3. To implement the logic of FIR and IIR filter technique using MATLAB code and TMS320 Processor.

Course Outcomes

C505.1	Understand the concept basic signals and convolution technique	[AN]
C505.2	Construct the applications of discrete Fourier Transform and Multirate signal processing.	[AN]
C505.3	Analyze and simulate various techniques for design of FIR filters.	[AN]
C505.4	Analyze and simulate the transformation techniques for analog to digital IIR filter design	[AN]
C505.5	Simulate quantization effects and the behavioral changes in filter response	[AN]
C505.6	Implementing the application of DSP using MATLAB code	[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	C505.2	[AP]
4.	Design of FIR filter using windowing technique	C505.3	[AN]
5	Design of IIR filter using Impulse invariant and Bilinear transformationtechnique	C505.4	[AN]
6	Quantization effects in digital filter design	C505.5	[AN]
7	Multirate Signal processing- Interpolation Decimation	C505.2	[AP]
8	Analysis of ECG signal	C505.6	[AN]
9	Analysis of EEG signal	C505.6	[AN]
Experiments Using TMS320C50/6713 Processor			
10	Study of architecture of Digital signal processor	C505.1	[U]
11	Implementation of N-Point DFT	C505.2	[E]
12	Implementation of FFT algorithm	C505.2	[E]
13	Convolution process	C505.1	[E]
14	Implementation of FIR filter	C505.3	[E]
15	Implementation of IIR filter	C505.4	[E]
		Total Hours	**30**

Reference Books:

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

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	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PSO	PSO
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
C505.1	2	2	2	1	2	-	-	-	-	1	-	-	3	-
C505.2	2	2	2	1	2	-	-	-	-	1	-	-	3	-
C505.3	2	2	2	1	2	-	-	-	-	1	-	-	3	-
C505.4	2	2	2	1	2	-	-	-	-	1	-	-	3	-
C505.5	2	2	2	1	2	-	-	-	-	1	-	-	3	-
C505.6	3	3	3	2	2	-	-	-	-	1	1	1	3	1
1	Reasonably agreed				2	Moderately agreed				3	Strongly agreed			

21EC506	VLSI LABORATORY	0/0/2/1

Nature of Course: M (Practical application)

Course Objectives:

1. To design, construct and debug MOSFET circuits.
2. To simulate basic combinational and sequential logic circuits using Verilog HDL language
3. Implementing logical circuits using FPGA.

Course Outcomes

C506.1	Construct various types of MOSFET circuits and analyze their behaviour	[AN]
C506.2	Construct basic logic gates using backend tool and analyze their power and timing parameters	[AN]
C506.3	Construct and simulate various Combinational logic circuits using Verilog HDL	[AN]
C506.4	Construct and simulate various Sequential logic circuits using Verilog HDL	[AN]
C506.5	Construct, simulate and synthesize various Architecture based Designs using Verilog HDL	[AN]
C506.6	Implement logical circuits by interfacing with FPGA	[AP]

Course Content:

S.No	List of Experiments	CO Mapping	BT
	SPICE Simulation		
1	DC Characteristics of CMOS	C506.1	[AN]
2	Switching Characteristics of CMOS Inverter	C506.1	[AN]
3	Transient analysis of CMOS NAND, NOR and simple multiplexers	C506.2	[AN]
4	Transient Analysis of XNOR & XOR gate using Pass transistor logic	C506.2	[AN]
5	Characterization of CMOS Ring Oscillator	C506.1	[AN]
	Logic Simulation & Synthesis using Verilog		
6	Simulation and Synthesis of MSI combinational circuits (Full Adder, Full subtractor, Multiplexer, Demultiplexer, Encoder and Decoder)	C506.3	[AN]
7	Simulation and Synthesis of MSI sequential circuits (Flipflops, Registers, Memory Elements- Simple RAM, FIFO)	C506.4	[AN]
8	Simulation and Synthesis of Architecture based Designs (Adder-Subtractor, Ripple carry Adder, Booth Multiplier)	C506.5	[AN]
9	Implementation of Combinational Circuits using FPGA	C506.6	[AP]
		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

4. A. Pucknell, Kamran Eshraghian, “Basic VLSI Design”, Third Edition, Prentice Hall of India, 2007.

Web References:

1. http://www.electrical4u.com/digital-electronics.htm
2. 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	20	20	40
Analyse	80	80	60
Evaluate			
Create			

Course Articulation Matrix														
CO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PSO	PSO
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
C506.1	2	2	2	1	2	-	-	-	1	1	-	-	3	-
C506.2	2	2	2	1	2	-	-	-	1	1	-	-	3	-
C506.3	2	2	2	1	2	-	-	-	1	1	-	-	3	-
C506.4	2	2	2	1	2	-	-	-	1	1	-	-	3	-
C506.5	2	2	2	1	2	-	-	-	1	1	-	-	3	-
C506.6	3	3	3	2	2	-	-	-	1	1	1	1	3	1
1	Reasonably agreed				2	Moderately agreed				3	Strongly agreed			

21EC601	ANTENNAS AND WAVE PROPAGATION	3/0/0/3
Nature of Course	G (Theory & Analytical)	

Course Objectives:

1	To gain knowledge in radiation field and its basic characteristics
2	To know the basics of antenna array and its applications.
3	To acquire knowledge on different types of antennas and its applications
4	To gain knowledge in different wave propagation phenomenon
5	To gain knowledge in transmission line characteristics and diversity techniques

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

C601.1	Recall basic electromagnetic theory concepts.	[R]
C601.2	Draw antenna radiation pattern and measure different antenna parameters.	[U]
C601.3	Design antenna array pattern and determine its basic parameters	[AP]
C601.4	Performance analysis of special antennas	[AN]
C601.5	Apply wave propagation techniques in different applications	[AP]
C601.6	Select and apply diversity techniques for antenna design and to recall transmission line characteristics	[AP]

Course Contents:

Fundamental Concepts and Antenna Arrays: 15

Physical concept of radiation, Antenna parameters: Radiation pattern, gain, directivity, effective aperture, Baluns,Antenna noise temperature, Radiation from oscillating dipole, half wave dipole folded dipole antenna, Array of point sources, end fire and broadside arrays, pattern multiplication, synthesis of binomial array,Tschebyscheff array, Planar array antennas.

Special Antennas: 15

Huygens' Principle, Slot antenna, Babinet's principle, Radiation from rectangular MSA,Circular MSA and feeding techniques, horn antenna, parabolic reflector antennas, feeding techniques, Smart antenna: Historical development of smart antennas, Phased array antennas, fixed weight beamforming basics, Adaptive beamforming, switched weight beamforming,UWB-antenna,RFID-Antenna,Werable-antenna,Bandwidth-and-Gain enhancement techniques.

Wave Propagation, Transmission line characteristics and Diversity Techniques: 15

Modes of propagation: Ground wave, surface wave, and space wave propagation; Tropospheric and duct propagation; Multipath fading and ray bending, Flat earth and curved earth concept, Virtual height, Critical frequency, Maximum usable frequency, Skip distance,Fading,Multi hop propagation, Transmission line Parameters, Characteristic Impedance, Impedance matching and transformation, Propagation Constant, Space diversity, Polarization diversity, Frequency diversity, Time diversity.

Total Hours:	**45**

Text Books:

1	K D Prasad, "Antenna and Wave Propagation", Third Edition (Reprint), Satya Prakashan, 2017.
2	Edward C. Jordan and Keith G. Balmain, "Electromagnetic Waves and Radiating Systems", 2nd Ed., Prentice-Hall of India.2015.
3	Frank B Gross, "Smart Antennas with MATLAB",Second Edition, Tata McGraw-Hill Publications 2015.

Reference Books:

1	Constantine A. Balanis, "Antenna Theory and Design", Third Edition, John Wiley & Sons. 2015.
2	Theodore S Rappaport, "Wireless Communication:Principles and Practice,SecondEdition,Prentice Hall of India,2002.
3	John D.Kraus Ronald J Marhefka, and Ahmad S Khan "Antennas and Wave Propagation", Fifth Edition, Tata McGraw-Hill Publications, 2017.
4	John D Rider, "Neworks, Lines and Fields", Prentice-Hall of India (PHI), Second Edition, 2014.

Web References:	
1	http://www.antenna-theory.com
2	https://www.tutorialspoint.com/antenna_theory
3	http://www.amanogawa.com/archive/antennaA.html
Online Resources:	
1	https://archive.nptel.ac.in/courses/108/101/108101092/
2	https://onlinecourses.nptel.ac.in/noc23_ee130/preview

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]
C601.1	Remember	Quiz	20
C601.2	Understand	Class Presentation	20
C601.3&C601.4	Apply	Problem Solving	20
C601.5&C601.6	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	20	20	20
Understand	30	30	30
Apply	50	30	50
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**	**PO**	**PO**	**PO**	**PO**	**PO**	**PO**	**PO**	**PO**	**PO**	**PO**	**PO**	**PSO**	**PSO**
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	1	-	-	-	-	-	-	-	-	-	-	1	-	1
2	2	1	-	-	-	-	-	-	-	2	-	1	-	1
3	3	2	2	1	-	-	-	-	-	-	-	1	-	1
4	3	3	2	2	-	-	-	-	-	-	-	2	-	2
5	3	2	2	1	-	-	-	-	2	-	-	1	-	1
6	3	2	2	1	-	-	-	-	2	-	-	1	-	1
1	Reasonably agreed				2	Moderately agreed				3	Strongly agreed			

21EC602	EMBEDDED SYSTEMS AND ITS APPLICATIONS	3/0/0/3

Nature of Course	: F (Theory)

Course Objectives:

1	Learn the architecture and process of embedded systems
2	Observe the importance of embedded systems in network scenario
3	Be familiar with the embedded computing platform design and analysis.
4	Be exposed to the basic concepts of real time Operating system.
5	Learn the system design techniques and networks for embedded systems
6	Experience the real time consumer electronic systems

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

C602.1	Understand the various characteristics and challenges of Embedded systems	[U]
C602.2	Understand the role of embedded systems in network and vehicle as network	[U]
C602.3	Understand the requirements, specification and basic compilation techniques	[U]
C602.4	Analyze the program and validation through testing	[AN]
C602.5	Apply the real time operating system characteristics such as scheduling algorithms for the real time scenario	[AP]
C602.6	Ability to design a system by gaining knowledge from various real time practical applications	[AP]

Course Contents:

Introduction of Embedded systems and Networks for Embedded Systems :
Characteristics-Challenges of Embedded Systems –Categories of embedded systems, overview of embedded architecture, specialities of embedded systems, recent trends in embedded systems,Networks for Embedded Systems, Vehicles as Networks, Design Example: Elevator Controller.

Embedded system design process and system design techniques: 15
Requirements, specifications, designing hardware and software components, system integration, Basic compilation techniques. Design methodologies, requirement analysis, specifications, quality assurance. Program validation and testing, clear box testing, black box testing, evaluation function tests, performance testing.

Real time operating system concepts, characteristics and case studies:15
Introduction – Multiple tasks and multiple processes. Architecture of the kernel, tasks and task scheduler, task states, context switching, scheduling algorithms, rate monotonic analysis, task management function calls, interrupt service routine, semaphore, mutex, mailboxes, message queues, event registers, pipes, signals timers, memory management, priority inversion problems, Clock driven approach, Round robin approach, priority driven approach, dynamic vs static systems, Effective release time and deadlines. Off-line vs on-line scheduling, overview of RTOS, off the shelf operating systems, embedded OS, real time operating systems, handheld OS. Case studies of program modelling and programming with RTOS, Automatic chocolate vending machine, Orchestra playing robots, adaptive cruise control in a car, smart card

Total Hours:	45

Text Books:

1	Dr KVKK Prasad," Embedded/Real time systems: Concepts, design and programming", 25th Edition, Pearson education, Dreamtech press,2017
2	Marilyn Wolf, "Computers as Components - Principles of Embedded Computing System Design", Fifth Edition ,Morgan Kaufmann Publisher , 2022
3	Rajkamal, "Embedded Systems: Architecture, Programming and Design", Third Edition, TMH Publications, ,2017,

Reference Books:

1	Qing Li, “Real time concepts for Embedded systems, CMP Books 2005
2	Jane W S Liu, “Real time systems”, Prentice Hall,2000
3	Jonathan W.Valvano, “Embedded Microcomputer Systems Real Time Interfacing”, Third Edition Cengage Learning, 2012.
Web References:	
1	https://www.tutorialspoint.com/embedded_systems/es_overview.htm
2	https://www.electronics-notes.com/articles/digital-embedded-processing/embeddedsystems/basics-primer.php
3	https://www.mathworks.com/solutions/embedded-systems.html
4	https://spectrum.ieee.org/computing/embedded-systems
Online Resources:	
1	https://www.edx.org/course/embedded-systems-shape-the-world-microcontroller-inputoutput
2	https://onlinecourses.nptel.ac.in/noc18_cs54
3	https://www.coursera.org/learn/introduction-embedded-systems
4	https://www.coursera.org/learn/embedded-operating-system

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]**
C602.1& C602.2	Understand	Quiz	20
C602.3& C602.4	Understand, Analyze	Assignment	20
C602.5	Apply	Simulation Exercise	20
C602.6	Apply	Design	20

Assessment based on Continuous 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	30
Analyse	40	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	1	1	1	1	-	-	-	-	-	-	2	3	-
2	2	2	2	1	1	-	-	-	-	-	-	2	2	-
3	2	3	2	2	1	-	-	-	-	-	-	2	3	-
4	2	3	2	2	1	-	-	-	-	-	-	2	3	-
5	2	2	3	2	1	-	-	-	-	-	-	3	3	1
6	2	2	3	2	1	-	-	-	-	-	-	3	3	2
1	Reasonably agreed				2	Moderately agreed				3	Strongly agreed			

21EE611	CONTROL ENGINEERING	3/0/0/3

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

C611.1	Construct the mathematical models of various control systems and obtain The transfer functions of a system.	[AP]
C611.2	Analyze the first and second order systems in time domain and frequency domain.	[A]
C611.3	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]
C611.4	Analyze the concepts of Compensators using Bode Plot.	[A]
C611.5	Construct state space model of a system and test its controllability and observability.	[AP]

Course Contents:

Module 1:System modeling **15**

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

Module 2: Time and frequency response analysis **15**

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 **15**

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

Total Hours **45**

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**
C611.1 & C611.2	Apply	Technical Quiz	**20**
C611.3 & C611.4	Apply	Assignment	**40**
C611.5	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
C611.1	3	2	1	1	1	1						1	3	
C611.2	3	3	2	2	1							1	3	
C611.3	3	3	2	2								1	3	
C611.4	3	3	3	3	3							1	3	1
C611.5	3	2	1	1	1							1	3	

21EC603	MICROCONTROLLERS AND EMBEDDED SYSTEMS LABORATORY	0/0/2/1

Nature of Course: M (Practical application)

Course Objectives:

To write a program for simple applications and analysis the output

Course Outcomes

C603.1	Write programs for interfacing display devices	[AP]
C603.2	Write programs to interface I/Os and various sensors with processor	[AP]
C603.3	Write programs to interface Bluetooth and UART	[AP]
C603.4	Write programs to Exchange data, interface programmable peripheral interfaces and ADC/DAC using 8051 microcontroller	[AP]
C603.5	Write programs to interface LED and Seven segment display using ARM Processor	[AP]

Course Content:

S.No	List of Experiments	CO Mapping	BT
1	Interface 16X2 LCD and display the data Interfacing	C603.1	[U]
2	Interfacing a temperature sensor (LM35) to display the temperature on PC via serial monitor and indicate when temperature is high	C603.2	[AP]
3	Interfacing a gas sensor (MQ2) and display on PC via serial monitor	C603.2	[AP]
4	Interfacing a Bluetooth module and transmit/receive data from the host system to the development board. Interface UART to microcontroller development board and transmit/receive data from the host system	C603.4	[AN]
5	Data exchange using 8051 Microcontroller	C603.5	[AN]
6	Programmable peripheral Interface using 8051 Microcontroller	C603.5	[AN]
7	Interface ADC/DAC with 8051 Microcontroller	C603.5	[AN]
8	Interface LED/ Seven Segment Display using Arm Processor	C603.6	[AN]

Total Hours **30**

Reference Books:

1. Y.Zhu., Embedded Systems with ARM Cortex-M Microcontrollers in Assembly Language and C: Third Edition, E-Man Press LLC,2017
2. Jonathan W.Valvano, “Embedded Microcomputer Systems Real Time Interfacing”, Third Edition Cengage Learning, 2012.
3. Michael J. Pont, “Embedded C”, Pearson Education, 2nd Edition, 2008

Web References:

1.https://blog.edx.org/embedded-systems-a-hands-on-lab-based-course
2. http://www.vlab.co.in/participating-institute-iit-kharagpur
3. ttps://github.com/virtual-labs/fpga-and-embedded-systems-lab-coep
4.https://www.arm.com

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
1	3	3	3	2	1	1				1	2	2	3	1
2	2	1	2	1	1	1				1	1	1	3	1
3	2	1	2	1	1	1				1	1	1	3	1
4	2	1	2	1	1	1				1	1	1	3	1
5	2	1	2	1	1	1				1	3	2	3	1
1	Reasonably agreed			2	Moderately agreed						3	Strongly agreed		

Course Code	Course Name	Contact Hours
21EN601	**BUSINESS COMMUNICATION SKILLS LABORATORY (Department of Electronics and Communication Engineering) (VI Semester)**	**1/0/2/2**

Nature of Course	A (Language Concept)
Pre- requisites	Technical Communication Skills

Course Objectives:	
1	To develop the prominence of speaking, listening and reading practices using authentic business vocabulary.
2	To instil analytical thinking and logical reasoning to enhance LSRW skills in Business related situations.
3	To urge the need of effective communication in corporate sector with Business English.
4	To concentrate more on conversation skills, group skills, persuasion skills, presentation skills, critical and creative thinking.
5	To teach the students to be effective communicators in workplace and social environments.

Course Outcomes: **Upon completion of the course, students shall have ability to**		
C601.1	Recall and gain proficiency with business vocabulary.	[R]
C601.2	Understand and Communicate effectively at managerial and professional level	[U]
C601.3	Apply Task- based activities to enhance an effective communication.	[AP]
C601.4	Articulate oral and written messages in a clear, appropriate and persuasive manner to suit specific purposes, audiences and contexts at work place.	[AP]
C601.5	Analyse and Apply creative skills, critical thinking skills and problem solving skills in work place.	[AN]

Course Contents:

Lab Components		
1	Phonetics and Listening Skills	3
2	Non Verbal Communication and Body Language	3
3	Business Writing: Case Analysis and Proposals	3
4	Report Writing	3
5	Meeting Management and Writing Agenda and Minutes of the Meeting	3
6	Reading Comprehensions	3
7	Business Correspondence , Verbal Aptitude Exercises	3
8	Resume Writing, Handwriting Analysis	3
9	Presentation Skills (Paper Presentation) What to Present and How	3

10	Speaking Skills and Telephonic interviews	3
11	Critical Thinking and Problem Solving, Importance of Human Values-Developing key traits in motivation, persuasion, negotiation and leadership skills.	3
12	Group Discussion	3
13	Human values-Engineering Ethics-Professional Etiquettes-Manners-Team Work, Situational Role Play.	3
14	Online Test	3
15	Interview Evaluation	3
	Total Hours:	**45**

Reference Books:

1	Rizvi Ashraf M , “Effective Technical Communication”, McGraw Hill Education(India) Private Limited, 2016.
2	Dr Sumanth S, English for Engineers, Vijay Nicole Imprints Private Limited, 2005.
3	Life Skills for Engineers, Compiled by ICT Academy of Kerala, McGraw HillEducation(India) Private Ltd., 2016.

Web References:

1	http://mindinthemaking.org/7-essential-skills/
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 Bloom’s 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]**
C601.1	Remember	Quiz	20
C601.2	Understand	Technical Presentation	20
C601.3	Apply	Case Study	20
C601.4	Analyse	Group Assignment	20
C601.5	Evaluate	-	-
			-

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	30	20	20
Understand	30	30	30
Apply	40	30	30
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	-	-	-	-	-	-	-	-	2	3	-	2	-	2
2	-	-	-	-	-	-	-	-	3	3	-	1	-	1
3	-	-	-	-	-	-	-	2	2	2	-	1	-	1
4	-	-	-	-	-	-	-	1	1	2	-	2	-	1
5	-	-	-	-	-	-	-	1	3	3	-	-	-	2
1	Reasonably agreed				2	Moderately agreed				3	Strongly agreed			

21EC701	MICROWAVE AND OPTICAL COMMUNICATION	3/0/0/3

Nature of Course	:G (Theory & Analytical)

Course Objectives:

1	To study the basics of Microwave network and characterization of passive microwave components.
2	To enable the students to understand the principles and operations of Microwave tubes
3	To enable the students to understand the principles and operations of Microwave semiconductor devices.
4	To enable the students to understand the fundamentals of optical fibre communication.
5	To enable the students to understand characteristics of optical transmitters and receivers

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

C701.1	Understand the concepts of microwave network characterization	[U]
C701.2	Understanding microwave passive components and to apply for various design implementation.	[AP]
C701.3	Design and Implementation of semiconductor devices.	[AP]
C701.4	Understand the operation of optical fiber and their operational modes.	[U]
C701.5	Understand the concepts of optical transmitter and apply knowledge to modern fiber optic systems.	[AP]
C701.6	Understand the concepts of optical receiver and apply knowledge to modern fiber optic systems	[AP]

Course Contents:

Network Characterization and Passive Components: Microwave Frequency band and RF Spectrum -S parameter representation of N ports- Losses in terms of S parameters- Properties of S parameters, Directional Coupler- Microwave Hybrid circuits-Circulator and Isolator- branch line coupler (equal & unequal), Rat Race Coupler (180^o hybrid coupler) Millimetre Wave Techniques**.**

15

Tubes and Semiconductor Devices: Two cavity klystron - Reflex Klystron- Travelling Wave Tube Gunn Diode, Avalanche Breakdown diodes (TRAPATT,IMPATT,BARITT)- Manley – Rowe Power Relations - Wilkinson power divider, Microwave Resonators: Series and Parallel Resonant Circuits, Microwave Radar (MR)- Applications of MR.

15

Optical Transmitters and Receivers: Optical Fibers: Optical Fiber Modes and Configuration, Fiber Loss, Dispersions. Power coupling: splices, connectors, coupler, Light Emitting diode and Laser diodes Operational principles of WDM-Passive optical coupler-2x2 Fiber coupler. PIN and APD, Erbium Doped Fiber Amplifier. **15**

Total Hours:	**45**

Text Books:

1	Annapurna Das and Sisir K Das, Microwave Engineering, Third Edition, Tata McGraw Hill,Inc., 2014.
2	D.M.Pozar,Microwave Engineering,4^{th} Edition, John Wiley & sons, Inc., 2011.

3	Gerd Keiser, Optical Fiber Communications, 5th Ed, McGrawHill, 2013.
Reference Books:	
1	Samuel Y Liao, Microwave Devices & Circuits, Third Edition, Pearson Education, 2011.
2	Robert E.Collin,Foundations for Microwave Engineering,SecondEdition,Wiley IEEE Press,2001.
3	S. Kumar and M. J. Deen,Fiber Optic Communications, John Wiley & sons,2014.
Web References:	
1	https://radfiz.org.ua/.../Collin.%20Foundations%20for%20Microwave%20Engineering.p
2	https://www.slac.stanford.edu/slac/sass/talks/opticalfiber.pdf
3	https://www.utdallas.edu/~torlak/courses/ee4367/lectures/FIBEROPTICS.pdf
4	https://www.cse.wustl.edu/~jain/tutorials/ftp/t_3opt.pdf
Online Resources:	
1	https://onlinecourses.nptel.ac.in/noc18_ee22
2	https://onlinecourses.nptel.ac.in/noc18_ee28
3	https://nptel.ac.in/courses/108101112/
4	https://nptel.ac.in/courses/117101054/

Assessment Methods & Levels (based on Blooms'Taxonomy)

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

Course Outcome	Bloom's Level	Assessment Component	Marks
C701.1	Understand	Quiz	20
C701.2 & 701.3	Apply	Problem Solving	20
C701.4	Understand	Assignment	20
C701.5 & C701.6	Apply	Problem Solving	20

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	Understand	Quiz	20
C701.2 & C701.3	Apply	Problem Solving	20
C701.4	Understand	Assignment	20
C701.5 & C701.6	Apply	Problem Solving	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	40	30
Apply	30	30	40	30
Analyze	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**	**PSO 1**	**PSO 2**
1	3	2	2	2	-	-	-	-	-	-	-	1	3	1
2	3	2	2	2	-	-	-	-	1	-	-	1	3	1
3	3	3	3	2	-	-	-	-	1	-	-	1	3	1
4	3	2	2	2	-	-	-	-	1	-	-	1	3	1
5	3	2	2	2	-	-	-	-	1	-	-	1	3	1
6	3	2	2	2	-	-	-	-	1	-	-	1	3	1
1	Reasonably agreed				2	Moderately agreed				3	Strongly agreed			

21EC702	MICROWAVE AND OPTICAL COMMUNICATION LABORATORY	0/0/2/1

Nature of Course: M (Practical application)

Course Objectives:

1 To learn the various parameters of microwave networks.
2 To measure the characteristics of optical diodes.
3 To study the performance of different types of antenna and its radiation pattern.
4 To gain knowledge about the reflex klystron.
5 To study the performance of Microwave passive components using HFSS

Course Outcomes

C702.1	Analyze the power distribution in microwave components.	[AN]
C702.2	Compute the impedance and frequency in microwave components.	[AN]
C702.3	Design and analyze radiation pattern of antenna.	[AN]
C702.4	Compute the optical fiber losses and parameters.	[AN]
C702.5	Design and Simulation of Microwave Tee's.	[AP]

Course Content:

S.No	List of Experiments	CO Mapping	BT
1	Analyze the Mode characteristics of Reflex Klystron	C702.1	[AN]
2	Compute the V-I Characteristics of Gunn Diode.	C702.1	[AN]
3	Compute VSWR, frequency and wave length parameters of microwave components.	C702.2	[AN]
4	Compute Directivity,CouplingCoefficient,S-parameter of Directional Coupler.	C702.1	[AN]
5	Analyze the Radiation Pattern of Antennas.	C702.3	[AN]
6	Design and Simulation of E-Plane / H-Plane Tee in HFSS	C702.5	[AP]
7	Design and Simulation of Magic Tee in HFSS.	C702.5	[AP]
8	Compute bending losses in optical fiber	C702.4	[AN]
9	Analyze the performance of fiber optic analog and digital link.	C702.4	[AN]
10	Compute the numerical aperture for optical fiber.	C702.4	[AN]

Total Hours	**30**

Continuous Assessment	End Semester	Total

Reference Books:

1. Annapurna Das and Sisir K Das, Microwave Engineering, Third Edition, Tata McGraw Hill,Inc., 2014.
2. D.M.Pozar,Microwave Engineering,4th Edition, John Wiley & sons, Inc., 2011.
3. Gerd Keiser, Optical Fiber Communications, 5th Ed, McGrawHill, 2013.
4. Samuel Y Liao, Microwave Devices & Circuits, Third Edition, Pearson Education, 2011.

Web References:

1. https://www.antennatheory.com
2. https://www.mwrf.com/technologies/passive-components
3. https://www.ansys.com/search?keyword=hfss

Formative Assessment	Summative Assessment	Total	Total Continuous Assessment	Examination	
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	60	60	60
Analyse	30	30	30
Evaluate	10	10	10
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	3	2	1	-	-	-	-	-	-	-	2	3	2
2	3	3	2	1	-	-	-	-	-	-	-	2	3	2
3	3	2	1	1	-	-	-	-	-	-	-	2	2	2
4	3	2	1	1	-	-	-	-	-	-	-	2	2	2
5	3	2	1	1	-	-	-	-	-	-	-	2	2	2
1	Reasonably agreed				2	Moderately agreed				3	Strongly agreed			

21EC901	HIGH SPEED DIGITAL DESIGN	3/0/0/3

Nature of Course :	G(Theory & Analytical)

Course Objectives:

1	To familiarize the basic circuit terminologies
2	To understand the properties of high-speed logic gates
3	To build the ability of analyzing standard high speed measurement techniques
4	To identify challenges in designing high speed digital transmission lines, terminators, Vias and power Systems
5	To attribute the timing analysis and clocking schemes of high speed circuits

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

C901.1	Discuss the various high speed digital circuit terminologies and properties	[U]
C901.2	Explain the measurement techniques involved in high speed digital systems	[U]
C901.3	Discuss the challenges of crosstalks and design high speed transmission lines	[AP]
C901.4	Apply the high speed design concepts in terminators, Vias and power Systems	[AP]
C901.5	Analyze the timing characteristics of digital circuits and clocking schemes	[AN]

Course Contents:

Introduction to high-speed digital design: 15

Frequency and Time, Time and Distance, Lumped Versus Distributed Systems, 3dB and RMS Frequencies, Four kinds of Reactance, Ordinary capacitance, Ordinary Inductance, Mutual capacitance, Mutual Inductance; **High speed properties of Logic Gates**-Power-Speed-Packaging; **Measurement Techniques**- Rise time and Bandwidth of oscilloscope probes.Self-inductance of a Probe ground Loop-Slowing down system clock-Observing Crosstalk-Measuring Operating margins-Observing metastable states

Transmission lines, Terminators, Vias and power Systems: 15

Shortcomings of ordinary point to point wiring, Infinite Uniform transmission line, Effects of source and load impedance, Crosstalk in solid ground planes; **Terminators**-End, Source, Middle Terminators, crosstalk in terminators; **Vias**- Mechanical properties of Vias-Inductance and capacitance of Vias; **Power Systems**: Providing a stable voltage reference-Distributing uniform voltage.

Timing and Clocking Schemes: 15

Timing Margin, Clock Skew, Using low impedance Drivers, Using low impedance Clock distribution lines, Source termination of multiple clock lines, controlling crosstalk on clock lines; Delay adjustment ,Clock Oscillators, clock Jitters.

Total Hours:	**45**

Text Books:

1	Howard Johnson & Martin Graham, “High Speed Digital Design” A Handbook of Black Magic, Pearson education, 2009

Reference Books:

1	Jan M, Rabaey, et al, “Digital Integrated Circuits”, A Design Perspective, Prentice Hall India, Third edition, 2008
2	Tom Granberg,”Digital Techniques for High-speed Design”, Prentice Hall,2010

3	Eric Bogatin, Signal and Power Integrity- Simplified, , Prentice Hall, Second edition,2010
Web References:	
1	https://dl.acm.org/citation.cfm?id=151151
2	https://courses.soe.ucsc.edu/courses/ee173
Online Resources:	
1	https://courses.soe.ucsc.edu/courses/ee173
2	https://www.aticourses.com/High-Speed-Digital-Design-PCB.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, CaseStudy, Seminar, Group Assignment)**	**FA(16%) [80Marks]**
C901.1 C901.2	Analyze Understand	Quiz	20
C901.3	Apply	Assignment	20
C901.4	Understand	Quiz	20
C901.5	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	2	1	-	-	-	-	-	-	1	1	-
2	2	3	3	3	1	-	-	-	-	-	-	-	2	-
3	1	3	3	3	2	-	1	-	-	-	-	-	2	-
4	1	3	3	3	1	-	-	-	-	-	-	-	2	-
5	1	2	3	2	2	-	-	-	-	-	-	-	2	-
1	Reasonably agreed				2	Moderately agreed				3	Strongly agreed			

21EC902	HARDWARE DESCRIPTION LANGUAGES	3/0/0/3

Nature of Course :	F (Theory & Programming)

Course Objectives:

1	To provide understanding of HDL for prototyping various digital circuits
2	To develop ability to solve problems using the VHDL and Verilog languages
3	To understand various modelling styles in coding and its methodologies
4	To develop skills in digital circuits design and synthesis
5	To demonstrate ability to analyze digital circuits design.

Course Outcomes:

Upon completion of the course, students shall have ability to

C902.1	Understand the HDL design flow process	[U]
C902.2	Apply VHDL modelling styles and test bench code for any digital circuits.	[AP]
C902.3	Infer the synthesis of combinational and sequential logic circuits using VHDL	[AN]
C902.4	Apply verilog code for any digital circuit using various modelling styles	[AP]
C902.5	Construct the methodology for testing a program using Test Benches	[AP]
C902.6	Infer the synthesis of combinational and sequential logic circuits using Verilog	[AN]

Course Contents:

VHDL : **15**

Overview of Design Procedures used for System Design - Libraries, Data Objects, Data Types, Data Operators, Entities, Architectures- syntax of VHDL. Basic Concurrent Statements, Usage of Blocks In Dataflow Modelling. Component Declarations, Component Instantiation. Types of Component Instantiation, Test Benches, Process, Delays, Basic Sequential Statements, Usage of Variables inside the Process, Multi Process Statements, Generics, Operator Overloading, Conversion Functions, Attributes, File Concepts, Packages, Functions and Procedures - Predefined and User Defined Library Implementations.

Verilog: **15**

Design Methodology, Module, Ports, Operators, Data Types, Arrays, Parameters, Gate Delays, Operator Types, Conditional Statements, Modelling Elements, Dataflow Modelling, Continuous Assignment. Delays, Expression, Operators and Operands, Behavioral Modelling: Procedural Assignments, Timing Controls, Loops, implementation of Basic Circuit Using Dataflow and Behavioral Modelling. Switch Level Modelling, FSM Implementation, Test Benches.

Synthesis: **15**

VHDL Synthesis: Synthesis basics - Modeling a wire: Synthesis of combinational logic and sequential logic circuits, Modeling of Flip-flops with Synchronous/ Asynchronous Preset and clear, Modeling of latch using positive and negative triggered clock. Formatted ASCII I/O Operators, MSI-Based Design. **Verilog Synthesis**: Synthesis of combinational logic and sequential logic, synthesis of explicit and implicit state machines, Synthesis of gated clocks and clock enables, synthesis of Loops. Case study: Implementation of Evolutionary Algorithm using HDL Languages

Total Hours:	**45**

Text Books:

1	M. D. Ciletti, “Advanced VLSI Design with the Verilog HDL”, Prentice-Hall of India, 2008
2	J. Bhaskar, “A VHDL Synthesis Primer”, BS Publications, II Edition, 2009
3	Samir Palnitkar, ”Verilog HDL: A Guide to Digital Design and Synthesis” Prentice Hall, Second Edition, 2009

Reference Books:

1	“VHDL Programming By Examples”, Douglas L. Perry, McGraw-Hill, Fourth Edition , 2010
2	Kevin Skahill ”VHDL for Programmable Logic” Pearson Education India, second edition, 2008

3	James M. Lee,“Verilog Quickstart”, Kluwer Academic Publishers, Third edition, 2013
Web References:	
1	https://www.engineersgarage.com/vhdl-tutorial-1-introduction-to-vhdl/
2	https://www.tutorialspoint.com/vlsi_design/vlsi_design_vhdl_introduction.htm
Online Resources:	
1	https://vhdlwhiz.com/basic-vhdl-tutorials/
2	https://buzztech.in/vhdl-modelling-styles-behavioral-dataflow-structural/

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, CaseStudy, Seminar, Group Assignment)**	**FA(16%) [80Marks]**
C902.1 C902.2	Analyze Understand	Quiz	20
C902.3	Apply	Assignment	20
C902.4	Understand	Quiz	20
C902.5 C902.6	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	1	2	1	-	1	-	-	-	-	-	-	2	3	-
2	2	1	3	2	-	-	-	-	-	-	-		3	-
3	2	1	3	1	-	-	-	-	-	-	-	1	2	-
4	2	1	2	2	3	-	-	-	-	-	-	1	2	1
5	1	2	3	1	2	-	-	-	-	-	-	1	3	1
6	2	3	3	2	2	1	-	-	-	-	-	1	3	2
1	Reasonably agreed				2	Moderately agreed				3	Strongly agreed			

21EC903	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**		
C903.1	To understand the ASIC design flow and logic synthesis.	[U]
C903.2	To understand the programming technologies of an ASIC and its construction.	[U]
C903.3	Apply partitioning algorithms to partition the network to meet the objectives.	[AP]
C903.4	Apply floor planning algorithms to place the logic cells inside the flexible blocks of an ASIC to meet the objectives.	[AP]
C903.5	Apply routing algorithms to route the channels	[AP]
C903.6	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, CaseStudy, Seminar, Group Assignment)**	**FA(16%) [80Marks]**
C903.1 C903.2	Analyze Understand	Quiz	20
C903.3	Apply	Assignment	20
C903.4	Understand	Quiz	20
C903.5 C903.6	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	2	2	3	2	-	-	-	-	-	-	-	-	3	-
2	2	2	3	2	-	-	-	-	-	-	-	-	3	-
3	2	2	3	3	-	-	-	-	-	-	-	-	3	-
4	2	2	3	3	-	-	-	-	-	-	-	-	3	-
5	1	1	3	3	3	-	-	-	-	-	-	-	3	-
6	1	1	3	3	3	-	-	-	-	-	-	-	3	-

1	Reasonably agreed	2	Moderately agreed	3	Strongly agreed

21EC904	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 FPGA and PLA	
5	To learn the principles in UVM	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C904.1	To recall the basic concepts of logic gates	[U]
C904.2	To perform the interconnection, layouts in combinational logic networks	[AP]
C904.3	To illustrate the functional ideas of the sequential machines	[U]
C904.4	To develop the subsystem combinational and sequential designs	[AP]
C904.5	To examine the operation of FPGA and PLA	[AN]
C904.6	To examine about the UVM	[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).

UNIVERSAL VERIFICATION METHODOLOGY: **15**

Introduction -Phasing -UVM Components-Shorthand Macros-Sequences & Sequencer-Ports-UVM Events -RAL-Callbacks-Configuration Service -Factory

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**	**FA (16%) [80 Marks]**
C904.1 C904.2	Understand	Quiz	20
C904.3 C904.4	Apply	Problem Solving	20
C904.5	Understand	Group Assignment	20
C904.6	Apply	Case Study	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	40	30
Apply	30	30	40	30
Analyze	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**	**PSO 1**	**PSO 2**
1	2	1	-	-	1	-	-	-	-	-	-	2	3	-
2	3	2	1	-	2	-	-	-	-	-	-	3	3	-
3	2	1	-	-	1	-	-	-	-	-	-	2	2	-
4	3	2	1	-	2	-	-	-	-	-	-	3	2	1
5	3	3	3	2	2	-	-	-	-	-	-	1	3	1
6	3	3	3	2	2	1	-	-	-	-	-	1	3	2
1	Reasonably agreed				2	Moderately agreed				3	Strongly agreed			

21EC905	ELECTRONIC DESIGN AUTOMATION TOOLS	3/0/0/3

Nature of Course	:G (Theory & Analytical)

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 T-Spice 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

C905.1	Understand overview of impact of EDA tools on physical design methods of VLSI designs	[U]
C905.2	Familiarize about various tools available of EDA family	[U]
C905.3	Interpret the design rule set to achieve optimization in DC & AC circuit analysis	[AN]
C905.4	Apply the different programming tools to understand the program concepts and Construct and simulate various sequential logic circuits using HDL	[AP]
C905.5	Analyze different levels of abstraction and simulation in VLSI circuits	[AN]
C905.6	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 & VMM

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

Finite State Machines (FSM) Synthesis in Verilog, Memory Design -Single Port and Dual Port SRAM, Tasks, Functions, User Defined Primitives (UDP)-Timing and Delays, Compiler Directives-Verilog –Behavior modelling, dataflow and structural modelling -functions – packages- System C basic programming- functions and loops- 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- Case Study: Simulation of complex Boolean functions using Tanner Tools.

Total Hours:	**45**

Text Books:

1.	Ming -Bo Lin, Digital System Designs and Practices using Verilog HDL and FPGAs, Wiley, Reprinted 2018.
2.	SamirPalnitkar, 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 VerilogPrimer , 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, CaseStudy, Seminar, Group Assignment)**	**FA(16%) [80Marks]**
C905.1 C905.2	Analyze Understand	Quiz	20
C905.3	Apply	Assignment	20
C905.4	Understand	Quiz	20
C905.5 C905.6	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	3	2	3	1	-	-	-	-	-	1	1	-	-
2	3	2	3	2	1	-	-	-	-	-	2	1	-	-
3	3	3	3	3	2	-	-	-	-	-	1	1	-	-
4	2	3	3	2	1	-	-	-	-	-	2	1	-	-
5	3	2	3	2	1	-	-	-	-	-	1	2	-	-
6	3	3	2	3	1	1	-	-	-	-	1	1	-	-
1	Reasonably agreed				2	Moderately agreed				3	Strongly agreed			

21EC906	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**		
C906.1	Understand the embedded system design life cycle.	[U]
C906.2	Analyze the instruction set of embedded processors.	[AN]
C906.3	Design embedded systems for different types of applications.	[AN]
C906.4	Describe the different interfacing techniques	[U]
C906.5	Analyze the performance of a multiprocessor system	[AN]
C906.6	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, designing with microprocessor, development and debugging, System-Level 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..*

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

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]**
C906.1	Apply	Assignment	**20**
C906.2 & C906.3	Analyze	Quiz	**20**
C906.4	Analyze	Case Study	**20**
C906.5 & C906.6	Understand	Seminar Presentation	**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]	**CIA1 : [60 Marks]**		
Remember	20	20		20
Understand	40	40	20	40
Apply	10	10	20	10
Analyse	30	30	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	2	1	3	1
1	Reasonably agreed				2	Moderately agreed				3	Strongly agreed			

21EC907	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

C907.1	Understand the ARM architecture and its pipelining stages,.	[U]
C907.2	Analyze various instructions sets of ARM processor.	[AN]
C907.3	Interpret the importance of co processor interface with ARM	[AP]
C907.4	Understand the function of memory unit and multiple level cache	[U]
C907.5	Illustrate the ARM bus architecture and its features	[AN]
C907.6	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– ARM programming model – ARM Development Tools –5 Stage Pipeline ARM Organization – ARM 10 TDMI; ARM Assembly Language programming, 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 processor, Exception Handling – Interrupts – Interrupt handling schemes- VLSI Bluetooth baseband controller-Self-timed Design

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/	

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	Understand	Quiz	20
C907.2	Analyse	Group Assignment	20
C907.3	Apply	Case Study	20
C907.4	Understand		
C907.5	Analyse	Assignment	20
C907.6	Apply		

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	40	40	20	40
Apply	20	40	40	20
Analyze	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**	**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			

21EC908	INTERNET OF MEDICAL THINGS	3/0/0/3
Nature of Course	G (Theory Analytical)	
Course Objectives:		
1	To understand the fundamentals of IoT	
2	To learn the principles of various IoT Protocols	
3	To understand Network and Application layer protocols	
4	To understand cyber physical systems and IoT models for medicine	
5	To develop IoT infrastructure for healthcare and cloud base data analytics	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C908.1	Understanding the basic concepts of IoT	[U]
C908.2	Understand the various protocols for IoT	[U]
C908.3	Understand the network and application layer protocols	[U]
C908.4	Understand and apply IoT concepts for medicine.	[AP]
C908.5	Analyze IoT for healthcare and perform cloud based data analytics	[AN]

Course Contents:

FUNDAMENTALS OF IOT : 15

Evolution of Internet of Things – Enabling Technologies – IoT Architectures: one M2M,– Simplified IoT Architecture and Core IoT Functional Stack " Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem -Sensors, Actuators, Smart Objects and Connecting Smart Objects

IoT PROTOCOLS 15

IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: 6LowPAN, Routing over Low Power and Lossy Networks – Application Layer Protocols: CoAP and MQTT

APPLICATIONS OF IOT IN MEDICINE 15

NSUM Technique for Diabetes Patients, Healthcare Monitoring system through Cyber-physical system, An IoT Model for Neuro sensors, AdaBoost with feature selection using IoT for somatic mutations evaluation in Cancer, A Fuzzy-Based expert System to diagnose Alzheimer"s Disease, Secured architecture for IoT enabled Personalized Healthcare Systems, Healthcare Application Development in Mobile and Cloud Environments, Approach to predict Diabetic Retinopathy through data analytics, Diagnosis of chest diseases using artificial neural networks. Connected inhalers, Robotic surgery

Total Hours:	**45**

Text Books:

1	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017.

2	Venkata Krishna, Sasikumar Gurumoorthy, Mohammad S. Obaidat, “Internet of Things and Personalized Healthcare Systems”, Springer Briefs in Applied Sciences, and Technology, Forensic and Medical Bioinformatics, 2019.
Reference Books:	
1	Arshdeep Bahga, Vijay Madisetti, “Internet of Things – A hands-on approach”, Universities Press, 2015
2	Olivier Hersent, David Boswarthick, Omar Elloumi , “The Internet of Things – Key applications and Protocols”, Wiley, 2012.
3	Jan Ho” ller, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, “From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence”, Elsevier, 2014.
4	Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), “Architecting the Internet of Things”, Springer, 2011.
5	Michael Margolis, Arduino Cookbook, “Recipes to Begin, Expand, and Enhance Your Projects”, OReilly Media, 2nd Edition.
Web References:	
1	https://nptel.ac.in/courses/106/105/106105166/
Online Resources:	
1	https://onlinecourses.nptel.ac.in/noc21_cs17/preview
2	https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-cs31/

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, CaseStudy, Seminar, Group Assignment)**	**FA(16%) [80Marks]**
C908.1 C908.2	Analyze Understand	Quiz	20
C908.3	Apply	Assignment	20
C908.4	Understand	Quiz	20

C908.5 C908.6	Apply	Group Assignment	20

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)**	

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				

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	3	1
2	2	1	1	1	-	1	-	-	-	-	-	2	2	2
3	2	2	2	2	-	1	-	-	-	-	-	2	2	2
4	3	3	3	2	-	2	-	-	-	1	-	2	3	2
5	3	3	3	3	-	2	-	-	-	2	-	2	3	2
1	Reasonably agreed				2	Moderately agreed				3	Strongly agreed			

21EC909	INTERNET OF THINGS AND ITS APPLICATIONS	3/0/0/3
Nature of Course	G (Theory Analytical)	
Course Objectives:		
1	To Understand the vision of IOT from a global context.	
2	To enable the students to understand the State of the Art – IOT Architecture.	
3	To interpret the use of internet principles, protocols and network management in IOT.	
4	To help the students to understand the principles of design in prototyping and provide ability to change and modify it.	
5	To analyze how the related concepts helps to challenge the product idea a well-thought-out model of the business	
6	Application of IOT in Industrial and Commercial Building Automation and Real World Design Constraints.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C909.1	Understand the concepts of IOT from a global context	[U]
C909.2	Infer the architecture of IOT and future development	[U]
C909.3	Understand the role of network layers in Data Management using IOT.	[U]
C909.4	Interpret the features of prototyping of the embedded device with IoT	[AP]
C909.5	Elucidate the knowledge on Raspberry pi and Arduino architecture for IoT Applications	[AN]
C909.6	Analyze and construct the application specific IoT models for real time implementation	[AP]

Course Contents:

FUNDAMENTALS OF IOT : 15

Introduction – Characteristics - Physical design - Protocols – Logical design – Enabling technologies –Input and output devices for IoT– IoT Levels – Domain Specific IoTs – IoTvsM2M. Future developments, Possible Architecture for the future IoT.

IOT PROTOCOLS AND CHALLENGES: 15

Internet communication, IP addresses, MAC addresses, TCP and UDP ports, Application layer protocols, IEEE 802 committee family of protocols, IoT Mesh Network Protocols, physical layer and Media access control layer. Design challenges, development challenges and Security challenges.

BUILDING IOT WITH RASPBERRY PI &ARDUINO : 15

Python–Algorithms, Building Blocks Of Algorithms (Statements, State, Control Flow, Functions), Notation(Pseudo Code, Flow Chart, Programming Language), Algorithmic Problem Solving, Simple Strategies For Developing Algorithms, Physical devices-Operating systems of Raspberry Pi-Raspberry Pi Interfaces – Programming – APIs / Packages – Web services –Arduino IDE – Programming APIs and Various Real time applications of IoT -Home automation, Surveillance applications, Health care and Agriculture –Connecting IoT to Cloud–Cloud Storage for IoT– Data Analytics for IoT, , Concept of Data Cleaning in IoT, IoT Security, case studies – Automobiles, Smart city and Supply chain management.

Total Hours:	**45**

Text Books:	
1	Adrian McEwen and Hackim Cassimally," Designing the Internet of Things" , 1st Edition ,John wiley and Sons Ltd.,UK,2014.
2	Arshdeep Bahga, Vijay Madisetti, "Internet of Things (A Hands-On-Approach)", 1st Edition ,VPT, 2014.
3	Dieter Uckelmann ,Mark Harrison, Florian MIchahelles,"Architecting the Internet of Things", 1st Edition ,Springer,Newyork,2011.
4	Allen B. Downey, "Think Python: How to Think Like a Computer Scientist'', 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)
Reference Books:	
1	Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013.
2	ManoelCarlosRamon,"Intel®GalileoandIntel®GalileoGen2:APIFeaturesand Arduino Projects for Linux Programmers", 1st Edition, Apress,2014
3	Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things - key applications and Protocols",1st Edition, Wiley,2012.
Web References:	
1	http://www.cisco.com/c/en_in/solutions/internet-of-things/resources.html
Online Resources:	
1	http://iot.ieee.org/newsletter/january-2016/hypercat-resource-discovery-on-the-internet-of-things.html
2	https://www.coursera.org/specializations/Internet-of-things

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 (16%)			
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	Understand	Quiz	20
C909.2, C909.3	Apply	Assignment	20
C909.4, C909.5	Apply	Programming	20
C909.6	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	10	10		10
Understand	30	20	20	40
Apply	40	40	60	30
Analyze	20	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	2	-	-	-	-	-	-	-	-	-	-
2	3	3	2	2	-	-	-	-	-	-	-	-	-	-
3	3	3	2	2	-	-	-	-	-	-	-	-	1	-
4	3	3	3	3	-	-	-	-	-	-	-	-	1	-
5	3	3	3	3	-	-	-	-	-	-	-	-	2	-
6	3	3	2	2	3	-	-	-	2	2	1	-	2	-
1	Reasonably agreed				2	Moderately agreed				3	Strongly agreed			

21EC911	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 impart the design principles in cooperative and relay system	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C911.1	Analyze the difference of LTE-A network design from 4G standard	AN
C911.2	Explore the network architecture of the current 5G standard.	U
C911.3	Appreciate the necessity and the design aspects of cooperative communication.	U
C911.4	Understand the different power saving strategies and energy efficient signal, system and network design	U
C911.5	Learn and impart new techniques in wireless communication.	U
C911.6	Impart the design principles in cooperative and relay system	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.

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 andNetworking: 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

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, CaseStudy, Seminar, Group Assignment)**	**FA(16%) [80Marks]**
C911.1 C911.2	Analyze Understand	Quiz	20
C911.3	Understand	Assignment	20

C911.4 C911.5	Understand	Quiz	20
C911.6	Understand	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	60	30
Apply	20	20		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	-	-	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			

21EC912	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 earth station	
3	To acquire knowledge about the propagation characteristics of satellite links	
4	To enable the students to understand multiple access techniques and Communication Satellites	
5	To enable the students to study the concept of GPS and its applications	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C912.1	Understand the basic concepts of Orbit Dynamics	[U]
C912.2	Apply the concepts of launch vehicles and spectrum allocations	[AP]
C912.3	Understand the concept of spacecraft sub systems.	[U]
C912.4	Apply the concepts of earth stations space links.	[AP]
C912.5	Understand the concepts of satellite television systems.	[U]
C912.6	Apply the concepts of satellite navigation and GPS	[AP]

Course Contents:

Orbital Mechanics: **15**

Overview of satellite communication, 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, 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, Power Systems, Communication Subsystems, Transponders, Antennas, Equipment Reliability, Earth Stations 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, 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 – DTH television principles-Direct broadcast satellite television systems, Satellite Navigation & GPS: Introduction, GPS and GLONASS, Galileo satellite system Compass, Indian Regional Navigation Satellite System Overview, Differential and Augmented GPS, Applications,.Role of satellites in future networks.

	45

Text Books:

1	Bruce R.Elbert, “The Satellite Communication:Ground Segment and Earth Station”,Artech House Inc.,second edition,2014
2	Dennis Roddy, “Satellite Communications”, Mc Graw Hill International Editions, 4th Edition 2008.

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	https://ocw.mit.edu/courses/16-892j-space-system-architecture-and-design-fall-2004/6e3a4535cf1edbdc995422ab0520bb68_06005xtossubsyst.pdf
3	https://www.nasa.gov/directorates/somd/space-communications-navigation-program/gps/
Online Resources:	
1	https://lecturenotes.in/subject/102/satellite-communication-system-scs
2	https://nptel.ac.in/courses/117105131
3	https://www.mathworks.com/videos/what-is-satellite-communications-toolbox-1614251681806.html

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**	**FA (16%) [80 Marks]**
C912.1 C912.3	Understand	Quiz	20
C912.2 C912.4	Analyse	Group Assignment	20
C912.5	Understand	Seminar	20
C912.6	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	10	10		10
Understand	40	40	40	40
Apply	30	30	20	30
Analyze	20	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	PSO 2
1	3	2	2	-	-	2	-	-	-	-		1	1	1
2	3	2	2	2	-	-	-	-	1	-	-	2	3	1
3	3	3	3	2	-	-	-	-	1	-	-	1	3	1
4	3	3	3	2	-	-	-	-	-	-	-	2	3	1
5	2	-	-	-	-	-	-	-	-	-	-	2	3	3
6	2	3	3	2	1	-	-	-	-	-	-	1	-	-

1	Reasonably agreed	2	Moderately agreed	3	Strongly agreed

21EC913	LONG TERM EVOLUTION TECHNOLOGY	3/0/0/3
Nature of Course	G (Theory Analytical)	
Course Objectives:		
1	Understand the basics of LTE standardization and LTE Architecture	
2	Analyze the role of OFDMA and SC-FDMA principles	
3	Understand the concepts of Multi antenna techniques and Flat Network Architecture Analyze the role of OFDMA and SC-FDMA principles and channel structure	
4	Analyze the physical layer concept and resource allocation	
5	Understand Mobility Management and interference	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C913.1	Analyze the system architecture and the functional standard specified in LTE 4G.	[AN]
C913.2	Analyze the role of OFDMA and SC-FDMA principles	[AN]
C913.3	Understand the Muti antenna Techniques and Flat Network Architecture	[U]
C913.4	Analyze the physical layer procedure and resource management	[AN]
C913.5	Understand the Mobility Management and interference coordination	[U]

Course Contents:

Fundamentals of LTE and LTE architecture: Performance requirements - data rates, spectral efficiency, spectrum flexibility, performance at cell edges, LTE Network architecture and Protocol Architecture - Evolved Packet System (EPS): Evolved Packet Core (EPC) and Evolved Universal Terrestrial RAN (E-UTRAN),eNodeB, EPC elements - Packet Data Network Gateway (P-GW), Serving Gateway (S-GW) and Mobility Management Entity (MME), LTE – Protocol stack layers , VoLTE

Key Enablers for LTE features and Channel Structure: OFDM, Single carrier FDMA, Single carrier FDE, Channel Dependent Multiuser Resource Scheduling, Multi antenna Techniques, IP based Flat network Architecture, Introduction to LTE, Channel Structure of LTE, Downlink OFDMA Radio Resource, Uplink SC-FDMA Radio Resource

Physical Layer Procedures, Radio Resource Management and Mobility Management: Hybrid – ARQ procedures, Channel Quality Indicator, CQI feedback, Pre-coder for closed loop MIMO Operations, Uplink channel sounding, Buffer status Reporting in uplink, Scheduling and Resource Allocation, PDCP overview, MAC/RLC overview, RRC overview, Mobility Management, Inter-cell Interference Coordination.

	45

Text Books:

1	Fundamentals of LTE, Arunabha Ghosh, Jan Zhang, Jefferey Andrews, Riaz Mohammed,2010, Prentice Hall, Communications Engg. and Emerging Technologies, ISBN 978-0-137-03311-9.
2	An Introduction to LTE: LTE, LTE-Advanced, SAE, VoLTE and 4G Mobile Communications,byChristopher Cox,2012,Wiley Publishers, ISBN 978-1-118-81801-5.

3	Design, Deployment and Performance of 4G LTE Networks: A Practical Approach, by Ayman ElNashar,MahmoudSherif, and Mohamed A.El-saidny,2014,Wiley Publishers, ISBN: 9781118703434
Reference Books:	
1	LTE for UMTS Evolution to LTE-Advanced HarriHolma and Antti Toskala, Second Edition - 2011, John Wiley & Sons, Ltd. Print ISBN: 9780470660003.
2	Evolved Packet System (EPS) the LTE and SAE evolution of 3G UMTS by Pierre Lescuyer and Thierry Lucidarme, 2008, John Wiley & Sons, Ltd. Print ISBN:978-0-470-05976-0
3	LTE – The UMTS Long Term Evolution from Theory to Practice by StefaniaSesia, IssamToufik, and Matthew Baker, 2009 John Wiley & Sons Ltd, ISBN 978-0-470-69716-0.
Web References:	
1	www.techplayon.com/lte-a-lte
2	www.3gpp.org/lte
3	http://rfmw.em.keysight.com/wireless/helpfiles/89600B/WebHelp/subsystems/lte/content/lte_overview.htm
Online Resources:	
1	LTE Tutorial – MATLAB & SIMULINK - Mathworks
2	http://niviuk.free.fr/lte_resource_grid.html
3	http://www.3glte.info.com

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]**
C913.1	Remember	Quiz	20
C913.2	Understand	Assignment	20
C913.3& C913.4	Understand	Assignment	20
C913.5	Understand	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	10	20	10
Understand	30	40	60	40
Apply	30	40		30
Analyze	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	1	-	-	-	-	-	-	-	-	-	2	2	2
2	2	2	-	-	-	-	-	-	-	-	-	3	3	2
3	3	2	-	-	-	-	-	-	-	-	-	-	3	2
4	3	2	-	-	-	-	-	-	-	-	-	2	2	2
5	3	2	-	-	-	-	-	-	-	-	-	1	3	2
1	Reasonably agreed		2	Moderately agreed					3	Strongly agreed				

21EC914	MEMS	3/0/0/3
Nature of Course	G (Theory Analytical)	
Course Objectives:		
1	To provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices.	
2	To educate on the rudiments of Micro fabrication techniques.	
3	To introduce various sensors and actuators	
4	To introduce different materials used for MEMS	
5	To introduce micromachining processes and synthesis	
6	To educate on the applications of MEMS to disciplines beyond Electrical and Mechanical engineering.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C914.1	Understand the basic concepts of MEMS and its various processes	[U]
C914.2	Describe the various processes involved in Micro fabrication	[U]
C914.3	Differentiate between the sensors and actuators	[AN]
C914.4	Illustrate the different materials used for MEMS	[AP]
C914.5	Explain the concepts of micromachining process	[U]
C914.6	Apply MEMS to polymer and optical components	[AP]

Course Contents:

INTRODUCTION TO MEMS AND MICRO INTEGRATED SYSTEMS **15**

Intrinsic Characteristics of MEMS– Sensors and Actuators – Introduction to Micro fabrication – Silicon based MEMS processes – Packaging and Integration - New materials and Fabrication Processes – Process Selection and Design.

SENSING AND ACTUATION: **15**

Electrostatic sensing and actuation – parallel plate capacitor – Thermal sensing and Actuations – thermal sensors, actuators – Piezoresistive sensors- piezoresistive sensor material– stress in flexural cantilever and membrane–MEMS magnetic actuators- Micro magnetic actuation principle–deposition of magnetic materials–Design and fabrication of magnetic coil.

MICROMACHINING, POLYMER AND OPTICAL MEMS: **15**

Basic surface micromachining process – structural and sacrificial materials, stiction and anti-stiction methods - Process Synthesis - Polymers in MEMS – polymide-SU-8 Liquid Crystal Polymer (LCP) – PDMS –PMMA–Parylene– Flurocarbon - Optical MEMS –passive MEMS optical components– lenses – mirrors –Actuation for active optical MEMS.

Total Hours:	**45**

Text Books:

1	Chang Liu, 'Foundations of MEMS', Pearson Education Inc., 2012.
2	Stephen D Senturia, 'Microsystem Design', Springer Publication, 2007.
3	Tai Ran Hsu, "MEMS & Micro systems Design and Manufacture" Tata McGraw Hill, New Delhi, 2008.
4	Mark Madou, "Fundamentals of Microfabrication", CRC Press, New York, 1997.

Reference Books:

1	Nadim Maluf," An Introduction to Micro Electro Mechanical System Design", Artech House, 2004.
2	Mohamed Gad-el-Hak, editor, "The MEMS Handbook", CRC press Baco Raton, Second edition, 2005.

3	Julian w. Gardner, Vijay K. Varadan, Osama O. Awadelkarim, Micro Sensors MEMS and Smart Devices, John Wiley & Son LTD, 2004.
Web References:	
1	https://www.mems-exchange.org/MEMS/what-is.html
2	textofvideo.nptel.ac.in/117105082/lec1.pdf
3	http://home.earthlink.net/~trimmerw/mems/Links_All.html
Online Resources:	
1	http://nptel.ac.in/courses/117105082/4
2	https://swayam.gov.in/courses/4765-july-2018-fabrication-techniques-for-mems-based-sensors-clinical-pe
3	https://www.edx.org/course/micro-nanofabrication-mems-epflx-memsx-0

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, CaseStudy, Seminar, Group Assignment)**	**FA(16%) [80Marks]**
C914.1 C914.2	Analyze Understand	Quiz	20
C914.3	Apply	Assignment	20
C914.4	Understand	Quiz	20
C914.5 C914.6	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	1	-	-	-	-	-	-	-	-	-	-	2	-
2	2	2	1	-	-	-	-	-	-	-	-	-	3	-
3	3	2	-	3	-	-	-	-	-	-	-	-	3	-
4	3	2	1	-	-	-	-	-	-	-	-	-	2	-
5	3	2	2	-	-	-	-	-	-	-	-	-	3	-
6	2	2	1	-	-	-	-	-	-	-	-	-	-	3
1	Reasonably agreed				2	Moderately agreed				3	Strongly agreed			

21EC915	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 enable students to understand and analyze various narrow band signal processing.	
3	To gain knowledge in adaptive signal processing.	
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**		
C915.1	Recall the basic components of antenna and smart antennas	[R]
C915.2	Analysis and optimization of various Narrowband Signal processing in the absence of errors	[AN]
C915.3	Analysis of various algorithms to show how estimated solution converges to optimal solution	[AN]
C915.4	Apply Broadband Signal processing in time domain and frequency domain and realize broadband signal processing	[AP]
C915.5	Analyze performance of smart antenna using various direction of arrival estimation methods	[AN]
C915.6	Understand Conventional DOA Estimation Methods	[AN]

Course Contents:

INTRODUCTION: 15

Antenna gain, 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.

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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

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, 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	2	1	-	-	-	1	-	-	-	-	-	-	2	-
2	3	3	2	-	-	-	-	-	-	-	-	-	3	-
3	3	3	2	-	-	-	-	-	-	-	-	-	3	-
4	3	2	2	-	-	-	-	-	-	-	-	-	3	-
5	3	2	2	-	-	-	-	-	-	-	-	-	3	-
6	3	2	2	-	-	-	-	-	-	-	-	-	2	-
1	Reasonably agreed				2	Moderately agreed				3	Strongly agreed			

21EC916	RF SYSTEM DESIGN	3/0/0/3
Nature of Course	G (Theory Analytical)	
Course Objectives:		
1	To understand the fundamentals of RF circuit design.	
2	To differentiate and design basic RF Filters.	
3	To design and analyze RF Active components.	
4	To design and analyze RF transistor amplifier.	
5	To understand the operation of Oscillators and mixers used in RF design.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C916.1	Understand different RF Components such as passive components, chip Components.	[U]
C916.2	Design RF filters and analyse different types of RF filters.	[AN]
C916.3	Design RF Active Components and analyze their operations in matching networks	[AN]
C916.4	Design high and low gain RF amplifiers and analyze their characteristics	[AN]
C916.5	Understand the operation of RF oscillators.	[U]
C916.6	Understand the concepts of mixers.	[U]

Course Contents:

RF FUNDAMENTALS AND RF FILTER DESIGN: 15

Importance of RF Frequency Design, RF behaviour of Passive Components, Chip Components and Circuit Board Considerations, Basic Resonator and Filter Design, Special filter Realization, Filter Implementation-coupled filter.

IMPEDANCE MATCHING AND RF TRANSISTOR AMPLIFIER DESIGNS: 15

High electron mobility transistors, matching and biasing networks – impedance matching using discrete components, microstripline matching networks, amplifier – classes of operation and biasing networks. Characteristics of Amplifiers, Amplifier Power Relations, Stability Considerations, Constant Gain and VSWR Circles, Low noise Amplifier-Single ended and Differential LNAs, Medium power amplifiers.

RF OSCILLATORS AND MIXERS: **15** Basic Oscillator Model, High Frequency Oscillator Configurations – Fixed Frequency Oscillator, Dielectric Resonator Oscillator, Basics Concepts of Mixer and Frequency domain Considerations, Single balanced and double balanced mixers–subsampling mixers.	
Total Hours:	**45**
Text Books:	
1	Reinhold Ludwig, Gene Bogdanov, "RF circuit design, theory and applications", Pearson Asia Education, 2nd edition, 2009.
2	Tai Ran Hsu, “MEMS & Micro systems Design and Manufacture”, Tata McGraw hill, New Delhi, Pearson education, 2007.
3	Joseph. J. Carr, “Secrets of RF Circuit Design “, McGraw Hill Publishers, Third Edition,2000.
Reference Books:	
1	Stephen Santuria, “Microsystems Design”, Kluwer Publishers, 2000
2	MathewM. Radmanesh, “Radio Frequency &Microwave Electronics”, Pearson Education Asia, Second Edition, 2002
3	Ulrich L. Rohde and David P. NewKirk, “RF / Microwave Circuit Design”, John Wiley & Sons USA, 2000.
Web References:	
1	www.tf.uni-kiel.de/matwis/amat/semitech_en/kap_7/illustr/i7_1_3.html
2	www.memsjournal.com/.../an-overview-of-rf-mems-technologies-and-applications.ht.
3	http://www.qsl.net/va3iul/Files/RF_courses_lectures.html
4	http://www.seas.ucla.edu/brweb/teaching.html
Online Resources:	
1	http://www.ssc.pe.titech.ac.jp/materials/VLSICS03_shortcourse_matsu_homepage.pdf
2	http://www.ti.com/lit/ml/slap127/slap127.pdf
3	https://www.radio-electronics.com/info/rf-technology-design/
4	https://cds.cern.ch/record/1407402/files/p223.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, CaseStudy, Seminar, Group Assignment)**	**FA(16%) [80Marks]**
C916.1 C916.2	Analyze Understand	Quiz	20
C916.3	Apply	Assignment	20
C916.4	Understand	Quiz	20
C916.5 C916.6	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	1	-	-	-	-	-	-	-	-	-	2	2
2	2	2	3	-	-	-	-	-	-	-	-	-	2	3
3	3	2	3	-	-	-	-	-	-	-	-	-	2	2
4	2	2	3	-	-	-	-	-	-	-	-	-	3	3
5	2	3	2	-	-	-	-	-	-	-	-	-	2	2
6	3	3	3	-	-	-	-	-	-	-	-	-	1	1
1	Reasonably agreed				2	Moderately agreed				3	Strongly agreed			

21EC917	COGNITIVE RADIO COMMUNICATION	3/0/0/3
Nature of Course	C (Theory Concept)	
Course Objectives:		
1	Describe the basics of software defined radios.	
2	To learn the hardware and software architecture of software defined radio.	
3	Design the wireless networks based on the cognitive radios.	
4	Study about the cognition cycle and cognitive radio architecture.	
5	Understand the concepts of cooperative spectrum sensing and minimize the sensing time.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C917.1	Explain the concept of SDR and its architectures	[U]
C917.2	Examine the concept of Cognitive Radios and its architectures	[AN]
C917.3	Describe the various techniques in Cognitive Radios	[U]
C917.4	Illustrate the concept of Building the Cognitive Radio Architecture on SDR	[AP]
C917.5	Interpret the basics of various spectrum sensing techniques	[U]
C917.6	Recognize the concepts of cooperative spectrum sensing, security issues and advanced features of cognitive radio.	[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	Mohamed Ibnkahla, "Cooperative Cognitive Radio Networks:The complete Spectrum Cycle" I edition	

3	Kwang– Cheng Chen and Ramjee Prasad, “Cognitive Radio Networks, Wiley Pub
4	Artificial Intelligence in Wireless Communications by Thomas W. Rondeau, Charles W. Bostian.
Reference Books:	
1	AhamedKhattab, 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. (Unit V)
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, CaseStudy, Seminar, Group Assignment)**	**FA(16%) [80Marks]**
C917.1 C917.2	Analyze Understand	Quiz	20
C917.3	Apply	Assignment	20
C917.4	Understand	Quiz	20
C917.5 C917.6	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	-	-	-	-	-	-	-	-	-	-	3	-
2	3	2	-	-	-	-	-	-	-	-	-	-	3	-
3	-	3	-	-	-	-	-	-	-	-	-	-	3	-
4	-	2	3	-	-	-	-	-	-	-	-	-	3	-
5	3	-	-	-	-	-	-	-	-	-	-	-	3	-
6	-	3	-	-	-	-	-	-	-	-	-	-	3	-
1	Reasonably agreed				2	Moderately agreed				3	Strongly agreed			

21EC918	MIMO AND MULTI CARRIER SYSTEMS	3/0/0/3
Nature of Course	G (Theory Analytical)	
Course Objectives:		
1	To introduce the principles of Multiple Input Multiple Output (MIMO) Communication Systems.	
2	To enable the students to understand the Comparison of MIMO Systems with Single Input Single Output (SISO) Systems.	
3	To enable the students to apply the concepts of Spatial multiplexing in MIMO.	
4	To allow students to represent Space Time Block code and apply the concept on Orthogonal designs.	
5	To Impart knowledge on Multi Carrier Systems and analyse MIMO-OFDM Systems.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C918.1	Understand Multiple Input Multiple Output (MIMO) Communication Systems.	[U]
C918.2	Understand the concept of MIMO channel models.	[U]
C918.3	Apply the spatial multiplexing properties in MIMO.	[AP]
C918.4	Represent Space time Block codes and apply for Orthogonal designs.	[AP]
C918.5	Analyze Single carrier approach and Multi carrier approach.	[AN]
C918.6	Understand the concept of OFDM and Analyse performance of MIMO-OFDM Systems.	[AN]

Course Contents:

INFORMATION THEORETIC ASPECTS OF MIMO: 15

Introduction, Crowded Spectrum, need for high data rates, MIMO Systems, MIMO System model, MIMO System capacity, SIMO-MISO,Ergodic capacity,Outage capacity, capacity bounds and Influence of fading correlation on MIMO capacity, Influence of LOS on MIMO capacity, Physical Modelling of MIMO receiver-Modelling of MIMO fading channels-MIMO MMSE Receiver-SVD based optimal MIMO transmission & capacity, V-BLAST receiver

SPATIAL MULTIPLEXING AND SPACE TIME BLOCK CODES: 15

Spatial multiplexing, Space time receivers- ML, ZF, MMSE and Sphere decoding, BLAST receivers and Diversity multiplexing trade-off, Space time Block code - Rank and Determinant Criteria, Trace Criterion, Euclidean distance criterion, Orthogonal Space Time Block Codes - Alamouti space-time code.

MULTI CARRIER SYSTEMS: 15

Data transmission over multipath channels, Single carrier approach, Multi carrier approach, OFDM, OFDM generation, Advantages and drawbacks of OFDM, Cyclic prefix, MIMO frequency-selective channels – Capacity and Information rates of MIMO FS fading channels – Space-time coding and Channel detection for MIMO FS channels – MIMO OFDM systems, Basic concepts of MU- MIMO & OFDMA.

Total Hours:	**45**

Text Books:

1	David Tse and PramodViswanath, “Fundamentals of Wireless Communication”, Cambridge University Press 2013

2	Hamid Jafarkhani, “Space-Time Coding: Theory and Practice”, Cambridge University Press 2010
3	Yong Soo Cho, Jaekwonkim, Won Young yang, Chung G.Kang, MIMO OFDM Wireless Communications with MATLAB , Wiley- IEEE Press, 2010
4	MohinderJanakiram,” Space-Time processing and MIMO Systems”, Artech House, First Edition, 2004
Reference Books:	
1	EzioBiglieri, Robert Calderbank et al “MIMO Wireless Communications” Cambridge University Press 2007
2	Paulraj, R. Nabar and D. Gore, “Introduction to Space-Time Wireless Communications”,Cambridge University Press ,2008
Web References:	
1	https://massivemimo.eu/
2	https://www.electronics-notes.com/articles/antennas-propagation/mimo/
3	https://www.rfmw.com/data/SWA-MIMO-Basics.pdf
4	*https://ma-mimo.ellintech.se/2017/09/21/5-5-hours-of-massive-mimo-tutorials/*
Online Resources:	
1	https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-452-principles-of-wireless-communications-spring-2006/download-course-materials/
2	https://www.comsoc.org/best-readings/topics/massive-mimo
3	http://www.iitg.ac.in/engfac/krs/public_html/mimo.pdf
4	https://web.stanford.edu/~dntse/Chapters_PDF/Fundamentals_Wireless_Communication_chapter7.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, CaseStudy, Seminar, Group Assignment)**	**FA(16%) [80Marks]**
C918.1 C918.2	Analyze Understand	Quiz	20
C918.3	Apply	Assignment	20
C918.4	Understand	Quiz	20
C918.5 C918.6	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	1	-	-	-	-	-	-	-	-	-	2	-
2	3	2	2	-	-		-	-	-	-	-	-	2	-
3	2	3	-	2	-	-	-	-	-	-	-	-	3	-
4	2	-	3	3	-	-	-	-	-	-	-	-	2	-
5	2	2	3	-	-	-	-	-	-	-	-	-	2	-
6	2	3	3	-	-	-	-	-	-	-	-	-	3	-
1	Reasonably agreed				2	Moderately agreed				3	Strongly agreed			

21EC919	MILLIMETER WAVE COMMUNICATION SYSTEMS	3/0/0/3

Nature of Course	:C (Theory)

Course Objectives:

1	To understand the concepts of Millimeter waves and its characteristics.
2	To know about the 60GHz MM wave and its technology
3	To demonstrate the MMW transceivers and Antennas
4	To focus on the Millimeter wave MIMO techniques.
5	To understand about Beam steering and beam forming technologies

Course Outcomes:

Upon completion of the course, students shall have ability to

C919.1	Discuss the basics of millimetre wave and 60 GHz MMW technology	[AP]
C919.2	Understand the different millimeter wave standards	[U]
C919.3	Demonstrate the MMW transceivers and antennas	[A]
C919.4	Interpret the ideas about beam steering and beam forming antennas	[A]
C919.5	Examine the various diversity techniques of MMW	[AP]

Course Contents:

INTRODUCTION TO MILLIMETER WAVE AND IT'S CHARACTERISTICS 15

Frequency range, Antenna dimensions and Wave propagation of millimeterwave,Millimeter wave (MMW) Characteristics- 60 GHz MMW radio Principle and technology - Channel Performance at 60 GHz- Gigabit Wireless Communications - Development of Millimeter Wave Standards -Wi-Gig, IEEE 802.11ad, IEEE 802.15.3c,WirelessHD,ECMA-387/ISO/IEC 13156, Coexistence with Wireless Backhaul, Millimeter wave Applications.

TRANSCEIVERS AND MILLIMETER WAVES ANTENNAS FOR MILLIMETER WAVE COMMUNICATIONS: 15

MMW Transceivers- Transceiver Architecture- Research Trend: Transceiver Siliconization. MILLIMETER WAVES ANTENNAS**-** Path Loss and Antenna Directivity - Beam Steering Antenna, **ADVANCED BEAM STEERING AND BEAM FORMING:** The Need for Beam-Steering/Beam-Forming - Advanced Beam Steering Technology- Advanced Beam Forming Technology- Millimeter Wave Design Consideration.

MILLIMETER WAVE MIMO: 15

Spatial Diversity of Antenna Arrays - Multiple Antennas. Multiple Transceivers - Noise Coupling in a MIMO System- **DIVERSITY OVER MIMO CHANNELS -** Potential Benefits for Millimeter Wave Systems- Spatial and Temporal Diversity - Spatial and Frequency Diversity - Dynamic Spatial, Frequency, and Modulation Allocation, MM wave impact in upcoming 5G wireless equipments - mobile gadgets with Low Latency and High data rate

Total Hours:	45

Text Books:

1	Kao-Cheng Huang,Zhaocheng Wang, “Millimeter Wave Communication Systems” Wiley-IEEE Press 2011
2	Robert W.Heath, James N Murdock, Robert C Daniels, Theodore S Rappaport, “Millimetre Wave Wireless Communication”, Prentice hall, September 2014.
Reference Books:	
1	John S. Seybold, "introduction to rf propagation", John Wiley and Sons, 2005
2	Chia -chin chong, Kiyoshi hamaguchi, Peter F.M. Smulders and Su-Khiong," Millimeter wave Wireless Communication systems: Theory and Applications," Hindawl Publishing Corporation. 2007
Web References:	
1	https://www.oreilly.com/library/view/millimeter-wave-wireless/9780132173636/
2	https://jwcn-eurasipjournals.springeropen.com/articles/10.1155/2007/72831

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, CaseStudy, Seminar, Group Assignment)**	**FA(16%) [80Marks]**
C919.1 C919.2	Analyze Understand	Quiz	20
C919.3	Apply	Assignment	20
C919.4	Understand	Quiz	20
C919.5	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	1	-	-	-	-	-	-	-	-	-	3	1
2	2	2	-	-	-	-	-	-	-	-	-	-	3	1
3	3	1	-	2	-	-	-	-	-	-	-	-	2	-
4	2	2	-	2	-	-	-	-	-	-	-	-	2	-
5	2	2	-	2	-	-	-	-	-	-	-	-	2	-
1	Reasonably agreed				2	Moderately agreed				3	Strongly agreed			

21EC921	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

C921.1	Learn the basics of wireless sensor networks and its applications.	[R]
C921.2	Understand the architecture and elements of wireless sensor networks	[U]
C921.3	Analyze the MAC protocols for wireless sensor networks.	[AN]
C921.4	Apply the concept of Synchronization and Localization for sensor networks	[AP]
C921.5	Understand the various routing protocols of wireless sensor networks	[U]
C921.6	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

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, MagnetOSand OSPM - Application specific support: Target detection and tracking. Case study: Real-life Deployment of WSN

Total Hours:	**45**

Text Books:

1	Holger Karl and Andreas Willig, “Protocols And Architectures for Wireless Sensor Networks”, John Wiley, 1st edition, 2015.
2	KazemSohraby, Daniel Minoli and TaiebZnati, “Wireless Sensor Network-Technology, Protocolsand 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	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

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]**
C921.1 C921.2	Remember Understand	Quiz	20
C921.3	Analyze	Assignment	20
C921.4	Apply	Assignment	20
C921.5 C921.6	Understand	Technical presentation	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	40	30		30
Understand	30	30	40	30
Apply	10	10	20	10
Analyze	20	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			**SA 2 (60 Marks)**	**CA 2 : 100 Marks**		
SA 1 (60 Marks)	**FA 1 (40 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			

21EC922	SOFT COMPUTING	3/0/0/3

Nature of Course	: G (Theory & Analytical)

Course Objectives:

1	To understand the Fuzzy Logic concepts
2	To understand the concepts behind Natural language processing
3	To acquire the basic knowledge of Genetic algorithms
4	To equip the students with the latest application on Genetic Algorithm and its optimization
5	To make the students capable of applying soft computational techniques to solve various problems

Course Outcomes:

Upon completion of the course, students shall have ability to

C922.1	Understand the basic building block of Fuzzy Logic	[U]
C922.2	Develop the applications based fuzzy system	[AP]
C922.3	Relate the concepts of mutation and crossover in GA	[U]
C922.4	Establish the knowledge of Genetic algorithm approaches towards Fuzzy controller design	[AP]
C922.5	Analyze the optimization methods using Hybrid GA techniques	[AN]
C922.6	Analyze the optimization function by GA using deep learning process	[AN]

Course Contents:

NEURAL NETWORKS AND FUZZY LOGIC: 15

Supervised Learning Neural Networks – Reinforcement Learning – Unsupervised Learning Neural Networks, Bidirectional Associative Memories & Applications, Adaptive Resonance Theory, Fuzzy set theory - fuzzy rules and fuzzy reasoning - fuzzy inference systems, fuzzy automata and languages, fuzzy control methods, Adaptive neuro fuzzy inference systems - classification and regression trees - data clustering - rule base structure identification - neuro fuzzy controls, Fuzzy ARTMap, Fuzzification and Defuzzification methods, Applications.

GENETIC ALGORITHMS: 15

Basics of GA - Working principle - choice of encoding - selection probability - mutation and crossover - fitness evaluation – improving convergence rate - GA in Fuzzy Logic Controller Design, simplex GA - Hybrid approach, Soft Computing Tools.

OPTIMISATION TECHNIQUES IN GA: 15

Derivative based optimisation – Case study: fraud detection, health care monitoring using soft computing techniques - Learning Sets of Rules – Sequential Covering Algorithm – Learning Rule Set – First Order Rules – Sets of First Order Rules – Induction on Inverted Deduction – Inverting Resolution – Analytical Learning – Perfect Domain Theories – Explanation Base Learning – FOCL Algorithm – Reinforcement Learning – Task – Q-Learning – Temporal Difference Learning-Optimization function by Genetic algorithm using deep learning.

Total Hours:	**45**

Text Books:

1.	Jang J.S.R.Sun C.T and Mizutani E, “Neuro Fuzzy and Soft computing”, Pearson Education (Singapore), Reprinted, 2018.
2.	S. V. Kartalopoulos, “Understanding Neural Networks and Fuzzy Logic: Basic Concepts and Applications”, IEEE Press, PHI, 2016.

3.	David E.Goldberg, “Genetic Algorithms in Search, Optimization, and Machine Learning”, Pearson Education, Asia, Reprinted, 2015.
4.	Laurene V. Fausett, " Fundamentals of Neural Networks: Architectures, Algorithms and Applications" Pearson Prentice Hall, 2014.
5.	Machine Learning – Tom M. Mitchell, - MGH
6.	Machine Learning: An Algorithmic Perspective, Stephen Marsland, Taylor & Francis
7.	James A Freeman and Davis Skapura” Neural Networks Algorithm, applications and programming Techniques”, Pearson Education, 2002.
8.	Multilingual Natural Language Processing Applications: From Theory To Practice-Daniel M.Bikel and ImedZitouni , Pearson Publications.
9.	Natural Language Processing, A paninian perspective, AksharBharathi,Vineetchaitanya,Prentice – Hall of India.
Reference Books:	
1.	S.Rajasekaran and G.A.VijayalakshmiPai :”Neural networks, Fuzzylogics and Genetic algorithms”, PHI, 2017.
2.	Hung T. Nguyen, Elbert A. Walker, "A First Course in Fuzzy Logic", Third Edition, CRC Press, Reprinted, 2016.
3.	Timothy J.Ross: “Fuzzy Logic Engineering Applications”, Published by John Wiley and Sons, 2016.
4.	Mitchell Melanie, "An Introduction To Genetic Algorithms", Prentice Hall of India, New Delhi, 2013.
5.	Zurada, J.M. “Introduction to Artificial Neural systems”, JaicoPublishing House, 2013.
Web References:	
1	https://www.coursera.org/learn/neural-networks
2	http://www.digimat.in/nptel/courses/video/106105173/L05.html
3	https://onlinecourses.nptel.ac.in/noc18_cs13
4	http://www.digimat.in/nptel/courses/video/106105173/L12.html
Online References:	
1	http://cse.iitkgp.ac.in/~dsamanta/courses/sca/index.html
2	https://lecturenotes.in/subject/124/soft-computing-sc
3	http://users.du.se/~jwe/fuzzy/NFL/F9.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, CaseStudy, Seminar, Group Assignment)**	**FA(16%) [80Marks]**
C922.1 C922.2	Analyze Understand	Quiz	20
C922.3	Apply	Assignment	20
C922.4	Understand	Quiz	20
C922.5 C922.6	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			

21EC923	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

C923.1	Recall the basic definition of an image and human visual system	[R]
C923.2	Understand the principles of image formation, sampling, quantization and the human visual system to investigate specific image processing techniques	[U]
C923.3	Understand various image intensity transformations and spatial filtering for the purpose of image enhancement	[U]
C923.4	Apply appropriate technique to real problems in image and video analysis	[AP]
C923.5	Understand the principles of colour video processing	[U]
C934.6	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 **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, pixel based motion estimation, Block matching algorithm, Mesh based motion Estimation, global Motion Estimation, Region based motion estimation, multi resolution motion estimation.

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]**
C923.1 C923.2	Remember Understand	Quiz	20
C923.3	Apply	Assignment	20
C923.4 C923.5	Apply	Quiz	20
C923.6	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	30	30	60	30
Analyze	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**	**PSO 1**	**PSO 2**
1	3	2	2	-	-	-	-	-	-	-	-	-	3	1
2	3	3	2	1	-	-	-	-	-	-	-	-	3	1
3	3	3	2	1	-	-	-	-	1	1	-	1	3	1
4	3	2	2	1	-	-	-	-	-	-	-	1	3	1
5	3	2	3	1	-	-	-	-	-	-	-	1	3	1
6	3	2	2	1	-	-	-	-	-	1	-	1	3	1
1	Reasonably agreed				2	Moderately agreed				3	Strongly agreed			

21EC924	CONVERGENT NETWORKS	3/0/0/3

Nature of Course	:C (Theory Concept)
Pre requisites	:18EC403- Data Communication and Networks

Course Objectives:

1	To study about voice and video services on their data networks.
2	To study about convergence, switch hardware SIP and Proxy
3	To gain knowledge on speech coding and signalling
4	To understand the concept of SS7 and network architecture.
5	To understand the design of voice over IP network

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

C924.1	Understanding the concept of voices communication	[R]
C924.2	Gain knowledge on SIP and proxy	[U]
C924.3	Knowledge on speech coding andsignalling	[AN]
C924.4	Understand the concept of SS7 and network architecture	[U]
C924.5	Understanding the design of Voice over IP network	[AP]

Course Contents:

BACKBONE NETWORKAND SESSION MANAGEMENT **15**

Overview of Converged Networking, Benefits for Converged Networking, Converged Network Technologies, Voice Communication Network Concepts: Voice Transmission Schemes, PSTN, ISDN, Advanced Intelligent Networks, SONET Systems, Transporting voice by IP, Session Initiation Protocol-Architecture, overview, Message sequence, redirect and proxy server, structure of SDP, Use of SDP in SIP, Enhancements, H.323 protocol. Media Gateway control and soft switch Architecture, MEGACO

ENCRYPTION METHODS **15**

Speech coding techniques-Voice quality, sampling, types of coder,G.711,Selecting and cascaded Codec,H.323 Architecture RAS Signaling, Call Signaling,Call Scenarios,H.245 Control Signaling, Conference calls, Decomposed gateway.

15

SS7, ISUP ARCHITECTURE AND VOIP

MTP, SS7 Protocol Suite and network architecture, ISUP, Sigtran Architecture, M3UA Operation, QoS-Need and Overview, RSVP, Diffserv, MPLS.Designing Voice over IP Network, Design Criteria, Product and Vendor selection, Traffic forecast, Node locations and bandwidth requirements, Physical Connectivity

Total Hours:	**45**

Text Books:

1	Daniel Collins, (2005)“Carrier Grade Voice over IP”,(2nd ed.)

2	Oliver C. Ibe,(2002) “Converged Network Architectures, Delivering Voice and Data over IP, ATM, andFrame Relay”, John Wiley & Sons
Reference Books:	
1	Hu Hanrahan,(2007)”Network Convergence: Services, Applications, Transport, and Operations Support” John Wiley & Sons
2	Jeffrey Bannister, Paul Mather, Sebastian Coope,(2004)” Convergence Technologies for 3G Networks: IP,UMTS, EGPRS and ATM”, John Wiley & Sons & Sons
Web References:	
1	https://en.wikipedia.org/wiki/Network_convergence
2	https://shape.att.com/blog/network-convergence
3	https://www.techopedia.com/definition/15372/network-convergence
Online Resources:	
1	https://www.sciencedirect.com/topics/computer-science/converged-network
2	https://books.google.co.in/books?id=4YdqAAAAQBAJ&printsec=frontcover&dq=convergent+network+books+online&hl=en&sa=X&ved=0ahUKEwji3_-hgbfoAhWmxzgGHSLFCy8Q6AEILzAB#v=onepage&q&f=false
3	https://books.google.co.in/books?id=QlKpDgAAQBAJ&printsec=frontcover&dq=convergent+network+books+online&hl=en&sa=X&ved=0ahUKEwji3_-hgbfoAhWmxzgGHSLFCy8Q6AEIJzAA#v=onepage&q&f=false

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, CaseStudy, Seminar, Group Assignment)**	**FA(16%) [80Marks]**
C924.1 C9242	Analyze Understand	Quiz	20
C924.3	Apply	Assignment	20
C924.4	Understand	Quiz	20
C924.5	Apply	Group Assignment	20

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)	

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				

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
1	Reasonably agreed				2	Moderately agreed				3	Strongly agreed			

21EC925	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**		
C925.1	Recall the different network layers and various attacks possible on networking devices.	[R]
C925.2	Understand the concept of a firewall and its types and understand the intrusion detection and prevention of the system.	[U]
C925.3	Identify the concepts of virtual private networks and their types	[U]
C925.4	Understand the various methods, protocols, and WAN topologies.	[U]
C925.5	Interpret SSL or Firewall based solutions against security threats	[AP]
C925.6	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.

Security Services: **15**

Security Services for E-mail-attacks possible through E-mail – establishing keys privacy-authentication of the source-Message Integrity-Non-repudiation-Pretty Good Privacy-S/MIME-SSL/TLS Basic Protocol-computing the keys- client authentication-PKI as deployed by SSL Attacks fixed in v3- Exportability-Encoding-Secure Electronic Transaction (SET), Kerberos - 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	Amir Ranjbar, “CCNP ONT Official Exam Certification Guide”, Cisco Press, 2007.
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/

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

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)	

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	Remember	Quiz	20
C925.2	Understand	Group Assignment	20
C925.3	Understand	Case Study	20
C925.4	Understand		
C925.5	Apply	Assignment	20
C925.6	Analyse		

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	20
Understand	40	40	60	40

Apply	20	40		20
Analyze	20			20
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	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			

21EC926	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 andanalyze neural networks

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

C926.1	Demonstrate knowledge on design principles of pattern recognition	[R]
C926.2	Understand the concepts of statistical pattern recognition	[U]
C926.3	Analyse the various Pattern Recognition models.	[AN]
C926.4	Apply the non parametric and non parametric techniques in Pattern Recognition	[AP]
C926.5	Perform Feature extraction, feature reduction and structural pattern recognition.	[AN]
C926.6	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

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, CaseStudy, Seminar, Group Assignment)**	**FA(16%) [80Marks]**
C926.1 C926.2	Analyze Understand	Quiz	20
C926.3	Apply	Assignment	20

C926.4	Understand	Quiz	20
C926.5 C926.6	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			

21EC927	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**		
C927.1	Illustrate the concepts behind ATM and Frame relay networks	[U]
C927.2	Understand the concepts of high speed LAN and Ethernet	[U]
C927.3	Analyze the concepts and congestions associated with TCP and ATM	[AN]
C927.4	Understand the various traffic management strategies of ABR and GFR	[U]
C927.5	Categorize queuing disciplines of Integrated and Differentiated Services	[AN]
C927.6	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 – Traffic Management – Congestion Control in Frame Relay.

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 –Network management- choosing a configuration method-MIB

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	Warland, PravinVaraiya, “High Performance Communication Networks”, Reprinted Second Edition, Jean Harcourt Asia Pvt. Ltd., 2009.
Reference Books:	
1	IrvanPepelnjk, Jim Guichard, Jeff Apcar, “MPLS and VPN architecture”, 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 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)	

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	Understand	Assignment	20
C927.4	Understand	Assignment	20
C927.5 &C927.6	Analyse, Understand	Class Presentation	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	60	30
Apply	40	40		40

Analyze	10	10	20	10
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	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			

21EC928	ADVANCED WIRELESS NETWORKS	3/0/0/3
Nature of Course	C (Theory Concept)	

Course Objectives:

1	To understand the fundamentals and technologies of wireless networks.
2	To introduce the various IEEE network standards in advanced wireless network architectures.
3	To focus on evolution and mobility management of mobile communication technologies.
4	To examine the various ADHOC networks and protocols.
5	To understand the Bluetooth Low Energy Protocol and smart sensor networks.

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

C928.1	Demonstrate the concepts and standards of wireless local area networks.	[U]
C928.2	Explain the architecture of wireless personal area networks.	[U]
C928.3	Illustrate wireless wide area networks using 5G and Mobile cloud..	[AP]
C928.4	Implement the tools and characteristics of ADHOC networks.	[AP]
C928.5	Interpret the various ADHOC Protocols, Bluetooth Low Energy Protocol and smart sensor network	[AN]

Course Contents:

WIRELESS LOCAL AND PERSONAL AREA NETWORKS : 15

Local Area Networks**:** Introduction to Wireless LANs – WLAN Equipment ,Topologies, Technologies ,IEEE 802.11 WLAN –Architecture and Services, Physical Layer– MAC SubLayer– MAC Management SubLayer; Other IEEE 802.11
Standards: HIPERLAN–WiMAX. Personal Area Networks**:** Introduction to Bluetooth –Protocol Stack ,Network Connection Establishment – Topology Applications – Interference between Bluetooth and 802.11 – Low Rate and High Rate WPAN –Wireless Sensor Network – Protocol Stack – Zigbee Technology– IEEE 802.15.4 WPAN Device Architecture – IEEE 802.15.3 –Ultra Wideband.

MOBILE NETWORKS: **15**

Cellular Network Organization –Operation of Cellular Systems, GSM network Architecture, GSM channels, Call procedures, hand off procedures –CDMA Digital cellular standards. Evolution of LTE technology to beyond 4G-10 pillars of 5G-5G internet: Network Reconfiguration and visualization-Mobility –QoS-Emerging approach for resource over- provisioning-Small cell technologies and challenges-The Mobile cloud and Enablers.

ADHOC WIRELESS NETWORKS: 15

Characteristics of Adhoc Networks –Classifications of MAC Protocols–Table driven and Source initiated On Demand routing protocols –DSDV, AODV ,DSR, Hybrid Protocols ,TCP Over Ad Hoc Wireless Networks, Bluetooth Low Energy Real Time Protocol

Total Hours:	**45**

Text Books:

1	William Stallings, ”Wireless Communications and Networks”, Pearson- Prentice Hall India, Second Edition (Re-printed), 2017.
2	Clint Smith and Daniel Collins, “Wireless Networks**”,** McGraw-Hill Education, Third Edition, 2014.

3	W.C.Y.Lee, “Mobile communications Engineering: Theory And Applications”, Tata McGraw Hill, Third Edition,2011
4	Jonathan rodriguez, “ Fundamentals oF 5G mobile network”, John Wiley & Sons publications,1st edition,2015
5	Stefania Sesia, IssamToufik and Matthew Baker, “LTE – The UMTS Long Term Evolution From Theory to Practice”, John Wiley & Sons, Inc. Publication, Second Edition, 2011

Reference Books:	
1	EldadPerahia, Robert Stacey, “Next Generation Wireless LANs” Cambridge University Press, Second edition, 2013
2	ItiSahaMisra, “Wireless Communication and Networks 3G and Beyond”, Tata McGraw Hill, 2009.
Web References:	
1	http://ceng.usc.edu/~bkrishna/research/talks/WSN_Tutorial_Krishnamachari_ICISIP05.pdf
2	www.tfb.edu.mk/amarkoski/WSN/Kniga-w02
3	http://profsite.um.ac.ir/~hyaghmae/ACN/WSNbook.pdf
4	http://www.utdallas.edu/~venky/ 5. http://www.public.asu.edu/~dshin17/ 6.
5	https://www.researchgate.net/publication/309390203_A_Bluetooth_Low_Energy_real-time_protocol_for_Industrial_Wireless_mesh_Networks
Online Resources:	
1	https://onlinecourses.nptel.ac.in/noc17_cs37/
2	https://www.coursera.org/learn/wireless-communications
3	https://www.mooc-list.com/.../wireless-communication-emerging-technologies-coursera/

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]
C928.1, C928.2	Understand	Quiz	20
C928.3	Apply	Assignment	20
C928.4	Apply	Group assignment	20
C928.5	Apply	Case study	20

Assessment based on Summative and End Semester Examination				
Bloom's Level	Summative Assessment (24%) [120 Marks]		FA (16%) [80 Marks]	End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]		
Remember	20	10		10
Understand	40	10	20	40
Apply	40	40	60	30
Analyse		40		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		3								3	
2	3	2			3					2			3	
3	3	2		1	3								3	
4	3	2	1		3								3	
5	3	2	1		3								3	
1	Reasonably agreed				2	Moderately agreed				3	Strongly agreed			

21EC929	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**		
C929.1	Understand the concepts of Neural Networks.	[U]
C929.2	Illustrate the operation of Feed Forward Networks	[U]
C929.3	Recall the concepts of Associative Memory	[R]
C929.4	Enumerate the concepts of Vector Quantization.	[U]
C929.5	Understand the basics of Deep learning and Convolutional Neural Networks	[U]
C929.6	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				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, CaseStudy, Seminar, Group Assignment)**	**FA(16%) [80Marks]**
C929.1 C929.2	Analyze Understand	Quiz	20
C929.3	Apply	Assignment	20
C929.4	Understand	Quiz	20
C929.5 C929.6	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

21EC001	PRINCIPLES OF CYBER PHYSICAL SYSTEM	3/0/0/3
Nature of Course	:C (Theory Concept)	

Course Objectives:

1	To Obtain cyber physical systems fundamentals and principles knowledge as building blocks to promote further design and implementation of more complex real time systems.
2	To Understand cyber physical systems design for synchronous model with specific case study for arm processor
3	To Understand In what way cyber physical systems are crucial for the optimal performance of asynchronous model.
4	To Comprehend the cyber physical systems design and implementation in dynamical models.
5	To Hybridize cyber physical systems which will help the students to anticipate upcoming technologies.

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

C001.1	Understand the basics of cyber physical systems.	[U]
C001.2	Identify safety specifications and critical properties	[AP]
C001.3	Understand abstraction in system designs	[U]
C001.4	Express pre- and post-conditions and invariants for CPS models	[U]
C001.5	Come up with cost effective, reliable, robust and feasible designs for real world problems.	[AN]

Course Contents:

Introduction to Cyber Physical systems: 15

Introduction to Cyber-Physical Systems - Cyber-Physical Systems Design Recommendations - Cyber-Physical System Requirements - Requirements Engineering – Interoperability - Real Time System - GPU Computing - Radio Frequency Identification Technology - Wireless Sensor Networks Technology - Powerline Communication. CASE STUDY: Cyber Physical Vehicle Tracking System.

CPS HW Platforms : 15

Processors, Sensors, Actuators, CPS Network, CPS Network – Wireless Hart – CAN - Automotive Ethernet - CPS Sw stack – RTOS, Scheduling Real Time control tasks Principles of Automated Control Design: Dynamical Systems and Stability Controller Design Techniques - Stability Analysis: CLFs – MLFs - stability under slow switching - Performance under Packet drop and Noise.

Safety Assurance of Cyber-Physical Systems:15

Advanced Automata based modelling and analysis: Basic introduction and examples - Timed and Hybrid Automata - Definition of trajectories – zenoness - Formal Analysis: Flow pipe construction - reachability analysis - Analysis of CPS Software - Weakest Pre-conditions - Bounded Model checking.Case study: Attacks on SmartGrids, UAVs in Industries, Industry 4.0 Applications for Medical/Healthcare Services.

Total Hours:	**45**

Text Books:

1	Raj Rajkumar, Dionisio De Niz , and Mark Klein, “Cyber-Physical Systems” Addison-Wesley Professional, 1st Edition 2016.
2	E. A. Lee and S. A. Seshia, “Introduction to Embedded Systems: A Cyber-Physical Systems Approach”, Second Edition - MIT Press, 2017.

Reference Books:

1	R. Alur, “Principles of Cyber-Physical Systems,” MIT Press, 2015.

2	T. D. Lewis “Network Science: Theory and Applications”, Wiley, 2016.
3	Jean J. Labrosse, Embedded Systems Building Blocks: Complete and Ready-To-Use Modules in C, The publisher, Paul Temme, 2016.
Web References:	
1	https://www.cambridge.org/core/books/principles-of-cyberphysical-systems/83EE40D7563646BE161A45F27C3F4F67
2	https://www.cs.cmu.edu/~aplatzer/course/fcps14/fcps14.pdf
Online Resources:	
1	https://www.nielit.gov.in/calicut/course-calendar?coursecode=CPS100
2	https://nptel.ac.in/courses/106/105/106105195/
3	https://www.coursera.org/learn/cyber-physical-systems-1

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	t**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]**
C001.1	Understand	Quiz	20
C001.2	Apply	Assignment	20
C001.3	Understand	Group Assignment	20
C001.4	Understand		
C001.5	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	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			

21EC002	INTRODUCTION TO RASPBERRY PI AND ARDUINO	3/0/0/3

Nature of Course	: K (Problem Programming)

Course Objectives:

1	Introduce the basics of Python Programming.
2	Familiarize with the concepts of IOT Processors, compiler and interpreter
3	Gain knowledge on Architectures of Raspberry pi &Arduino
4	Impart knowledge on various sensors on the Raspberry pi Environment.
5	Implement the real time sensors to the selected IoT processors

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

C002.1	Understand the basic concepts of embedded programming	[U]
C002.2	Apply the knowledge of processor and architecture in IoTmodeling	[AP]
C002.3	Apply the knowledge of sensor parsing data to create the project	[AP]
C002.4	Understand the concepts and architecture of Arduino, Atmega328	[U]
C002.5	Analyze the methods to interface the sensors and actuators with the Arduino	[AN]

Course Contents:

Introduction to Raspberry pi: 15

Introduction to Python programming, Interpreter vs compiler programming, preprocessors, assembler, linker and loader, Introduction to Raspberry Pi, Implementation of IoT with Raspberry Pi-Preparing Raspberry Pi - Clayster libraries –**Hardware Interacting with the hardware** - Interfacing the hardware- Internal representation of sensor values - Persisting data - External representation of sensor values - Exporting sensor data - Creating the actuator project- - Creating a controller - Representing sensor values - Parsing sensor data - Calculating control states - Creating a camera - Hardware -Accessing the serial port on Raspberry Pi - persistent default settings - Adding configurable properties - Persisting the settings and Working - Initializing the camera - Creating the sensor project

Arduino Processors: 15

IOT Processors- Atmel's Atmega328p, Arduino abstraction, Architecture, Arduino History and Family, General Hardware Interfacings: LED's, Switches, Seven Segment Display, Multi Segment Displays, Relays, LCD, Buzzer, IR Sensors, Other Digital Sensors,Basic programming- LED blinking,Fading, Traffic Light, LCD Display, Reading various sensor data on serial monitor and LCD Display, **Case Study**: ARDUINO based home automation, ARDUINO Based Solar Street Light system, ARDUINO Based Alarm Clock, ARDUINO Based Car Parking System

Frame works & Protocols : 15

Software: openFrameworks as our IDE (C/C++) - "Arduino" Language (C/C++) -Digital vs. Analog circuits, audio and communication, - ADC - DAC - Serial& Parallel Communication - Hardware to Hardware Communication - I^2C/IIC (Inter-Integrated Circuit) - SPI– Serial UARTCommunication, **Wireless:** IEEE 802.15.4 standard-Zigbee, LORA wired : CAN, SPI, Implementation of IoT with Raspberry Pi - Introduction to SDN, SDN for IoT, Setting Up a Raspberry Pi - Blinking an LED

Controlling a Relay with Raspberry Pi**Case Study :** Raspberry Pi Based temperature control, trans-receiver and Alarm Clock,	
Total Hours:	**45**
Text Books:	
1	Simon Monk, Hacking Electronics: Learning Electronics with Arduino and Raspberry Pi, 2nd Edition, McGraw-Hill Education, 2017
2	Monk, Simon. Programming the Raspberry Pi: getting started with Python, 1st edition, McGraw-Hill Education, 2016.
3	Yamanoor, Sai, and SrihariYamanoor. Python Programming with Raspberry Pi, 1st edition, Packt -2016
	Publishing Ltd, 2017. Donald Norris, The Internet of Things: Do-It-Yourself Projects with Arduino, Raspberry Pi, and Beagle Bone Black, 1 stedition,McGraw Hill Education, 2015
Reference Books:	
1	Eben Upton and Gareth Halfacree, “Raspberry Pi User Guide”, , 4th edition, John Wiley & Sons, August 2016
2	Alex Bradbury and Ben Everard, “Learning Python with Raspberry Pi, John Wiley& Sons, ”, Feb 2014.
3	Michael Margolis, “Arduino Cookbook”, First Edition, O'Reilly Media, Inc, March 2014
Web References:	
1	https://www.arduino.cc/reference/en/libraries/wifiwebserver/
2	https://www.arduino.cc/en/Tutorial/LibraryExamples/WebServer
3	https://www.raspberrypi.org/courses/featured
4	https://www.edx.org/learn/raspberry-pi
Online Resources:	
1	https://www.coursera.org/learn/raspberry-pi-platform
2	https://www.udemy.com/topic/raspberry-pi/
3	https://www.futurelearn.com/partners/raspberry-pi

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	t**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]**
C002.1	Understand	Quiz	20
C002.2	Apply	Assignment	20
C002.3	Understand	Group Assignment	20
C002.4	Understand		
C002.5	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	3	2	2	2	1	-	-	-	-	-	-	2	3	1
2	3	3	2	3	1	-	-	-	-	-	-	1	3	1
3	2	3	2	2	1	-	-	-	-	-	-	2	3	1
4	2	3	2	3	1	-	-	-	-	-	-	2	3	1
5	2	2	2	2	1	-	-	-	-	-	-	1	3	1
1	Reasonably agreed				2	Moderately agreed				3	Strongly agreed			

21EC003	IT WORKSHOP SCILAB / MATLAB	3/0/0/3
Nature of Course:	K (Problem Programming)	
Pre requisites:	NIL	

Course Objectives:

1. To study the concepts of MATLAB introduction, variables and assignment statements.
2. To understand the vectors and matrices as a function of argument
3. To study the concepts of MATLAB script with input output, functions and commands.
4. To study the concept of Loop statements and selection statements
5. To understand the various debugging techniques and Toolboxes.

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

C003.1	Understand the fundamentals of MATLAB and Creating MATLAB variables, workspace and miscellaneous commands.	[U]
C003.2	Practice the Matrix, array and basic mathematical functions, solving linear equations and other mathematical functions.	[R]
C003.3	Analyze the programming script with input/output functions, script side-effects and anatomy of a M-File function	[AN]
C003.4	Develop script with relational, logical operators, flow structures in order to save the output as a file	[AP]
C003.5	Understand the Debugging process, thereby debugging and correcting an M-file	[U]

Course Contents:

Introduction to MATLB and Vectors - Matrix: **15**

Getting in to MATLAB – Variable and Assignment statements – Characters and Strings – Relational Expressions –Type Ranges and Type Casting– Vectors and Matrices –Scalar and array Operations on Vectors and Matrices – Logical Vectors –Plotting function – 2D, 3D plots.

MATLAB programming: **15**

MATLAB scripts – Input and Output – User defined functions that return a single value – Commands and functions – The if statement – The if-else statement – Nested if-else statements –The switch statement – The ‘”is” functions in MATLAB, The “for” Loop – Nested for Loops – While loops

Programming with Co-Design: **15**

MATLAB program organization – Application: Menu Driven modular program – Debugging Techniques – SCILAB Toolbox - Image Import, Export and conversion - Image Filtering Enhancement - Image Segmentation – Image Compression Techniques. **Total Hours: 45**

Text Books:

1	Stormy Attaway and Butterworth-Heinemann,“MATLAB: A Practical Introduction to Programming and Problem Solving”, BH publisher, 2018
2.	Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, “Digital Image Processing using MATLAB”, Pearson Education, 2018.

Reference Books:	
1.	Cleve Moler, “Experiments with MATLAB”, MathWorks, 2017
2.	Stephen J. Chapman, “MATLAB Programming for Engineers”, Thomson Learning, 2017
Web References:	
1.	https://in.mathworks.com/help/matlab/index.html
2.	https://in.mathworks.com/help/matlab/mathematics.html?s_tid=CRUX_lftnav
3.	https://www.mathworks.com/videos/introduction-to-matlab-with-image-processing-toolbox-90409.html
Online Resources:	
1.	https://nptel.ac.in/courses/103/106/103106118/
2.	https://www.coursera.org/learn/matlab
3.	https://www.youtube.com/watch?v=O41BWhXFu8E

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	tTotal	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]**
C003.1	Understand	Quiz	20
C003.2	Remember	Assignment	20
C003.3	Analyse	Group Assignment	20
C003.4	Apply		
C003.5	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	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	3	-	-	-	-	-	-	-	-	-	-	1	1	1
2	2	-	2	-	-	-	-	-	-	-	-	2	3	2
3	-	2	2	-	-	-	-	-	-	-	-	2	3	2
4	3	2	-	-	-	-	-	-	-	-	-	1	1	1
5	-	3	2	-	-	-	-	-	-	-	-	2	2	1
1	Reasonably agreed				2	Moderately agreed				3	Strongly agreed			

21EC004	BRAIN COMPUTER INTERFACE AND ITS APPLICATIONS	3/0/0/3
Nature of Course	C (Theory Concept)	
Course Objectives:		
1	Understand the basic concepts of Brain Computer Interface	
2	Apply the various signal acquisition methods	
3	Learn about signal processing methods used in BCI	
4	Understand the various machine learning methods of BCI	
5	Learn the various applications of BCI	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C004.1	Comprehend and appreciate the significance and role of this course in the present contemporary world	[U]
C004.2	Understand the concept of BCI	[U]
C004.3	Assign functions appropriately to the human and to the machine	[AN]
C004.4	Select appropriate feature extraction methods	[AP]
C004.5	Use machine learning algorithms for translation	[AP]

Course Contents:

Introduction to BCI and Brain Activation Patterns **15**

Brain structure and function, Brain Computer Interface Types – Synchronous and Asynchronous- Invasive BCI – Partially Invasive BCI–Non Invasive BCI, Structure of BCI System, BCI Monitoring Hardware, EEG, ECoG, MEG, fMRI, Brain activation patterns – Spikes, Oscillatory potential and ERD, slow cortical potentials, Movement related potentials – Mu rhythms, motor imagery, stimulus related potentials, potentials related to cognitive tasks.

Feature Extraction and Machine Learning Methods **15**

Data Processing- spike sorting, Frequency Domain Analysis, Wavelet analysis, Time domain analysis, Spatial filtering – Principal Component Analysis (PCA), Independent Component Analysis (ICA), Artefacts reduction, Feature Extraction – Phase synchronization and coherence. Machine Learning Methods for BCI – Classification techniques – Binary classification, Ensemble classification, Multiclass Classification, Evaluation of classification performance, Regression – Linear, Polynomial, RBF's, Perceptron's, support vector machine, Graph theoretical functional connectivity analysis- Building a BCI

Applications of BCI: **15**

Case studies – Invasive BCIs: Decoding and tracking arm (hand) position, controlling prosthetic devices such as orthotic hands, cursor and robotic controlling using multi electrode array implant, Cortical control of muscles via functional electrical simulation, Noninvasive BCIs– P300 Mind Speller, Visual Cognitive BCI, Emotion detection.. Ethics of Brain Computer Interfacing.

Total Hours:	**45**

Text Books:

1	Nam C S, Nijihot and Lotte, “Brain -Computer Interface Handbook Technological and Theoretical Advances”, CRC Press, 2018.
2	Ella Hassianien, A&Azar.A.T (Editors), “Brain-Computer Interfaces Current Trends and Applications”, Springer, 2015
3	Rajesh.P.N.Rao, “Brain-Computer Interfacing: An Introduction”, Cambridge University Press, First Edition, 2013
Reference Books:	
1	Christoph, Brendan and Junichi, “Brain-Computer Interface Research: State of the art Summary”, Springer, 2017
2	Ali Bashashati, MehradadFatourechi, Rabab K Ward, Gary E Birch, “A survey of signal Processing algorithma in brain-computer interfaces based on electrical brain signals” Journal of Neural Engineering, Vol.4. 2007, PP.33-57
3	Andrew Webb, “Statistical Pattern Recognition”, Wiley International, Second Edition, 2002.
Web References:	
1	https://sccn.ucsd.edu/wiki/Introduction_To_Modern_Brain-computer_Interface_Design
2	https://www.ncbi.nlm.nih.gov/pubmed/21438193
3	https://www.sciencedirect.com/science/article/pii/S1110866515000237
Online Resources:	
1	https://www.edx.org/course/circuits-electronics-1-basic-circuit
2	https://nptel.ac.in/courses/108/108/108108167/

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	t**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]**
C004.1	Understand	Quiz	20
C004.2		Group Assignment	20
C004.3	Analyse	Seminar	20
C004.4	Apply		
C004.5	Apply	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	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	2	1	1	-	-	-	-	-	-	-	-	1	-	-
2	3	1	2	1	-	-	-	-	-	-	-	2	1	-
3	1	2	3	3	-	-	-	-	-	-	-	3	2	-
4	1	3	2	1	-	-	-	-	-	-	-	2	3	-
5	2	2	2	3	-	-	-	-	-	-	-	3	2	-
1	Reasonably agreed				2	Moderately agreed				3	Strongly agreed			

21EC005	WIRELESS WEARABLE SENSORS	3/0/0/3
Nature of Course	C (Theory Concept)	
Course Objectives:		
1	To understand the basics for the need of Wearable Devices	
2	To understand the operation of wearable devices and mobile sensing	
3	To learn how to use software programs to perform varying and complex tasks	
4	To expand upon the knowledge learned and apply it to solve real world problems	
5	To apply the wearable algorithms for developing wearable sensing	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C005.1	Understanding the fundamental concepts of Wearable devices	[U]
C005.2	Recall the operation of different types of wireless wearable sensors	[R]
C005.3	Categorize the various wearable haptic and tactile display	[AN]
C005.4	Mind mapping of organizing and working of wireless wearable sensors based on application	[AP]
C005.5	Apply the concept of wearable sensors in heart rate monitoring, smart fabrics and remote monitoring of human body.	[AP]

Course Contents:

Introduction to Wearable's: **15**

Fundamentals-wearable sensing technology, Social Aspects of Wear ability, Adoption of Innovation and Aesthetic Change, On-Body Interaction, Wearable Haptics, Categories of Wearable Haptic and Tactile Display, wearable Sensorimotor Enhancer, Wearable Bio and Chemical Sensors, Wearable Inertial Sensors and Their Applications, Cameras in wearable devices, Applications in safety and security, navigation.

Wearable Wireless sensors: **15**

Overview of various wireless wearable sensors, Accelerometer, gyroscope, magnetometer, Smartphone orientation and heading detection, Health monitoring and fitness tracking, Wrist-worn wearable's, gesture and remote interaction, Sensor fusion in body-area networks, Application of Optical Heart Rate Monitoring, Measurement of Energy Expenditure by Body-worn Heat-flow Sensor, Biomechanical Sensing, Non-Invasive Sweat Monitoring by Textile Sensors, Smart Fabrics and Interactive Textile Platforms for Remote Monitoring, Physical Activity Body Sensor Technology

Future Trends of Wearable Sensing Elements: **15**

Channel Models for On-Body Communications, Establishment in Wireless Body Area Networks, Wearable Sensors for the Monitoring of Physical and Physiological Changes in Daily Life, Wearing Sensors Inside and Outside of the Human Body for the Early Detection of Diseases, Wearable and Non-Invasive Assistive Technologies, Wireless Tracking of Tongue Motion, Detection and Characterization of Food Intake by Wearable, future trends in wearable and implantable sensor technology :CASE STUDY: Wearable Event Device, Google Glass, Apple Watch.

Total Hours:	**45**

Text Books:	
1.	Edward Sazonov, Michael R. Neuman “Wearable Sensors: Fundamentals, Implementation and Applications”, 7th Edition, Academic Press/Elsevier, 2020.
2.	Woodrow Barfield “Fundamentals of Wearable Computers and Augmented Reality”, 2nd Edition, CRC Press, 2015.
3.	Annalisa Bonfiglo, Danilo De Rossi, “Wearable Monitoring Systems”, Springer Publishers, 4thEdition ,2014.
Reference Books:	
1.	Micheal, Katina “Wearable Technologies: Concepts, Methodologies, Tools, and Applications” 2nd Edition, IGI Global Engineering Publishers, 2018
2.	OmeshTickoo, Ravi Iyer “Making Sense of Sensors: End-to-End Algorithms and Infrastructure Design” ,2nd Edition, Apress Publishers, 2017
3.	Kate Hartman, “Make: Wearable Electronics: Design, Prototype and wear your own interactive garments”, 3rd Edition, Maker Media, 2015.
4.	Elijah Hunter, “Wearable Technology”, 3rd Edition, Kindle, 2014.
5	GuangZhong Yang, “Body Sensor Networks”,4th Edition, Springer Publisher, 2016.
Web References:	
1.	https://www.sciencedirect.com/science/book/9780124186620
2.	https://pdfs.semanticscholar.org/.../4331017b99da992456c4a6e9b98bd2d54a41.pdf
3.	https://www.elsevier.com/books/wearable-sensors/sazonov/978-0-12-418662-0
Online Resources:	
1.	https://www.slideshare.net/Funk98/wearable-electronics-in-healthcare
2.	https://www.csd.uoc.gr/~hy541/Lectures_files/Lectures_pdfs/CS541_Lecture1.pdf

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**tTotal**	**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]**
C005.1	Understand	Quiz	20
C005.2	Remember	Assignment	20
C005.3 C005.4	Analyse Apply	Group Assignment	20
C005.5	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	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	2	1	1	1	-	-	-	-	-	-	-	2	1	-
2	2	2	1	1	-	-	-	-	-	-	-	3	2	-
3	3	1	2	2	-	-	-	-	-	-	-	2	3	-
4	3	2	2	3	-	-	-	-	-	-	-	2	2	-
5	1	2	3	3	-	-	-	-	-	-	-	3	3	-
1	Reasonably agreed				2	Moderately agreed				3	Strongly agreed			

21EC006	ORGANIZATIONAL BEHAVIOUR	3/0/0/3

Nature of Course	: C (Theory Concept)

Course Objectives:

1	The objective of the course is to provide basic knowledge about organizational behaviourto familiarize the students with the individual and group behaviour.
2	The course is designed to enable the students to adapt & apply concepts in their day to day life at work place
3	To know about the role of engineer in the area of organisational behaviour.
4	To create and implement team building strategies for organisation building.

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

C006.1	Identify and understand different learning theories, complexities associated with management ofindividual behavior in working environment.	[U]
C006.2	Apply organisation behavioural fundamentals to solve organization problems	[U]
C006.3	Analyse the changes within an individual and group behaviour which will lead to better leadership and also evaluate the role of relationships in the organization.	U]
C006.4	Identify the need for managing the change process in the industry	[AN]
C006.5	Analyse organizational behaviour with a case study.	[AN]

Course Contents:

INDIVIDUAL BEHAVIOUR **15**

Definition, need and importance -Nature and scope-Importance of Learning- Introduction and learning theories. Motivation: Content and process theories-Perception-Personality- Attitudes.

GROUP BEHAVIOUR **15**

Definition, need and importance -Nature and scope-Importance of Groups and Teams-Leadership: Styles and Theories -Role relationships and conflict-Group dynamics- Power-Politics-Work values.

ORGANISATION DEVELOPMENT **15**

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 change

Total Hours:	**45**

Text Books:

1	Stephen P. Robins, Organisational Behaviour, PHI Learning / Pearson Education, 11th edition, 2008.
2	Fred Luthans, Organisational Behaviour, McGraw Hill, 11th Edition, 2001.

Reference Books:	
1	Schermerhorn, Hunt and Osborn, Organisational behaviour, John Wiley, 9th Edition, 2008.
2	UdaiPareek, Understanding Organisational Behaviour, 2nd Edition, Oxford Higher Education, 2004.
3	Mc Shane & Von Glinov, Organisational Behaviour, 4th Edition, Tata Mc Graw Hill, 2007.
4	Robbins , S., Judge, T.A., &Sanghi, S.. (2009). Organizational behavior 13th Ed.). New Delhi:Pearson Education
Web References:	
1	https://www.civilserviceindia.com/subject/Management/notes/the-dynamics-of-organization-behavior-communication.html
2	https://www.tutorialspoint.com/organizational_behavior/organizational_behavior_models.htm
3	https://www.researchgate.net/publication/43456555_Leadership_and_Power_Identity_Processes_in_Groups_and_Organizations
Online Resources:	
1	https://www.edx.org/learn/organizational-behavior
2	https://www.coursera.org/courses?query=organizational%20behavior
3	https://onlinecourses.nptel.ac.in/noc21_mg82/preview

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**tTotal**	**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]**
C006.1	Understand	Quiz	20
C006.2	Understand	Assignment	20
C006.3	Understand	Group Assignment	20
C006.4	Analyse		
C006.5	Analyse	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	-	-	-	-	-	-	-	-	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			

21EC007	ROBOTICS	3/0/0/3
Nature of Course	C (Theory Concept)	

Course Objectives:

1	To learn the basics of robotics and hardware.
2	To study the programming and communication techniques of robots.
3	To study the use of image processing and artificial intelligence in robotics.

Course Outcomes:

Upon completion of the course, students shall have ability to

C007.1	Understand the basics of robotics and its behaviour & Revisit the control system concepts	[U]
C007.2	Understand the various types of sensors, actuators and hardware used in the design of robotics	[U]
C007.3	Apply the concepts of embedded robotics and communication modules to develop programming skills in robotics	[AP]
C007.4	To analyze the various expert systems including image processing and artificial intelligence	[A]
C007.5	To know about the recent trends of Robotics Applications, Connected Industry, IoT and Man- Machine Interface	[R]

Course Contents:

Overview of Robots and Hardware: 15

Introduction- Behavior of robots -Specification of Robots-Types of Robots-Design Challenges (choosing an Embedded system)-Engineering design process -Programming-Motors- Chassis -Direct Drive -Indirect Drive –Gearing- End Effectors-Wheels Vs Tank Tread. Parts Identification-Building Instruction for the Tetrix Platform, DC - wiring Configuration and Power Supplies - Loops-Switch blocks- sensors and actuators with ROS-SCOR BOT- Introduction to Robot Kinematics – Direct and inverse kinematics- Structures and Programming-IS.14533:2005 Manipulating Industrial robots.

Embedded robotics, communication modules and robot programming 15

Interfaces- Operating System- Sensors (types and output modes) -Soft encoder-Position sensitive Device- multitasking- Co-operative-Preemptive-Synchronization-Scheduling -Interrupt Appetites-Collaborative Robots- communication serial and parallel communication- methods of communication - man to robot (man to machine and machine to man) - Communicating modules(currently using communicating device) . Methods of Robot Programming – Characteristics of task level languages lead through programming methods – Motion interpolation.

Image Processing, Artificial Intelligence and Expert Systems 15

Image processing – techniques of image processing- digital image process –comparison - Artificial intelligence – Basics – Goals of artificial intelligence – AI techniques – problem representation in Artificial Intelligence (AI) – Problem reduction and solution techniques – Application of AI and Knowledge-based expert systems (KBES) in Robots. Robotics Applications- Connected Industry, IoT and Man- Machine Interface.	
Total Hours:	**45**
Text Books:	
1	Harry H Poole, "Fundamentals of Robotics Engineering , Springer, Poole Associates, First edition, 1989
2	Yoram Koren, "Robotics for Engineers", Tata McGraw Hill book company, Second edition,1995.
3	K.Rathmill, P.Macconaill, S.O'Leary, J.Browne, "Robot Technology and Applications", Springer, First edition,1985.
4	Thomas Braunl,"Embedded Robotics and Mobile Robot Design and Applications with Embedded systems, Springer, First edition,2003.
Reference Books:	
1	FuK.S, Gonzally,R.C, LeeC.S.G, "Robotics Control, Sensing, Vision and Intelligence Ⅱ,Tata McGraw Hill Book Company, Second Edition,2008.
2	Barry Leatham and Jones," Elements of Industrial Robotics Ⅱ,Pittman Publishing, Second Edition,1987.
3	Mikell P. Groover, Mitchell Weiss, Roger N. Nagel, Nicholas G. Odrey,"Industrial Robotic Technology Programming and Applications Ⅰ", Tata McGraw Hill Book Company, Second Edition,2008.
4	Subrata Ghoshal,"Embedded Systems and Robots: Projects using 8051 Microcontroller" Cengage Learning,2009.
Web References:	
1	https://www.scribd.com/document/33112950/Robotics-and-Its-Applications
2	https://www.elprocus.com/robots-types-applications
3	https://link.springer.com/chapter/10.1007/978-3-319-62533-1
Online Resources:	
1	https://onlinecourses.nptel.ac.in/noc18_me61/preview
2	https://www.futurelearn.com/courses/begin-robotics
3	https://www.edx.org/learn/robotics

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	tTotal	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]**
C007.1	Understand	Quiz	20
C007.2	Understand	Assignment	20
C007.3 C007.4	Apply Analyze	Group Assignment	20
C007.5	Remember	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	3	3	3	2	2	-	-	-	-	1	1	1	3	-
2	3	3	3	2	3	-	-	-	-	1	1	1	3	2
3	3	3	3	2	3	-	-	-	-	1	1	2	3	1
4	3	3	2	-	1	1	-	-	1	-	1	2	2	-
5	3	3	2	-	1	-	-	-	1	-	1	2	2	-
1	Reasonably agreed				2	Moderately agreed				3	Strongly agreed			

21EC008	AUGMENTED AND VIRTUAL REALITY	3/0/0/3
Nature of Course	C (Theory Concept)	
Course Objectives:		
1	Interpret the concepts of augmented reality	
2	Describe the various kinds of display techniques in augmented reality	
3	To Understand the basic concept and framework of virtual reality	
4	Describe the technology for multimodal user interaction and perception in VR	
5	Apply the virtual and augmented reality concepts in various fields	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C008.1	Understand the basic technology used in augmented reality	[U]
C008.2	Apply visual, audio and other contents in augmented reality	[AP]
C008.3	Understand the fundamental concepts and features of virtual reality	[U]
C008.4	Compare various input-output interfaces and interactive techniques in virtual reality	[AN]
C008.5	Apply AR concepts in various modern fields	[AP]
C008.6	Analyze and use VR technology in engineering and other fields	[AN]
Course Contents:		
Augmented Reality Concepts **15** **Introduction of Augmented Reality**: History of Augmented Reality, System Structure of Augmented Reality, Key Technology in AR, Augmented reality Vs Virtual Reality. **Display Techniques:** Monitor Based, Head Mounted Displays – Video See-through and optical See-through methods, Issues and Challenges in AR, **Augmented Reality Content**: Creating Visual Content, Creating Audio Content, Creating Content for Other Senses (Touch, Taste, Smell). Mobile Augmented Reality **Virtual Reality Concepts** **15** **Introduction of Virtual Reality:** Fundamental Concept and Components of Virtual Reality, Primary Features and Architecture of VR systems. **Multiple Modals of Input and Output Interface in Virtual Reality**: Input -- Tracker, Sensor, Digital Glove, Movement Capture, Video-based Input, 3D Menus & 3D Scanner, Output -- Visual / Auditory / Haptic Devices. **Interactive Techniques in Virtual Reality:** Body Track, Hand Gesture, 3D Manus, Object Grasp. **Applications and Tools** **15** **Application of AR**: Medicine, Broadcast Augmentation, Aircraft Operations, Collaboration **Application of VR**: VR Technology in Film & TV Production, VR Technology in Physical Exercises and Games, VR in Engineering, Education and Medicine. Tools: Cospaces – Hands-on Training & Case study on Real Time Human Body Analysis		
	Total Hours:	**45**
Text Books:		
1	Burdea, G. C. and P. Coffet. Virtual Reality Technology, Second Edition. Wiley-IEEE Press, 2003/2006.	
2	Alan Craig, Understanding Augmented Reality, First Edition, Morgan Kaufmann, 2013	
3	Tobias Hollerer , Dieter SchmalstiegAugmented Reality - Principles and Practice First Edition, Pearson Education, 2016	
Reference Books:		
1	Burdea, Grigore C and Philippe Coiffet, “Virtual Reality Technology”, Wiley	

	Interscience, India, 2003.
2	John Vince, “Virtual Reality Systems”, Addison Wesley, 1995.
3	William R Sherman and Alan B Craig, “Understanding Virtual Reality: Interface, Application and Design (The Morgan Kaufmann Series in Computer Graphics)”. Morgan Kaufmann Publishers, San Francisco, CA, 2002.
Web References:	
1	https://nptel.ac.in/courses/106/106/106106138/
2	https://www.coursera.org/learn/ar
Online Resources:	
1	https://stanford.edu/class/ee267/
2	https://ocw.mit.edu/courses/media-arts-and-sciences/mas-961-ambient-intelligence-spring-2005/lecture-notes

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	t**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]**
C008.1	Understand	Quiz	20
C008.2	Apply		
C008.3	Understand	Assignment	20
C008.4	Analyze		
C008.5	Apply	Group Assignment	20
C008.5	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	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**	**PSO1**	**PSO2**
1	3	1	-	-	-	-	-	-	-	-	-	1	1	1
2	2	-	2	-	-	-	-	-	-	-	-	2	2	1
3	3	1	-	-	-	-	-	-	-	-	-	1	1	1
4	2	2	-	-	-	-	-	-	-	-	-	2	2	1
5	-	-	2	-	2	-	-	-	-	-	-	2	3	1
1	Reasonably agreed				2	Moderately agreed				3	Strongly agreed			

21EC009	COMPUTER VISION	3/0/0/3
Nature of Course:	G (Theory analytical)	

Course Objectives:

1.	To review image processing techniques for computer vision along with feature detection and matching techniques.
2.	To understand the image formation techniques along with image processing operators
3.	To understand three-dimensional image analysis techniques
4.	To explore the dimensional analysis and motion analysis
5.	To study some applications of computer vision algorithms

Course Outcomes:

Upon completion of the course, students shall have ability to

C009.1	To apply mathematical modeling methods for low-, intermediate- and high- level image processing tasks	[U]
C009.2	To be able to design new algorithms to solve recent state of the art computer vision problems	[AP]
C009.3	To gather a basic understanding about the geometric relationships between 2D images and the 3D world	[U]
C009.4	To Apply the 3D object recognition and reconstruction	[AP]
C009.5	To build a complete system to solve a computer vision problem.	[AP]

Course Contents:

Introduction to Image Processing Foundations **15**

Review of image processing techniques – classical filtering operations – thresholding techniques – edge detection techniques – corner and interest point detection – mathematical morphology – texture-Image Formation – geometric primitives and transformations, photometric image formation, digital camera, Image Processing – point operators, linear filtering, neighbourhood operators, fourier transforms, segmentation

3D VISION AND MOTION **15**

Methods for 3D vision – projection schemes – shape from shading – photometric stereo – shape from texture – shape from focus – active range finding – surface representations – point-based representation – volumetric representations – 3D object recognition – 3D reconstruction – introduction to motion – triangulation – bundle adjustment – translational alignment – parametric motion – spline-based motion – optical flow – layered motion.

Applications **15**

Photo album – Face detection – Face recognition – Eigen faces – Active appearance and 3D shape models of faces Application: Surveillance – foreground-background separation – particle filters – Chamfer matching, tracking, and occlusion – combining views from multiple cameras – human gait analysis Application: In-vehicle vision system: locating roadway – road markings – identifying road signs – locating pedestrians.

Text Books:

1.	Szeliski R., “Computer Vision: Algorithms and Applications”, Springer, 2010.

2.	Forsyth D. A. and Ponce J., “Computer Vision – A Modern Approach”, Second Edition, Pearson Education, 2012.
3.	D. L. Baggio et al., —Mastering Open CV with Practical Computer Vision Projects‖, Packt Publishing, 2012
Reference Books:	
1.	E. R. Davies, —Computer & Machine Vision‖, Fourth Edition, Academic Press, 2012.
2.	Jan Erik Solem, —Programming Computer Vision with Python: Tools and algorithms for analyzing images‖, O'Reilly Media, 2012
3.	Mark Nixon and Alberto S. Aquado, —Feature Extraction & Image Processing for Computer Vision‖, Third Edition, Academic Press, 2012.
4.	R. Szeliski, —Computer Vision: Algorithms and Applications‖, Springer 2011.
5.	Simon J. D. Prince, —Computer Vision: Models, Learning, and Inference‖, Cambridge University Press, 2012.
Web References:	
1.	https://link.springer.com/chapter/10.1007/978-3-030-32022-5_24
2.	https://www.journals.elsevier.com/computer-vision-and-image-understanding
3.	https://www.coursera.org/learn/Computer-vision

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]**
C009.1	Understand	Quiz	20
C009.2	Apply	Assignment	20
C009.3 C009.4	Understand Apply	Group Assignment	20
C009.5	Apply	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	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	2	2	1	-	-	-	-	-	-	1	2	-
2	2	2	2	1	1	-	-	-	-	-	-	1	1	-
3	1	1	2	3	2	-	-	-	-	-	-	2	2	-
4	2	2	2	3	1	-	-	-	-	-	-	1	2	-
5	1	2	2	2	1	-	-	-	-	-	-	2	2	-
1	Reasonably agreed				2	Moderately agreed				3	Strongly agreed			

21EC010	BIO-INSPIRED HUMAN MACHINE INTERFACE	3/0/0/3
Nature of Course	C (Theory Concept)	
Course Objectives:		
1	Understand the basic concepts of Human Machine Interface	
2	Analyze the user interface design of Human Machine Interface	
3	Understand the Basics of Bio-inspired computation	
4	Learn the different bio-inspired methods	
5	Learn the various applications of Bio-inspired techniques in machine interface	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C010.1	Understand the basics of Human machine interface and the role of reasoning and problem solving in the design of HMI	[U]
C010.2	Understand the concept of user interface design and the significance in interfacing through web platform.	[U]
C010.3	Comprehend Bio-inspired techniques and their importance	[AN]
C010.4	Understand various bio-inspired techniques	[U]
C010.5	Apply Bio-inspired HMI to understand various applications	[AP]

Course Contents:

Introduction to BCI: **15**

Introduction to Human Machine Interface – I/O channels – Hardware, software and operating environments – Psychology of everyday actions – Reasoning and problem solving – Fundamentals principles of interaction: Models, frameworks, elements and interactivity - User interface design, prototyping and interface analysis methods –Web user interface design

Bio-inspired computational methods: **15**

Bio-inspired algorithms – Analysis of algorithms – Parameter tuning – Types of Evolutionary algorithms : Genetic algorithm, Particle swarm optimization, Ant colony optimization, Differential Evolution, Simulated annealing

Application of Bio-inspired techniques in HMI: **15**

Special topics in HMI: Ionic skin for theranostics – Bio-inspired HMI in automated vehicles – Bio-inspired controls for wearable devices – Bio-inspired emotive robots – Bio-inspired myocontrol design.

Total Hours:	**45**

Text Books:

1	Preece, J. Rogers, Y., and Sharp. H. (2017 or other years of edition) Interaction Design: Beyond human-computer interaction. John Wiley and Sons
2	Neville A. Stanton, Paul M. Salmon, Guy H. Walker, and Chris Baber (2005) Human FactorsMethods: A Practical Guide for Engineering and Design
3	Ben Shneiderman, Catherine Plaisant, Maxine Cohen, Steven Jacobs, Niklas Elmqvist, NicholasDiakopoulos. Designing the User Interface: Strategies for Effective Human-Computer Interaction, 6thEdition. Pearson, 2017.
4	Eiben. A.E.Smith,James E, "Introduction to Evolutionary Computing", Springer 2015.

Reference Books:	
1	Wilbert O. Galitz, “The Essential Guide to User Interface Design”, Wiley India Edition
2	Ben Schneidermann,” Designing the user interfaces”. 3rd Edition, Pearson Education Asia.
3	Alan Dix, Janet Finlay, GreGoryd, Abowd, Russell, Bealg, “human-computer Interaction”, Pearson Education.
Web References:	
1	https://www.computer.org/communities/special-technical-communities/bio-inspired-computing
2	https://www.mdpi.com/journal/applsci/topical_collections/BIC
3	https://engineering.purdue.edu/ME/Research/HumanMachine
Online Resources:	
1	https://onlinecourses.nptel.ac.in/noc19_cs86/preview
2	https://onlinecourses.nptel.ac.in/noc21_cs50/preview

Continuous Assessment				End Semester Examination	Total
Formative Assessment	**Summative Assessment**	t**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	Understand	Quiz	20
C401.2	Understand	Assignment	20
C401.3 C401.4	Analyze Understand	Group Assignment	20
C401.5	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	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	2	1	2	1	-	-	-	-	-	-	-	3	2	2
2	3	1	1	2	-	-	-	-	-	-	-	2	2	2
3	2	2	3	2	-	-	-	-	-	-	-	2	1	-
4	1	2	3	3	-	-	-	-	-	-	-	3	3	2
5	3	2	1	1	-	-	-	-	-	-	-	2	2	-
1	Reasonably agreed				2	Moderately agreed				3	Strongly agreed			

MANDATORY COURSE

21MC101	INDUCTION PROGRAMME (FOR ALL BRANCHES OF B.E / B.TECH PROGRAMMES)	2/0/0/0
Nature of Course	Induction Programme	
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)

21MC102	ENVIRONMENTAL SCIENCES	2 /0 /0 /0

Nature of Course	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 socialproblems.

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 forfuture generation.	[R]
C102.2	Understand the importance of natural resources and conservation ofbiodiversity.	[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:

Natural Resources:

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.

Environmental Pollutions:

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. Soil pollution - 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.

Social issues and the Environment:

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.

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 Press2015.

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

Bloom's Level	Continuous Assessment		
	CIA-I [0 marks]	CIA-II [0 marks]	Term End Assessment [50 marks]
Remember	-	-	30
Understand	-	-	40
Apply	-	-	30
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-

21MC103	SOFT SKILLS	2/0/0/0
Nature of Course	Theory Concept	
Pre requisites	Technical Communication Skills	

Course Objectives:

1.	To develop the student's 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 conflictwithin 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 Skillsamong 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 contextsat work place.	[AP]
C103.6	Apply good teamwork skills and Leadership Skills	[AP]

Course Contents:

Module 1: Professional Communication Skills **10 Hrs**

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 Hrs**

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- Beginto 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 Hrs**

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 ofInterview- 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

21MC104	MANAGEMENT ORGANIZATIONAL BEHAVIOUR	2/0/0/0
Nature of Course	Theory Concept	
Pre requisites	Nil	

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 Hrs
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 Hrs
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 Hrs
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

21MC105	GENERAL APTITUDE	2 /0 /0 /0

Nature of Course	Theory Concept

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 Hrs** 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 Hrs** 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 Hrs**

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 Hill Education.

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

21MC106	LIFE SKILLS AND ETHICS	2 /0 /0 /0

Nature of Course	Theory Concept

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 Hrs**

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 Hrs**

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 Hrs**

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**

21MC107	STRESS MANAGEMENT	2 /0 /0 /0

Nature of Course	Theory Concept

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 Hrs**

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 Hrs**

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 Hrs**

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**

21MC108	CONSTITUTION OF INDIA	2/0/0/0

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 Hrs**

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 Hrs**

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 Hrs**

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, 22nd Edition, 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**

21MC109	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	2/0/0/0
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 Hrs**

Indian Ethics: Individual and Social – Society state and Polity (Survey) - Education systems – Agriculture (Survey) – Early & Classical Architecture – Medieval & Colonial Architecture.

Module 2 **10 Hrs**

Astronomy in India — Martial Arts Traditions (Survey) - Indian Literatures - Indian Philosophical Systems - Indian Traditional Knowledge on Environmental Conservation

Module 3 **10 Hrs**

Ayurveda for Life, Health and Well-being - The Historical Evolution of Medical Tradition in Ancient 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**

21MC110	DESIGN AND ANALYSIS OF ALGORITHMS	2/0/0/0
Nature of Course	Theory Concept	
Course Pre-requisites	Nil	

Course Objectives:

1	To understand the techniques for analyzing the computer algorithms.
2	To learn the paradigms for designing the algorithms.
3	To analyze the efficiency of various algorithm design techniques / paradigms for the same problem.
4	To understand the graphical algorithms for solving problems.

Course Outcomes:

Upon completion of the course, students shall have ability to

C111.1	Illustrate the searching and sorting algorithms.	[U]
C111.2	Interpret the design principles of greedy and pattern searching algorithms with examples.	[AP]
C111.3	Explain the problem-solving methodology used in Backtracking.	[A]
C111.4	Analyze the time and space complexities of dynamic programming strategy in solving complex problems	[A]
C111.5	Employ range query and graph algorithms in real world problems.	[AP]

Course Contents:

Module - I: Sorting, Searching and String Algorithms10 Hrs

Searching & Sorting, Divide and Conquer – Bubble sort, Insertion sort, Selection sort, Binarysearch, quick sort, mergesort – Heaps&Hashing –Binaryheap, heap sort - Greedy Algorithms– Activityselectionproblem,Fractionalknapsack - String algorithms - Naive algorithm, Rabin Karp algorithm, KMP algorithm, Z algorithm, Manachers algorithm - Tries-Makingatrienode,Insert,SearchandRemoveoperationinTries,Huffmancoding.

Module - II:Greedy and Dynamic Programming10 Hrs

Backtracking - Rat in a maze, Permutation and Combination, N Queen problem and Problemson Backtracking, Knight's Tour Problem, Subset Sum, M-Coloring Problem, HamiltonianCycleProblem, Sudoku Solver,Sieveof Sundaram,PrimeNumbers after P with SumS. DynamicProgramming-GreedyvsDynamicprogramming,Topdownandbottom-upapproach, LongestCommonSubsequence,Longestincreasingsubsequence,Editdistance, 0-1 Knapsack, Coin change problem, Minimum Cost Path, Subset Sum Problem, MaximumSizeSquareSub Matrixwithall 1s, Longest PalindromicSubsequence.

Module – III: Tree and Graph Algorithms 10 Hrs

Rangequery Algorithms –RangeMinimumQuery (BruteForceApproach). Segment Tree, Range Minimum Query on the Constructed Segment Tree, Range MinimumQueryUsing Sparse Table. Graph Algorithms - Dijkstra's Algorithm, Floyd warshall Algorithm, Kruskal's Algorithm forMinimumSpanning Tree, Prim's AlgorithmforMinimum Spanning Tree.

Total Hours	**30**

Text Books:

1	Anany Levitin, “Introduction to Design and Analysis of Algorithms”, Pearson Publications, 3rd Edition, 2012.
2	Thomas H.Cormen, Charles E.Leiserson, R.L.Rivest, “Introduction to Algorithms”, Prentice Hall of India Publications, 3rd Edition, 2009.

Reference Books:

1	Ellis Horowitz, SartajSahni and SanguthevarRajasekaran, “Computer Algorithms/ C++”, 2nd Edition, Universities Press, 2019.
2	Sara Baase and Allen Van Gelder, “Computer Algorithms: Introduction to Design and Analysis”, Pearson Publications, 3rd Edition, 2008.

Web References:

1.	https://www.cs.usfca.edu/~galles/visualization/Algorithms.html
2.	https://www.coursera.org/learn/introduction-to-algorithms

3.	https://timroughgarden.org/videos.html
Online Resources:	
1.	https://onlinecourses.nptel.ac.in/noc19_cs47/preview
2.	https://www.csa.iisc.ac.in/~barman/daa18/E0225.html
3.	https://freevideolectures.com/course/2281/design-and-analysis-of-algorithms

AssessmentMethods&Levels(basedonBloom'sTaxonomy)			
FormativeassessmentbasedonCapstoneModel(Max.Marks:100)			
Course Outcome	**Bloom'sLevel**	**AssessmentComponent**	**Marks**
C111.1	Understand	Quiz	**20**
C111.2	Apply	GroupDiscussion	**30**
C111.3	Analyze	ClassPresentation	**30**
C111.4	Analyze		
C111.5	Apply	Assignment	**20**

VALUE ADDED COURSE

21VA401	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	Togain knowledge 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,Par Ingelstrom, “Computational Electromagnetics”, Springer, 2005.	
2	Ecole Polytechnique De Montr´ 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	

21VA402	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/

21VA403	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 Domingues Martinho, “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

21VA404	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/	

21VA405	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: Mcgraw hill , 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

21VA406	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	

21VA407	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, Zhixeng Niu, Rui Zhang, Shuguang Cui, "Energy Harvesting Wireless Communications", IEEE Press, Wiley	
3	Dushantha Nalin K.Jayakody, John Thompson, Symeon Chatzinotas, 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	

21VA160	AGILE PRODUCT DEVELOPMENT AND WEB APPLICATION DESIGN	2/0/0/2
Nature of Course	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 the ability to

C160.1	Identify the driving forces and adopt Agile approaches to software development practices.	[AP]
C160.2	Demonstrate the values and practices of Scrum and how to setup the GitHub repository.	[U]
C160.3	Find the working model and learn basic web concepts to develop Static and Dynamic web pages.	[R]
C160.4	Utilize the knowledge of HTML and CSS code to create personal and/or business websites following current professional and/or industry standards.	[AP]
C160.5	Develop dynamic web page with validation and event handling mechanisms.	[AP]

Course Contents:

Module1: **10 Hrs**

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 2: 10 Hrs

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 3: 10 Hrs

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:	**30 Hrs.**

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.
Suggested Readings:	
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

21VA161	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	

21VA162	Web Framework Technologies	2/0/0/2
Nature of Course:	D (Theory Application)	
Pre requisites:	Java Programming	

Course Objectives:

1	To impart the knowledge of REST API and HTTP methods used in Spring Boot Framework.
2	To discuss LIKE queries using JPA and handle CRUD operations with JPQL.
3	To explore the various relational mapping with JPA.
4	To deploy Spring AOP - Annotation Based applications.

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

C402.1	Create simple applications with REST API and handle HTTP methods.	[AP]
C402.2	Apply LIKE queries using JPA.	[AP]
C402.3	Build application using Spring Boot and handle CRUD operations with JPQL.	[AP]
C402.4	Demonstrate various relational mapping with JPA.	[U]
C402.5	Develop Spring AOP - Annotation Based Application	[AP]

Course Contents:

Module I : APIs and JSON **10 Hours**

REST API, HTTP Methods in Rest, Overview of JSON, Controller and Service Layer, GET API with JSON & Spring Boot, @Value annotation, Runnable JAR Of Spring Boot App, @JsonIgnore Usage, @JsonProperty Usage, MySQL Database.

Module II : Spring JPA **10 Hours**

Spring Boot-MySQL Database Connection with JPA, @Repository Annotation, GET API with JPA, HTTP POST API, PUT API, DELETE API with @RequestParam, Path variable - @PathVariable, AND,OR,IN Query using JPA, Pagination & Sorting using JPA. @Transient Annotation, Queries using JPA, Starts and Ends with query using JPA, JPQL with @Query Annotation, Select, Update, Delete with JPQL.

Module III: JPA Mapping with Spring Boot **10 Hours**

OneToOne Relationship Mapping with JPA, Join Query, Lazy Loading in JPA, BiDirectionalOneToOne Relationship with JPA, OneToMany Relationship with JPA, Insert Record with OneToOne and OneToMany Relationship and JPA. SwaggerUI with Spring Boot, OpenUI with Spring Boot, Logging with Spring Boot, Changing Log Level,Logging Request and Response JSON, Logging properties with Spring Boot. AOP Terms, @BeforeAdvice with Method Parameter,@After Advice,@AfterReturning Advice, @Around Advice.

Total Hours: 30

Text Books:

1.KirupaChinnathambi, “A Hands-On Guide to Building Web Applications Using React and Redux”, Addison-Wesley Professional, 2018.

2.Raja CSP Raman, LudovicDewailly, “Building RESTful Web Services with Spring 5”, Packt Publishing, 2018.

3.Leonard Richardson, Sam Ruby “RESTful Web Services” O'Reilly Media, 2008.

Reference Books:

1.RangaKaranam, “Master Java Web Services and REST API with Spring Boot”, Packt

Publishing, 2018.
2.Balaji Varanasi, .2015 ,Apress ,"Spring REST" ,SudhaBelida
Web References:
1.https://www.freecodecamp.org/news/how-to-build-a-rest-api-with-spring-boot-using-mysql-and-jpa-f931e348734b/
2.https://github.com/scbushan05/book-api-spring-boot
3.https://www.geeksforgeeks.org/spring-value-annotation-with-example/
4.https://www.baeldung.com/spring-jpa-like-queries
5.https://medium.com/thecodefountain/design-a-rest-api-with-spring-boot-and-mysql-a5572d94ccc7
Online Resources:
1.https://www.udemy.com/course/rest-api-with-java-spring-boot-spring-data-jpa-jparepository-swagger/
2.https://spring.io/guides/tutorials/rest/
3.https://www.javaguides.net/2018/10/spring-boot-2-restful-api-documentation-with-swagger2-tutorial.html