

# **B.E. (Electronics and Communication Engineering)**

## **Revised 2018 Regulations - Curriculum & Syllabi**

*(Candidates admitted during Academic Year 2021-2022)*



### **BANNARI AMMAN INSTITUTE OF TECHNOLOGY**

An Autonomous Institution Affiliated to Anna University – Chennai • Approved by AICTE • Accredited by NAAC with "A+" Grade

**SATHYAMANGALAM - 638401    ERODE DISTRICT    TAMILNADU    INDIA**

Ph : 04295-226000/221289 Fax : 04295-226666 E-mail : [stayahead@bitsathy.ac.in](mailto:stayahead@bitsathy.ac.in) Web : [www.bitsathy.ac.in](http://www.bitsathy.ac.in)

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## **VISION OF THE DEPARTMENT**

To foster academic excellence in Electronics and Communication Engineering education and research and turn out students into competent professionals to serve society.

## **MISSION OF THE DEPARTMENT**

1. To establish a unique learning environment and to enable the students to face the challenges in Electronics and Communication Engineering.
2. To provide a framework for professional career, higher education, and research activities.
3. To impart ethical and value-based education by promoting activities addressing the social needs.

## **PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)**

- I. Design and develop electronic circuits and systems, based on the existing as well as emerging technologies.
- II. Pursue higher education, research, and continue to learn in their profession.
- III. Become a successful professional engineer in Electronics/Communication/allied fields.

### **PROGRAMME OUTCOMES (POs)**

- a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- c. 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.
- d. 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.
- e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
- f. 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.
- g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- j. 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.
- k. 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.
- l. 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 SPECIFIC OUTCOMES (PSOs)**

1. Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.
2. Able to solve complex engineering problems using state-of-the-art hardware and software tools, along with analytical and managerial skills to arrive appropriate solutions.

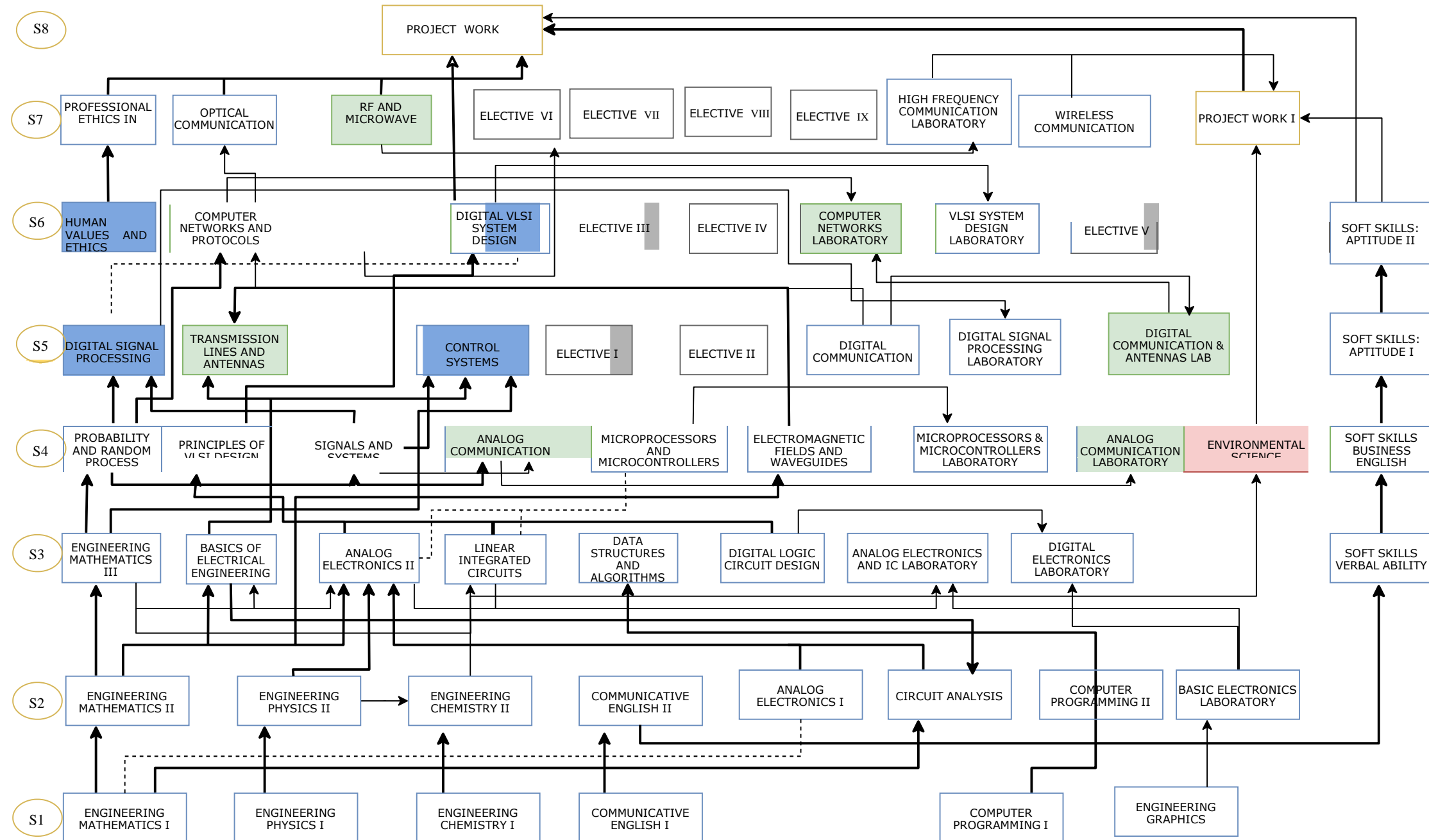
### **MAPPING OF PEOs AND POs**

PEO(s)	Programme Outcomes(s)											
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
I			X	X	X	X	X				X	
II	X	X	X	X	X	X			X	X	X	X
III							X	X	X	X	X	X

# DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

## CURRICULUM DESIGN & INTERLINKING OF COURSES 2018 R

General Electives (I to IX) are the courses offered by the departments that do not require any kind of prerequisite. It depends upon the students' interest.



DEPARTMENT OF ECE Minimum Credits to be Earned : 163										
I SEMESTER										
Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CA	ES	Total	
18EC101	ENGINEERING MATHEMATICS I	3	1	0	4	4	40	60	100	BS
18EC102	ENGINEERING PHYSICS I	2	0	2	3	4	50	50	100	BS
18EC103	ENGINEERING CHEMISTRY I	2	0	2	3	4	50	50	100	BS
18EC104	COMPUTER PROGRAMMING I	2	0	2	3	4	50	50	100	ES
18HS101	COMMUNICATIVE ENGLISH I	1	0	2	2	3	100	0	100	HS
18EC106	ENGINEERING GRAPHICS	1	0	4	3	5	100	0	100	ES
Total		11	1	12	18	24	-	-	-	-
II SEMESTER										
Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CA	ES	Total	
18EC201	ENGINEERING MATHEMATICS II	3	1	0	4	4	40	60	100	BS
18EC202	ENGINEERING PHYSICS II	2	0	2	3	4	50	50	100	BS
18EC203	ENGINEERING CHEMISTRY II	2	0	2	3	4	50	50	100	BS
18EC204	CIRCUIT ANALYSIS	3	1	0	4	4	40	60	100	ES
	LANGUAGE ELECTIVE	-	-	-	2	2	100	0	100	HS
18EC206	ANALOG ELECTRONICS I	3	0	0	3	3	40	60	100	ES
18EC207	COMPUTER PROGRAMMING II	2	0	2	3	4	50	50	100	ES
18EC208	BASIC ELECTRONICS LABORATORY	0	0	2	1	2	100	0	100	ES
Total		15	2	8	23	27	-	-	-	-



III SEMESTER										
Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CA	ES	Total	
18EC301	ENGINEERING MATHEMATICS III	3	1	0	4	4	40	60	100	BS
18EC302	BASICS OF ELECTRICAL ENGINEERING	2	0	2	3	4	50	50	100	ES
18EC303	DIGITAL LOGIC CIRCUIT DESIGN	3	1	0	4	4	40	60	100	PC
18EC304	ANALOG ELECTRONICS II	3	1	0	4	4	40	60	100	ES
18EC305	LINEAR INTEGRATED CIRCUITS	3	0	0	3	3	40	60	100	PC
18EC306	DATA STRUCTURES AND ALGORITHMS	2	0	2	3	4	50	50	100	ES
18EC307	ANALOG ELECTRONICS AND IC LABORATORY	0	0	2	1	2	100	0	100	PC
18EC308	DIGITAL ELECTRONICS LABORATORY	0	0	2	1	2	100	0	100	PC
18GE301	SOFT SKILLS - VERBAL ABILITY	0	0	2	-	2	100	0	100	EEC
<b>Total</b>		<b>16</b>	<b>3</b>	<b>10</b>	<b>23</b>	<b>29</b>	-	-	-	-
IV SEMESTER										
Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CA	ES	Total	
18EC401	PROBABILITY AND RANDOM PROCESS	3	1	0	4	4	40	60	100	BS
18EC402	SIGNALS AND SYSTEMS	3	1	0	4	4	40	60	100	PC
18EC403	ANALOG COMMUNICATION	3	0	0	3	3	40	60	100	PC
18EC404	PRINCIPLES OF VLSI DESIGN	3	0	0	3	3	40	60	100	PC
18EC405	ELECTROMAGNETIC FIELDS AND WAVEGUIDES	3	1	0	4	4	40	60	100	PC
18EC406	MICROPROCESSORS AND MICROCONTROLLERS	3	0	0	3	3	40	60	100	PC
18EC407	ANALOG COMMUNICATION LABORATORY	0	0	2	1	2	100	0	100	PC
18EC408	MICROPROCESSORS AND MICROCONTROLLERS LABORATORY	0	0	2	1	2	100	0	100	PC
18HS001	ENVIRONMENTAL SCIENCE	2	0	0	-	2	100	0	100	HS
18GE401	SOFT SKILLS – BUSINESS ENGLISH	0	0	2	-	2	100	0	100	EEC
<b>Total</b>		<b>20</b>	<b>3</b>	<b>6</b>	<b>23</b>	<b>29</b>	-	-	-	-

V SEMESTER										
Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CA	ES	Total	
21EC501	DIGITAL COMMUNICATION	3	1	0	4	4	40	60	100	PC
21EC502	DIGITAL SIGNAL PROCESSING	3	1	0	4	4	40	60	100	PC
21EC503	TRANSMISSION LINES AND ANTENNAS	3	1	0	4	4	40	60	100	PC
21EC504	CONTROL SYSTEMS	3	1	0	4	4	40	60	100	ES
	PROFESSIONAL ELECTIVE I	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE II	3	0	0	3	3	40	60	100	PE
21EC507	DIGITAL SIGNAL PROCESSING LABORATORY	0	0	2	1	2	100	0	100	PC
21EC508	DIGITAL COMMUNICATION AND ANTENNAS LABORATORY	0	0	2	1	2	100	0	100	PC
18GE501	SOFT SKILLS - APTITUDE I	0	0	2	-	2	100	0	100	EEC
<b>Total</b>		<b>18</b>	<b>4</b>	<b>6</b>	<b>24</b>	<b>28</b>	-	-	-	-
VI SEMESTER										
Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CA	ES	Total	
21HS002	HUMAN VALUES AND ETHICS	2	0	0	2	2	40	60	100	HS
21EC602	COMPUTER NETWORKS AND PROTOCOLS	3	0	0	3	3	40	60	100	PC
21EC603	DIGITAL VLSI SYSTEM DESIGN	3	1	0	4	4	40	60	100	PC
	PROFESSIONAL ELECTIVE III	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE IV	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE V	3	0	0	3	3	40	60	100	PE
21EC607	COMPUTER NETWORKS LABORATORY	0	0	2	1	2	100	0	100	PC
21EC608	VLSI DESIGN LABORATORY	0	0	2	1	2	100	0	100	PC
18GE601	SOFT SKILLS - APTITUDE II	0	0	2	-	2	100	0	100	EEC
<b>Total</b>		<b>17</b>	<b>1</b>	<b>6</b>	<b>20</b>	<b>24</b>	-	-	-	-

VII SEMESTER										
Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CA	ES	Total	
21EC701	RF AND MICROWAVE ENGINEERING	3	0	0	3	3	40	60	100	PC
21EC702	WIRELESS COMMUNICATION	3	0	2	4	5	50	50	100	PC
	PROFESSIONAL ELECTIVE VI	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE VII	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE VIII	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE IX	3	0	0	3	3	40	60	100	PE
21EC707	HIGH FREQUENCY COMMUNICATION LABORATORY	0	0	2	1	2	60	40	100	PC
21EC708	PROJECT WORK I	0	0	6	3	6	60	40	100	EEC
<b>Total</b>		<b>18</b>	<b>0</b>	<b>10</b>	<b>23</b>	<b>28</b>	-	-	-	-
VIII SEMESTER										
Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CA	ES	Total	
21EC801	PROJECT WORK II	0	0	18	9	18	60	40	100	EEC
<b>Total</b>		<b>0</b>	<b>0</b>	<b>18</b>	<b>9</b>	<b>18</b>	-	-	-	-

<b>ELECTIVES</b>										
<b>LANGUAGE ELECTIVES</b>										
Code No.	Course	L	T	P	C	Hours /Week	Maximum Marks			Category
							CA	ES	Total	
18HS201	COMMUNICATIVE ENGLISH II	1	0	2	2	3	100	0	100	HSS
18HSH01	HINDI	1	0	2	2	3	100	0	100	HSS
18HSG01	GERMAN	1	0	2	2	3	100	0	100	HSS
18HSJ01	JAPANESE	1	0	2	2	3	100	0	100	HSS
18HSC01	CHINESE	1	0	2	2	3	100	0	100	HSS
18HSF01	FRENCH	1	0	2	2	3	100	0	100	HSS

<b>PROFESSIONAL ELECTIVES</b>										
<b>VERTICAL I - EMBEDDED SYSTEM DESIGN</b>										
21EC001	ADVANCED PROCESSOR ARCHITECTURES	3	0	0	3	3	40	60	100	PE
21EC002	COMMUNICATION PROTOCOLS AND STANDARDS	3	0	0	3	3	40	60	100	PE
21EC003	EMBEDDED C PROGRAMMING	3	0	0	3	3	40	60	100	PE
21EC004	REAL TIME OPERATING SYSTEMS	3	0	0	3	3	40	60	100	PE
21EC005	EMBEDDED LINUX	3	0	0	3	3	40	60	100	PE
21EC006	VIRTUAL INSTRUMENTATION IN EMBEDDED SYSTEMS	3	0	0	3	3	40	60	100	PE
<b>VERTICAL II - SENSOR TECHNOLOGIES AND IOT</b>										
21EC007	IOT PROTOCOLS AND INDUSTRIAL SENSORS	3	0	0	3	3	40	60	100	PE
21EC008	IOT PROCESSORS	3	0	0	3	3	40	60	100	PE
21EC009	IOT SYSTEM DESIGN	3	0	0	3	3	40	60	100	PE
21EC010	WIRELESS SENSOR NETWORK DESIGN	3	0	0	3	3	40	60	100	PE
21EC011	INDUSTRIAL IOT AND INDUSTRY 4.0	3	0	0	3	3	40	60	100	PE

21EC012	DATA ANALYTICS FOR IOT	3	0	0	3	3	40	60	100	PE
<b>VERTICAL III- SEMICONDUCTOR CHIP DESIGN AND VERIFICATION</b>										
21EC013	ADVANCED DIGITAL SYSTEM DESIGN	3	0	0	3	3	40	60	100	PE
21EC014	ANALOG VLSI DESIGN	3	0	0	3	3	40	60	100	PE
21EC015	ASIC DESIGN	3	0	0	3	3	40	60	100	PE
21EC016	LOW POWER VLSI DESIGN	3	0	0	3	3	40	60	100	PE
21EC017	DSP INTEGRATED CIRCUITS	3	0	0	3	3	40	60	100	PE
21EC018	VLSI VERIFICATION	3	0	0	3	3	40	60	100	PE
<b>VERTICAL IV - SIGNAL AND IMAGE PROCESSING</b>										
21EC019	ADVANCED DIGITAL SIGNAL PROCESSING	3	0	0	3	3	40	60	100	PE
21EC020	SPEECH SIGNAL PROCESSING	3	0	0	3	3	40	60	100	PE
21EC021	DIGITAL IMAGE PROCESSING	3	0	0	3	3	40	60	100	PE
21EC022	MULTIMEDIA COMPRESSION TECHNIQUES	3	0	0	3	3	40	60	100	PE
21EC023	COMPUTER VISION	3	0	0	3	3	40	60	100	PE
21EC024	WAVELET TRANSFORMS AND APPLICATIONS	3	0	0	3	3	40	60	100	PE
<b>VERTICAL V - RF AND WIRELESS COMMUNICATION</b>										
21EC025	UNDERWATER ACOUSTIC COMMUNICATIONS	3	0	0	3	3	40	60	100	PE
21EC026	SATELLITE COMMUNICATION	3	0	0	3	3	40	60	100	PE
21EC027	OPTICAL COMMUNICATION AND NETWORKS	3	0	0	3	3	40	60	100	PE
21EC028	MIMO COMMUNICATION	3	0	0	3	3	40	60	100	PE
21EC029	SIGNAL PROCESSING FOR MMWAVE COMMUNICATION	3	0	0	3	3	40	60	100	PE
21EC030	MACHINE LEARNING FOR WIRELESS COMMUNICATIONS	3	0	0	3	3	40	60	100	PE
<b>VERTICAL VI – RADIO FREQUENCY AND ANTENNA SYSTEMS</b>										
21EC031	MICROWAVE CIRCUITS AND SYSTEMS	3	0	0	3	3	40	60	100	PE
21EC032	MICROWAVE INTEGRATED CIRCUITS	3	0	0	3	3	40	60	100	PE

21EC033	RF SYSTEM DESIGN	3	0	0	3	3	40	60	100	PE
21EC034	ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY	3	0	0	3	3	40	60	100	PE
21EC035	ANTENNA TECHNOLOGIES FOR WIRELESS APPLICATIONS	3	0	0	3	3	40	60	100	PE
21EC036	SMART ANTENNAS	3	0	0	3	3	40	60	100	PE
<b>VERTICAL VII - ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING</b>										
21EC037	SOFT COMPUTING	3	0	0	3	3	40	60	100	PE
21EC038	OPTIMIZATION TECHNIQUES	3	0	0	3	3	40	60	100	PE
21EC039	MACHINE LEARNING TECHNIQUES	3	0	0	3	3	40	60	100	PE
21EC040	PYTHON PROGRAMMING FOR AI AND ML	3	0	0	3	3	40	60	100	PE
21EC041	DEEP LEARNING TECHNIQUES	3	0	0	3	3	40	60	100	PE
21EC042	NATURAL LANGUAGE PROCESSING	3	0	0	3	3	40	60	100	PE
<b>VERTICAL VIII – DIVERSIFIED COURSES</b>										
21EC043	MEDICAL ELECTRONICS AND INSTRUMENTATION	3	0	0	3	3	40	60	100	PE
21EC044	CONSUMER ELECTRONICS	3	0	0	3	3	40	60	100	PE
21EC045	NANO ELECTRONICS	3	0	0	3	3	40	60	100	PE
21EC046	AUTOMOTIVE ELECTRONICS AND NETWORKING	3	0	0	3	3	40	60	100	PE
21EC047	PCB DESIGN AND FABRICATION	3	0	0	3	3	40	60	100	PE
21EC048	CRYPTOGRAPHY AND NETWORK SECURITY	3	0	0	3	3	40	60	100	PE
<b>HONOURS DEGREE (With Specialization) VERTICAL II - SENSOR TECHNOLOGIES AND IOT</b>										
21ECH01	IoT Protocols and Industrial Sensors	3	0	0	3	3	40	60	100	PE
21ECH02	IoT Processors	3	0	0	3	3	40	60	100	PE
21ECH03	IoT System Design	3	0	0	3	3	40	60	100	PE
21ECH04	Wireless Sensor Network Design	3	0	0	3	3	40	60	100	PE

21ECH05	Industrial IoT and Industry 4.0	3	0	0	3	3	40	60	100	PE
21ECH06	Data Analytics for IoT	3	0	0	3	3	40	60	100	PE
<b>MINOR DEGREE (Other than ECE Students) VERTICAL II - SENSOR</b>										
<b>TECHNOLOGIES AND IOT</b>										
21ECM01	IoT Protocols and Industrial Sensors	3	0	0	3	3	40	60	100	PE
21ECM02	IoT Processors	3	0	0	3	3	40	60	100	PE
21ECM03	IoT System Design	3	0	0	3	3	40	60	100	PE
21ECM04	Wireless Sensor Network Design	3	0	0	3	3	40	60	100	PE
21ECM05	Industrial IoT and Industry 4.0	3	0	0	3	3	40	60	100	PE
21ECM06	Data Analytics for IoT	3	0	0	3	3	40	60	100	PE
<b>ADDITIONAL ONE-CREDIT COURSES</b>										
18GE0XA	ETYMOLOGY	-	-	-	1	-	100	0	100	EEC
18GE0XB	GENERAL PSYCHOLOGY	-	-	-	1	-	100	0	100	EEC
18GE0XC	NEURO BEHAVIORAL SCIENCE	-	-	-	1	-	100	0	100	EEC
18GE0XD	VISUAL MEDIA AND FILM MAKING	-	-	-	1	-	100	0	100	EEC
18GE0XE	YOGA FOR HUMAN EXCELLENCE	-	-	-	1	-	100	0	100	EEC
18GE0XF	VEDIC MATHEMATICS	-	-	-	1	-	100	0	100	EEC
18GE0XG	HEALTH AND FITNESS	-	-	-	1	-	100	0	100	EEC
18GE0XH	CONCEPT, METHODOLOGY AND APPLICATIONS OF VERMICOMPOSTING	-	-	-	1	-	100	0	100	EEC
18GE0XI	BLOG WRITING	-	-	-	1	-	100	0	100	EEC
18GE0XJ	INTERPERSONAL SKILLS	-	-	-	1	-	100	0	100	EEC
18GE0XK	NEW AGE INNOVATION AND ENTREPRENEURSHIP	-	-	-	1	-	100	0	100	EEC
18GE0XL	NATIONAL CADET CORPS	-	-	-	1	-	100	0	100	EEC
18GE0XM	COMMUNITY SERVICE AND LEADERSHIP DEVELOPMENT	-	-	-	1	-	100	0	100	EEC
18GE0XN	DISRUPTIVE INNOVATION BASED STARTUP ACTIVITIES	-	-	-	1	-	100	0	100	EEC
18GE0XO	SOCIAL PSYCHOLOGY	-	-	-	1	-	100	0	100	EEC

18GE0XP	FM RADIO BROADCASTING TECHNOLOGY	-	-	-	1	-	100	0	100	EEC
<b>ONE CREDIT COURSES</b>										
18EC0XA	SIGNAL PROCESSING TECHNIQUES USING LABVIEW	-	-	-	1	-	100	0	100	EEC
18EC0XB	ANN AND FUZZY LOGIC APPLICATIONS	-	-	-	1	-	100	0	100	EEC
18EC0XC	M2M TECHNIQUE FOR SMART CITIES	-	-	-	1	-	100	0	100	EEC
18EC0XD	LABVIEW BASED MACHINE LEARNING	-	-	-	1	-	100	0	100	EEC
18EC0XE	EMBEDDED SYSTEM DESIGN FOR ROBOTICS	-	-	-	1	-	100	0	100	EEC
18EC0XF	INDUSTRIAL VISION INSPECTION SYSTEM	-	-	-	1	-	100	0	100	EEC
18EC0XG	RTOS MANAGEMENT	-	-	-	1	-	100	0	100	EEC
18EC0XH	LORA WAN IOT	-	-	-	1	-	100	0	100	EEC
18EC0XI	PCB DESIGN AND PROTOTYPE MAKING	-	-	-	1	-	100	0	100	EEC
18EC0XJ	EMBEDDED COMMUNICATION PROTOCOLS	-	-	-	1	-	100	0	100	EEC
18EC0XK	MATHEMATICAL MODELLING OF A SYSTEM AND ITS RESPONSE	-	-	-	1	-	100	0	100	EEC
18EC0XL	BLOCKCHAIN TECHNOLOGIES FOR SMART CITIES	-	-	-	1	-	100	0	100	EEC
18EC0XM	DATA ACQUISITION SYSTEM	-	-	-	1	-	100	0	100	EEC
18EC0XN	STM32 ARM CORTEX MICROCONTROLLER PROGRAMMING AND APPLICATIONS	-	-	-	1	-	100	0	100	EEC
18EC0XO	DESIGN AND VERIFICATION USING VERILOG	-	-	-	1	-	100	0	100	EEC
18EC0XP	MEANDER DIPOLE ANTENNA DESIGN FOR RFID TAGS	-	-	-	1	-	100	0	100	EEC
18EC0XQ	2D/3D GAME DEVELOPMENT	-	-	-	1	-	100	0	100	EEC
18EC0XR	IMPLANTABLE ANTENNA DESIGN FOR BIO-TELEMETRY APPLICATIONS	-	-	-	1	-	100	0	100	EEC
18EC0XS	TM4C123 TIVA LAUNCHPAD EMBEDDED PROGRAMMING AND APPLICATIONS	-	-	-	1	-	100	0	100	EEC
18EC0XT	MACHINE LEARNING FOR INTELLIGENT ROBOTS	-	-	-	1	-	100	0	100	EEC



18EC0XU	UAV DRONE WITH ARTIFICIAL INTELLIGENCE TECHNOLOGY	-	-	-	1	-	100	0	100	EEC
18EC0XV	EMC/EMI TESTING	-	-	-	1	-	100	0	100	EEC
18EC0XW	NETWORK OPTIMIZATION USING KEY PERFORMANCE INDICATOR	-	-	-	1	-	100	0	100	EEC
18EC0XX	MULTIMEDIA PROCESSING USING GRAPHICAL SYSTEM DESIGN	-	-	-	1	-	100	0	100	EEC
18EC0XY	NETWORK PROTOCOLS AND ANALYSING TOOLS	-	-	-	1	-	100	0	100	EEC
<b>OPEN ELECTIVES</b>										
21OCE01	ENERGY CONSERVATION AND MANAGEMENT	3	0	0	3	3	40	60	100	OE
21OCS01	OBJECT ORIENTED PROGRAMMING	3	0	0	3	3	40	60	100	OE
21OCS02	JAVA FUNDAMENTALS	3	0	0	3	3	40	60	100	OE
21OCS03	KNOWLEDGE DISCOVERY IN DATABASES	3	0	0	3	3	40	60	100	OE
21OCS04	E-LEARNING TECHNIQUES	3	0	0	3	3	40	60	100	OE
21OCS05	SOCIAL TEXT AND MEDIA ANALYTICS	3	0	0	3	3	40	60	100	OE
21OEI01	PROGRAMMABLE LOGIC CONTROLLER	3	0	0	3	3	40	60	100	OE
21OEI04	OPTOELECTRONICS AND LASER INSTRUMENTATION	3	0	0	3	3	40	60	100	OE
21OME01	DIGITAL MANUFACTURING	3	0	0	3	3	40	60	100	OE
21OME02	INDUSTRIAL PROCESS ENGINEERING	3	0	0	3	3	40	60	100	OE
21OME03	MAINTENANCE ENGINEERING	3	0	0	3	3	40	60	100	OE
21OME04	SAFETY ENGINEERING	3	0	0	3	3	40	60	100	OE
21OBT01	BIOFUELS	3	0	0	3	3	40	60	100	OE
21OFD01	TRADITIONAL FOODS	3	0	0	3	3	40	60	100	OE
21OFD02	FOOD LAWS AND REGULATIONS	3	0	0	3	3	40	60	100	OE
21OFD03	POST HARVEST TECHNOLOGY OF FRUITS AND VEGETABLES	3	0	0	3	3	40	60	100	OE
21OFD04	CEREAL, PULSES AND OIL SEED TECHNOLOGY	3	0	0	3	3	40	60	100	OE
21OFT01	FASHION CRAFTSMANSHIP	3	0	0	3	3	40	60	100	OE
21OFT02	INTERIOR DESIGN IN FASHION	3	0	0	3	3	40	60	100	OE

21OFT03	SURFACE ORNAMENTATION	3	0	0	3	3	40	60	100	OE
21OPH01	NANOMATERIALS SCIENCE	3	0	0	3	3	40	60	100	OE
21OPH02	SEMICONDUCTOR PHYSICS AND DEVICES	3	0	0	3	3	40	60	100	OE
21OPH03	APPLIED LASER SCIENCE	3	0	0	3	3	40	60	100	OE
21OPH04	BIO-PHOTONICS	3	0	0	3	3	40	60	100	OE
21OPH05	PHYSICS OF SOFT MATTER	3	0	0	3	3	40	60	100	OE
21OCH01	CORROSION SCIENCE AND ENGINEERING	3	0	0	3	3	40	60	100	OE
21OCH02	POLYMER SCIENCE	3	0	0	3	3	40	60	100	OE
21OCH03	ENERGY STORING DEVICES	3	0	0	3	3	40	60	100	OE
21OMA01	GRAPH THEORY AND COMBINATORICS	3	0	0	3	3	40	60	100	OE
21OGE01	PRINCIPLES OF MANAGEMENT	3	0	0	3	3	40	60	100	OE
21OGE02	ENTREPRENEURSHIP DEVELOPMENT I	3	0	0	3	3	40	60	100	OE
21OGE03	ENTREPRENEURSHIP DEVELOPMENT II	3	0	0	3	3	40	60	100	OE
21OGE04	NATION BUILDING: LEADERSHIP AND SOCIAL RESPONSIBILITY	3	0	0	3	3	40	60	100	OE

### SUMMARY OF CREDIT DISTRIBUTION

S.No	CATEGORY	CREDITS PER SEMESTER								TOTAL CREDIT	CREDITS in %	Range of Total Credits	
		I	II	III	IV	V	VI	VII	VIII			Min	Max
1	BS	10	10	4	4	-	-	-	-	28	17	15%	20%
2	ES	6	11	10	-	-	-	-	-	27	17	15%	20%
3	HSS	2	2	-	-	-	2	-	-	6	4	5%	10%
4	PC	-	-	9	19	18	9	8	-	63	39	35%	45%
5	PE	-	-	-	-	6	9	12	-	27	17	15%	20%
6	EEC	-	-	-	-	-	-	3	9	12	7	5%	10%
Total		18	23	23	23	24	20	23	9	163	100	-	-

BS - Basic Sciences  
 ES - Engineering Sciences  
 HSS - Humanities and Social Sciences  
 PC - Professional Core  
 PE - Professional Elective  
 EEC - Employability Enhancement Course  
 CA - Continuous Assessment  
 ES - End Semester Examination

**18EC101 ENGINEERING MATHEMATICS I****3 1 0 4****Course Objectives**

- Understand the concepts of vectors and Eigenvectors for different matrices to describe the stability of the linear systems in engineering fields
- Exemplify the concepts of differentiation and integration to identify the area of 2D and 3D surfaces in engineering problems.
- Explain the concepts of analytic functions in complex domain to predict the nature of different engineering systems

**Course Outcomes (COs)**

- Represent the different forms of coordinate system in complex plane and characteristics of linear systems by Eigenvalues and Eigenvectors
- Analyse various types of functions and their differentiation techniques involved in engineering fields
- Implement different methods of integration used in engineering problems.
- Execute the suitable integration technique to calculate the area and volume of different surfaces.
- Apply the concept of analytic function to estimate the integral in complex plane.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3												
2	3	2												
3	3	2												
4	3	2	3											
5	3	3												

**UNIT I****9 Hours****COMPLEX NUMBERS, VECTORS AND MATRICES**

Complex plane, polar coordinates and polar form of complex numbers, powers and roots, fundamental theorem of algebra. Vector algebra in 2-D and 3-D space, dot product and cross product. Matrices : Eigen values and Eigen vectors, Properties of eigen values and eigen vectors.

**UNIT II****9 Hours****CALCULUS**

Limits and Continuity of Functions: Limits of functions, types of limits, evaluation of limits, continuity of functions, properties of continuous functions. Derivatives: Derivatives, differentiability, rules and properties, differentiation of transcendental functions, higher order derivatives, implicit differentiation, and differentiation of hyperbolic functions. Integration: Anti-derivatives, Riemann Sum, indefinite and definite integration, Mean Value Theorem for definite integral, Fundamental Theorem of Calculus.

**UNIT III****9 Hours****INTEGRATION METHODS**

Basic integration formulae for algebraic and transcendental functions. Integration by special devices: integration by parts, rationalizing substitution or trigonometric substitution, partial fractions, reduction formulas, improper integrals, convergence tests.

#### UNIT IV

9 Hours

##### APPLICATIONS OF DERIVATIVES AND INTEGRATIONS

Extreme values, points of inflection and curve sketching, Rolles Theorem, Mean Value Theorem, optimization, indeterminate forms, L Hopitals Rule. Area between curves, volume of a general solid by slicing and cylindrical shell methods, volume of a solid of revolution, length of plane curves, area of a surface of revolution.

#### UNIT V

9 Hours

##### COMPLEX ANALYSIS

Analytic Functions- Properties of Analytic function - Determination of Analytic Function using Milne Thompson method. Cauchy's Integral Formula - Classification of Singularities - Cauchy's Residue Theorem.

##### FOR FURTHER READING

Applications of mass spring system in ordinary differential equations of higher order.

**Total: 60 Hours**

##### Reference(s)

1. Finney RL, Weir MD and Giordano FR, Thomas Calculus, 10th edition, Addison-Wesley, 2001
2. Erwin Kreyszig, Advanced Engineering Mathematics, Tenth Edition, Wiley India Private Limited, New Delhi 2015.
3. Smith RT and Minton RB, Calculus, 2nd Edition, McGraw Hill, 2002
4. Anton H, Calculus with Analytic Geometry, 5th edition, John Wiley & Sons, 1995.
5. 5Ayres F Jr and Mendelson E, Schaum s Outline of Theory and Problems of Calculus, 4th edition, McGraw Hill, 1999.
6. T.Veerarajan, Engineering mathematics for First Year, Tata McGraw-Hill Publishing company Limited, New Delhi, 2014.

**18EC102 ENGINEERING PHYSICS I****2023****Course Objectives**

- Illustrate the Newtons laws of motion and wave motion with applications
- Understand the basic properties of electricity, magnetism and optics
- Differentiate the special theory of relativity and quantum physics from classical physics

**Course Outcomes (COs)**

1. Illustrate the Newtons three laws of motion and apply the same to solve the real world problems involving elevator, atwood machine and acceleration of objects
2. Exemplify the physical characteristics of simple harmonic motion, wave motion and find the solutions for wave equations
3. Infer the fundamental laws, properties of electricity and magnetism and apply the same to electric and magnetic elements.
4. Apply the principles of physical and geometrical optics in the mirrors, lenses, microscopes and diffraction gratings
5. Outline the importance of special theory of relativity, quantum physics and analyse the wave and particle nature of matter

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2						2	2	2			2	
2	2	2						2	2	2			2	
3	2	2						2	2	2			2	
4	2	2						2	2	2			2	
5	2	1						2	2	2			2	

**UNIT I****6 Hours****MECHANICS**

Newtons laws of motion: Concept of force and its nature - Newtons first law and inertial frames - definition of mass - Newtons second law-gravitational force and weight- Newtons third law. Applications of Newtons laws: particle in equilibrium, particle under net force - weighing a mass in an elevator, at wood machine and acceleration of two objects connected by a cord

**UNIT II****6 Hours****OSCILLATIONS AND WAVES**

Fundamentals of simple harmonic motion - energy of simple harmonic oscillator - spring mass system - time period of simple pendulum, compound pendulum and torsional pendulum - Damped oscillations. Travelling wave motion - sinusoidal waves on strings - speed of a wave - reflection and transmission - rate of energy transfer in wave motion

**UNIT III****6 Hours****ELECTRICITY AND MAGNETISM**

Point charges - electric fields - Gauss law and its applications - electric potential - capacitance - energy stored in a capacitor. Concept and source of magnetic fields - Amperes theorem - determination of magnetic field due to different current distributions - Faradays law - self-induction and mutual induction - energy stored in an inductor

#### **UNIT IV**

**6 Hours**

##### **LIGHT AND OPTICS**

Nature of light - laws of reflection and refraction - refractive index and Snells law dispersion of light - total internal reflection - image formation: concave mirrors - convex mirrors - thin lenses - compound microscope - human eye. Conditions of interference - Youngs double slit experiment - intensity distribution of interference - phase change due to reflection - diffraction - narrow slit diffraction -single slit and two slit - intensity distribution - diffraction grating - applications

#### **UNIT V**

**6 Hours**

##### **MODERN PHYSICS**

Special theory of relativity - simultaneity and time dilation - twin paradox - length contraction - relativistic mass variation - space time graph. Black body radiation and Planck hypothesis - allowed energy levels - thermal radiation from different objects - photoelectric and Compton effect. Matter waves - de-Broglie hypothesis - wave nature of particles - Davission-Germer experiment.

**1**

**5 Hours**

##### **EXPERIMENT 1**

Determination of resultant of system of concurrent coplanar forces-Parallelogram law of forces

**2**

**5 Hours**

##### **EXPERIMENT 2**

Determination of moment of inertia-Torsional pendulum

**3**

**5 Hours**

##### **EXPERIMENT 3**

Determination of wavelength of mercury spectral lines-spectrometer

**4**

**4 Hours**

##### **EXPERIMENT 4**

Determination of refractive index of solid and liquid-travelling microscope

**5**

**3 Hours**

##### **EXPERIMENT 5**

Determination of wavelength of laser-diffraction grating

**6**

**4 Hours**

##### **EXPERIMENT 6**

Determination of frequency of a tuning fork-Meldes apparatus

**7**

**4 Hours**

##### **EXPERIMENT 7**

Thickness of a thin wire using interference of light-Air wedge method

**Total: 60 Hours**

#### **Reference(s)**

1. R A Serway and J W Jewitt, Physics for Scientists and Engineers, Thomson Brooks/Cole, 2011
2. Halliday and Resnick, Fundamentals of Physics, John Wiley and Sons, Inc, 2011

3. H C Verma, Concepts of Physics (Vol I & II), Bharathi Bhawan Publishers & Distributors, New Delhi, 2017
4. H D Young and R A Freedman, Sears and Zemansky's University Physics with Modern Physics, Pearson education, 2016
5. R K Gaur and S L Gupta, Engineering Physics, Dhanpat Rai Publications, 2012



**18EC103 ENGINEERING CHEMISTRY I****2023****Course Objectives**

- ✓ Summarize the unique properties of group IV elements and their applications in electronics
- ✓ Infer the purpose of alloying and the applications of alloys in electronic industries
- ✓ Outline the concept of nanomaterials and their application in electronics
- ✓ Deduce the importance of nanoelectronics and understand nanofabrication techniques
- ✓ Outline the concept of electrochemistry to protect materials from corrosion

**Course Outcomes (COs)**

1. Understand the role of oxides of silicon and germanium for electronics applications
2. Apply the properties of ferrous and non-ferrous alloys in electronics industries
3. Assess the preparation and properties of nanomaterial for the electronics applications.
4. Identify the role of nanofabrication techniques in nanoelectronics and analyze the morphology of materials using AFM, SEM and TEM techniques
5. Analyze the electrochemical reactions in metals and predict the suitable corrosion protection method.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2						2	2	2				
2	3	2						2	2	2				
3	3	2						2	2	2				2
4	3	2					1	2	2	2				2
5	3	2					2	2	2	2				

**UNIT I****6 Hours****CHEMISTRY OF SEMI CONDUCTORS**

Group IV elements - structure and properties - oxides of silicon and germanium - applications in electronics - IC device and VLSI design fabrication.

**UNIT II****6 Hours****ALLOYS**

Purpose of alloying - properties and classification of alloys - ferrous and non-ferrous - silicon-germanium alloys-silicon and germanium-tin alloys - applications.

**UNIT III****5 Hours****NANOMATERIALS**

Nanomaterials: Introduction - advantages over macromolecules - classification - general properties. Synthesis of nanomaterials and applications in electronics.

**UNIT IV****6 Hours****NANOELECTRONICS**

Nanoelectronics - introduction - nanoelectronic architectures - nanofabrication - nanopatterning of metallic/semiconducting nanostructures, structural characterization (SEM, TEM and AFM).

## UNIT V

7 Hours

### ELECTRO CHEMISTRY AND CORROSION CONTROL

Electrodes - cells - types and applications - electrochemical series. Corrosion - types - corrosion control methods - electroplating (copper) - electroless plating (nickel) - applications in PCB.

### FURTHER READING

Impact of corrosion on electronic appliances. Applications of nanomaterials in electronics. Conducting polymers.

1

3 Hours

#### EXPERIMENT 1

Determination of silica content in given potassium silicate sample by titration method

2

3 Hours

#### EXPERIMENT 2

Determine the composition of copper present in the given brass alloy by EDTA method

3

4 Hours

#### EXPERIMENT 3

Synthesis of metal nanoparticles and their characterization

4

4 Hours

#### EXPERIMENT 4

Preparation of cadmium sulfide nano crystals using thiourea

5

4 Hours

#### EXPERIMENT 5

Estimation of extent of corrosion of given metal by weight loss method

6

3 Hours

#### EXPERIMENT 6

Estimation of iron in the given sample by potentiometric method using saturated calomel electrode

7

5 Hours

#### EXPERIMENT 7

Electroplating of copper on a given target object and estimate the amount of copper corroded at anode

8

4 Hours

#### EXPERIMENT 8

Determination strength of mixture of acids (Hydrochloric acid and acetic acid) by conductometric titration

**Total: 60 Hours**

### Reference(s)

1. Jain and Jain, Engineering Chemistry, 16th Edition, Dhanpat Rai Publishing Company, New Delhi, 2013.
2. P.H. Rieger, Electrochemistry, Second Edition (Reprint), Springer, Netherland, 2012.
3. E.McCafferty, Introduction to Corrosion Science, Springer; 2010 Edition, January 2010.
4. R. Gowariker, N. V. Viswanathan, J. Sreedhar, Polymer Science, 1st Edition, New age International Publishers, New Delhi, 2014.

5. S. Vairam, Engineering Chemistry, John Wiley & sons, 2014.
6. Charles P. Poole Jr and. Frank J. Owens, Introduction to Nanotechnology, Wiley Interscience, 2007.

**18EC104 COMPUTER PROGRAMMING I****2023****Course Objectives**

- ✓ Understand the basics of C primitives, operators and expressions.
- ✓ Gain knowledge about the different primitive and user defined data types.
- ✓ Impart knowledge about the structural programming concepts.

**Course Outcomes (COs)**

1. Implement C programs using operators, type conversion and input-output functions.
2. Apply decision making and looping statements in writing C programs.
3. Develop C programs using the concepts of Arrays and strings.
4. Design applications using functions and pointers in C.
5. Apply the concepts of structures and files in writing C programs.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3		1	3				2	2		2		1
2	2	3		1	3				2	2		2		2
3	2	3	1	2	3		1		2	2	1	3		2
4	1	3		2	3		1		2	2	1	2		2
5	1	3	3	2	3		1		2	2	1	2		2

**UNIT I****6 Hours****INTRODUCTORY CONCEPTS**

Introduction to C- Planning and writing a C program- Operators and Expressions- Arithmetic - Relational - Logical - Increment and decrement - Conditional - Bitwise - Comma - Sizeof() - Assignment - Shift operator Precedence and order of evaluation.

**UNIT II****6 Hours****CONTROL STATEMENTS**

Decision Making and Branching- Decision Making and Looping -Jump Statements.

**UNIT III****6 Hours****ARRAYS AND STRINGS**

Arrays- Introduction, declaration - Initialization of one dimensional array, two-dimensional arrays, initializing two dimensional arrays. Strings- String handling functions.

**UNIT IV****6 Hours****FUNCTIONS AND POINTERS**

User Defined Functions- Elements of user defined functions -categories of function - call by value and call by reference - recursion. Pointers - Accessing address of a variable -Declaring, Initializing and Accessing of pointer variables.

**UNIT V** **6 Hours**

**STRUCTURES AND FILES**

Structures - Introduction - defining a structure - declaring structure variables - accessing structure members -File Management in C.

**FOR FURTHER READING**

Problem solving - Logical thinking - logic - symbolic logic - truth tables - Math puzzles - magic triangles - magic squares - alphametic puzzles - Cross number puzzles.

**1** **2 Hours**

**EXPERIMENT 1**

Write a C program to perform arithmetic operations on integers and floating point numbers.

**2** **2 Hours**

**EXPERIMENT 2**

Implement a C program to perform the Arithmetic Operations using primitive data types.

**3** **2 Hours**

**EXPERIMENT 3**

Implementation of logical, relational, bitwise, increment/decrement and conditional Operators in C.

**4** **2 Hours**

**EXPERIMENT 4**

Implementation of Simple if else Conditional Statement.

**5** **2 Hours**

**EXPERIMENT 5**

Implementation of nested if else Conditional Statement

**6** **2 Hours**

**EXPERIMENT 6**

Implementation of Switch Case Statement.

**7** **2 Hours**

**EXPERIMENT 7**

Implement a C program using for Looping Statement.

**8** **2 Hours**

**EXPERIMENT 8**

Implement a C program using Do-While Looping Statement.

**9** **2 Hours**

**EXPERIMENT 9**

Implement a C program using While Looping Statement.

**10** **2 Hours**

**EXPERIMENT 10**

Implementation of Jumping Statements

**11** **2 Hours**

**EXPERIMENT 11**

Implementation of One Dimensional Array.

**12** **2 Hours**

**EXPERIMENT 12**

Implementation of Two Dimensional Array.

**13** **2 Hours**

**EXPERIMENT 13**

Implement a C program to perform String Manipulation Functions.

**14** **2 Hours**

**EXPERIMENT 14**

Implement a C program using structures and pointers

**15** **2 Hours**

**EXPERIMENT 15**

Implement a C program which includes four categories of functions and recursive functions.

**Total: 60 Hours**

**Reference(s)**

1. Herbert Schildt, C -The complete Reference, Tata McGraw-Hill, 2013.
2. Byron Gottfried , Programming with C, Schaum's Outlines, Tata McGraw-Hill, 2013
3. E. Balagurusamy, Programming in ANSI C, Tata McGraw-Hill, 2012
4. Kernighan B W and Ritchie O M, The C programming Language. Prentice-Hall of India, 2009
5. Kelley A and I. Pohl, A Book on C : Programming in C, Pearson Education, 1998
6. Ashok.N.Kamthane, Programming in C, Pearson education,2013

**18HS101 COMMUNICATIVE ENGLISH I****1 0 2 2****Course Objectives**

- ✓ Read and understand the main points on familiar matters regularly encountered in work, school, or leisure
- ✓ Listen and respond in most common situations where English is spoken
- ✓ Write simple connected texts on topics which are familiar or of personal interest
- ✓ Describe experiences and events, hopes and ambitions and briefly give reasons and explanations for opinions and plans

**Course Outcomes (COs)**

1. Use appropriate grammar and vocabulary that is expected at the BEC Preliminary exam level
2. Use the general meaning of non-routine letters within own work area, and short reports of a predictable nature
3. Write formal, routine letters of factual nature, and make notes on routine matters, such as taking/placing orders
4. Follow simple presentations/demonstrations
5. Deal with predictable requests from a visitor, state routine requirements, and offer advice within own job area on simple matters

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									2	3		2		
2									2	3		2		
3									2	3		2		
4									2	3		2		
5									2	3		2		

**UNIT I****9 Hours****GRAMMAR**

Tenses Future continuous, Past continuous, Past perfect, Past simple, Past tense responses, Present perfect continuous, Present perfect/past simple Reported speech Adverbs intensifiers Comparatives and superlatives Conditionals 2nd and 3rd Connecting words expressing cause and effect, contrast Phrasal verbs Prepositions of place Simple passive - Wh-questions in the past Question tags Will and going to, for prediction.

**UNIT II****9 Hours****READING**

Understanding short real-world notices, messages Detailed comprehension of factual material; skimming and scanning skills - Interpreting visual information Reading for detailed factual information Reading for gist and specific information - Grammatical accuracy and understanding of text structure - Reading and information transfer.

**UNIT III****9 Hours****WRITING**

Internal communication including note, message, memo or email - arranging / rearranging appointments, asking for permission, giving instructions - Business correspondence including letter,

fax, email apologising and offering compensation, making or altering reservations, dealing with requests, giving information about a product.

#### **UNIT IV**

**9 Hours**

##### **LISTENING**

Listening for specific information Listening for numbers and letters Note completion Listening for gist listening to monologues (presentations, lectures, announcements and briefings) listening to interacting speakers (telephone conversations, face-to-face conversations, interviews and discussions).

#### **UNIT V**

**9 Hours**

##### **SPEAKING**

Exchanging personal and factual information expressing and finding out about attitudes and opinions organise a larger unit of discourse Turn-taking, negotiating, collaborating, exchanging information, expressing and justifying opinions, agreeing and/or disagreeing, suggesting, speculating, comparing and contrasting, and decision-making. 1. Goodbye party for Miss Pushpa T S - Nissim Ezekiel 2. Our Casuarina Tree - Toru Dutt 3. Palanquin Bearers - Sarojini Naidu 4. The Tyger - William Blake 5. Ode on a Grecian Urn - John Keats

**Total: 45 Hours**

##### **Reference(s)**

1. Alexander Garrett, Cambridge BEC Preliminary Students Book with Answers, Cambridge University Press, 2016.
2. Lan Wood, Anne Williams and Anna Cowper. Pass Cambridge BEC Preliminary, Second Edition, New Delhi, 2014.
3. Norman Whitby. Cambridge Business Benchmark. Pre-Intermediate to Intermediate, Students Book. South Asian Edition, 2018.



**18EC106 ENGINEERING GRAPHICS****1 0 4 3****Course Objectives**

- ✓ To provide knowledge on fundamentals of engineering drawings and conic sections.
- ✓ To familiarize on orthographic projections of points, lines, planes and simple solids, sections and development of surfaces of simple solids.
- ✓ To impart skill on conversion of isometric view to orthographic projection and vice versa.

**Course Outcomes (COs)**

1. Illustrate the engineering drawing concepts as per industrial standards.
2. Construct orthographic projections of points and lines.
3. Draw the projection of planes and simple solids.
4. Draw the section of solids and development of surfaces.
5. Draw the orthographic projection from an isometric view and vice versa.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2							2		2				
2	2							2		2				
3	2							2		2				
4	2							2		2				
5	2							2		2				

**UNIT I****3 Hours****FUNDAMENTALS OF ENGINEERING DRAWINGS**

Definition, standards, drawing tools, drawing sheets, scales, line and its types. Practices on lettering, numbering, dimension of drawings. Construction of conic sections-ellipse, parabola and hyperbola using eccentricity method.

**UNIT II****3 Hours****PROJECTION OF POINTS**

Principles of projection, projection of points in four quadrants, first angle projection of straight lines - perpendicular to one plane, parallel and inclined to both planes.

**UNIT III****3 Hours****PROJECTION OF PLANES AND SOLIDS**

Projection of simple planes and projection of simple solids - parallel, perpendicular and inclined to one plane using change of position method.

**UNIT IV****3 Hours****SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES**

Section of Solids - simple position with cutting plane parallel, perpendicular and inclined to one plane. Development of surfaces - simple and truncated solids.

**UNIT V****3 Hours****ORTHOGRAPHIC PROJECTIONS AND ISOMETRIC VIEW**

Orthographic projections and isometric view of components used in engineering applications.

**1** **12 Hours**

**EXPERIMENT 1**

Create 2D sketch of different components used in engineering applications.

**2** **12 Hours**

**EXPERIMENT 2**

Create part model of a component from given isometric drawings.

**3** **12 Hours**

**EXPERIMENT 3**

Create part model of a component from given orthographic views.

**4** **12 Hours**

**EXPERIMENT 4**

Create an assembly model of product from detailed parts drawing.

**5** **12 Hours**

**EXPERIMENT 5**

Create stl file from CAD model, transfer file to 3D printer, setup the machine parameters, build and post process the component using Additive Manufacturing Technology.

**Total: 75 Hours**

**Reference(s)**

1. K Venugopal, Engineering Drawing and Graphics, Third edition, New Age International, 2005.
2. Basant Agrawal, Mechanical drawing, Tata McGraw-Hill Education, 2008.
3. N. D. Bhatt and V. M. Panchal, Engineering Drawing, Charotar Publishing House Pvt. Limited, 2008.
4. K.V. Natarajan, A Text Book of Engineering Graphics, Dhanalakshmi Publishers, 2013.
5. Chua Chee Kai, Leong Kah Fai, Rapid Prototyping: Principles & Applications, World Scientific, 2003.
6. Ian Gibson, David W Rosen, Brent Stucker., Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, 2010

**18EC201 ENGINEERING MATHEMATICS II****3 1 0 4****Course Objectives**

- ✓ Understand the concepts of partial derivatives and multiple integrals to define the area, volume and extreme values of various surfaces in engineering fields.
- ✓ Classify the sequences and series in linear systems is convergent or divergent.
- ✓ Formulate the real time engineering problem into mathematical model using ordinary differential equation and solve it by appropriate method.

**Course Outcomes (COs)**

1. Illustrate the various parameters in partial differentiation and characterize the maxima and minima functions for signals and systems.
2. Apply multiple integral concepts to calculate the area and volume by appropriate vector integral theorems.
3. Analyse the convergence and divergence of sequences and series by various tests.
4. Construct first order differential equations from real time phenomena and solve it by suitable method.
5. Execute the appropriate method to solve the second order differential equations.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2		2										
2	3	2		2										
3	3	2		2										
4	3	2		2										
5	3	3		2										

**UNIT I****9 Hours****PARTIAL DIFFERENTIATION**

Functions of several variables, plotting of 2-variable functions, introduction to cylindrical and spherical coordinates, chain rule, total differential, gradient, directional derivatives, normal lines and tangent planes, extreme of functions of two variables, applications.

**UNIT II****9 Hours****MULTIPLE INTEGRALS**

Double integrals, regions of integrations, triple integrals, applications (Cartesian coordinates only- Greens theorem and Gauss Divergence theorem).

**UNIT III****9 Hours****SEQUENCES AND SERIES**

Sequences and series, convergence and divergence of series, absolute convergence, conditional convergence, test for convergence and divergence. Power series for functions, interval of convergence, Taylor and Maclaurin series, Taylor s Theorem with remainder.

**UNIT IV**

**9 Hours**

**MAPPING OF COMPLEX FUNCTIONS**

Separable differential equations, homogeneous differential equations, exact differential equations, integrating factor, Bernoulli's equation, applications.

**UNIT V**

**9 Hours**

**SECOND ORDER DIFFERENTIAL EQUATIONS**

Second order homogeneous and non-homogeneous equations with constant coefficients, variation of parameters, method of undetermined coefficients, series solutions of differential equations, applications.

**FOR FURTHER READING**

Applications in Electromagnetic Fields, Applications in Communication Theory.

**Total: 60 Hours**

**Reference(s)**

1. Finney RL, Weir MD and Giordano FR, Thomas Calculus, 10th edition, Addison-Wesley, 2001
2. Smith RT and Minton RB, Calculus, 2nd Edition, McGraw Hill, 2002. Kreyszig E, Advanced Engineering Mathematics, 8th edition, John Wiley & Sons, 1999.
3. Ray Wylie and C Louis Barrett, Advanced Engineering Mathematics, Sixth Edition, Tata McGraw-Hill Publishing Company Ltd, 2003.
4. Peter V. O Neil, Advanced Engineering Mathematics, Seventh Edition, Cengage Learning India Private Limited, 2012.
5. Glyn James, Advanced Engineering Mathematics, Third Edition, Wiley India, 2014.

**18EC202 ENGINEERING PHYSICS II****2023****Course Objectives**

- ✓ Understand the fundamentals of crystal, transport properties of semiconductors and magnetic materials
- ✓ Differentiate passive and active components
- ✓ Compare different display devices and their functions

**Course Outcomes (COs)**

1. Identify the seven types of crystal systems, crystal planes and illustrate unit cell characteristics of SC, BCC, FCC and HCP crystal structures.
2. Exemplify the characteristics of semiconducting materials in terms of crystal lattice, charge carriers and energy band diagrams.
3. Differentiate the active and passive components in an electronic circuit and outline the working mechanisms of diodes.
4. Analyse the properties of magnetic materials, domain theory of ferromagnetism and the applications of recording and readout process.
5. Outline the interaction of electromagnetic radiation with matter and working principle of LED, LCD and OLED display devices

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1						2	2	2				
2	2	1						2	2	2			2	
3	2	1						2	2	2			2	
4	2	1						2	2	2			2	
5	2	1						2	2	2				

**UNIT I****6 Hours****CRYSTAL PHYSICS**

Classification of solids - crystal structure - lattice points and space lattice - unit cell and lattice parameters - crystal systems and Bravais lattices - crystallographic planes - Miller indices - interplanar space of lattice planes - anisotropic properties of crystal - unit cell characteristics of SC, BCC, FCC and HCP structures.

**UNIT II****7 Hours****SEMICONDUCTING MATERIALS**

Band theory of solids - classification of solids - electrical and thermal conductivity - Semiconductors: elemental and compound semiconductor - intrinsic and extrinsic semiconductors - energy band diagram and electrical conduction - variation of Fermi level with temperature and impurity concentration - temperature dependence of carrier concentration in extrinsic semiconductor - Hall effect - determination of Hall coefficient - solar cells

**UNIT III****5 Hours****PASSIVE AND ACTIVE COMPONENTS**

Fundamental definitions - types of resistors, capacitors, inductors and transformers - characteristics of PN junction. Diodes: laser diode - PIN diode - Schottky diode - step recovery diode - tunnel diode - varactor diode - Zener diode

#### UNIT IV

6 Hours

##### MAGNETIC MATERIALS

Basic definitions - origin of magnetic moment - classification of magnetic materials - influence of temperature on magnetic behaviour - domain theory of ferromagnetism - hysteresis of ferromagnetic materials - soft and hard magnetic materials - applications: magnetic recording - giant magnetoresistance (GMR) effect.

#### UNIT V

6 Hours

##### DISPLAY DEVICES

Electromagnetic radiation - interaction of radiation with solids - classification of optical materials - luminescence - types of luminescence - LED and OLED: principle, construction, working, advantages and disadvantages. LCD: characteristics of liquid crystals - types - phases - twisted nematic display: construction, working, merits and demerits. Comparison of LED, OLED and LCD

1

5 Hours

##### EXPERIMENT 1

Measurement of resistivity of a given material by four probe method

2

5 Hours

##### EXPERIMENT 2

Find the Hall coefficient and carrier concentration of semiconducting material using Hall effect apparatus

3

5 Hours

##### EXPERIMENT 3

Determine the V-I characteristics of a solar cell

4

5 Hours

##### EXPERIMENT 4

Find the band gap value of the given semiconductor diode. Based on the band gap value, identify the given semiconductor

5

5 Hours

##### EXPERIMENT 5

Determine the V-I characteristics of P-N diode and Zener diode

6

5 Hours

##### EXPERIMENT 6

Determine the thermal conductivity of a bad conductor by using Lee's disc method

**Total: 60 Hours**

#### Reference(s)

1. Balasubramaniam, R. "Callister's Materials Science and Engineering". Wiley India Pvt.Ltd., 2014
2. Kasap, S.O., Principles of Electronic Materials and Devices, McGraw-Hill Education, 2017
3. William D. Callister, Jr. & David G. Rethwisch, Fundamentals of Materials Science and Engineering, John Wiley and Sons Incl., 2008
4. Wahab, M.A., Solid State Physics: Structure and Properties of Materials, Alpha Science International Ltd., 2017

5. Donald A. Neamen. "Semiconductor Physics and Devices", Mc Graw-Hill, 2011
6. Palanisamy P. K. "Physics for electronics and information science" Dipti Press Pvt. Ltd., 2018.
7. Papadopoulos, Christo, "Solid-State Electronic Devices An Introduction", Springer, New York, 2014.
8. Raghavan, V. "Materials Science and Engineering: A First course". PHI Learning, 2015.
9. B.L.Theraja, "Basic Electronics Solid State", S.Chand& Company Ltd, New Delhi, 2000.

**18EC203 ENGINEERING CHEMISTRY II****2023****Course Objectives**

- ✓ Summarise the basics of polymer and its applications in electronics
- ✓ Infer the working principle of optoelectronic materials and their applications
- ✓ Interpret the application of ceramic insulating materials in electronics
- ✓ Introduce the concept of spectroscopy and analyze the interaction of electromagnetic radiations with matter
- ✓ Outline the basics of nuclear magnetic radiation techniques and their instrumentation

**Course Outcomes (COs)**

1. Analyze the physical, chemical and morphological properties of polymer materials used in various applications
2. Apply the basic concepts of optoelectronic materials to develop the electronic materials used in day-to-day life
3. Analyze the properties and various applications of ceramic materials in various fields
4. Select the suitable electromagnetic radiation and analytical method for the identification of target compounds
5. Apply the NMR, ESR spectroscopy and diffractometer techniques to elucidate the structure of samples.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2						2	2	2				
2	2	2						2	2	2				
3	2	1						2	2	2				
4	2	1						2	2	2				
5	2							2	2	2				

**UNIT I****6 Hours****ELECTRONIC POLYMERS**

Polymer - introduction - physical, chemical and morphological properties of electronic polymers and their applications - piezo and pyroelectric polymers. Polymers in optical media - data storage devices.

**UNIT II****6 Hours****CHEMISTRY FOR OPTOELECTRONICS**

Semiconducting materials - types. LED - types - working - advantages. Photovoltaics and organic solar cells - principle - working and applications.

**UNIT III****6 Hours****ELECTRONIC CERAMICS**

Properties of ceramic insulators - ceramic capacitor materials - ferrite (magnetic) ceramics - ceramic sensors. Application and characterization of ZnO varistors. Resistor materials: Carbon based materials and metal based materials.



**UNIT IV** **6 Hours**

**SPECTROSCOPY**

Spectroscopy: Electromagnetic spectrum - absorption of radiation - electronic, vibrational and rotational transitions. UV visible and IR spectroscopy - principle, instrumentation (block diagram) and applications.

**UNIT V** **6 Hours**

**MAGNETIC AND RADIATION TECHNIQUES**

Nuclear radiation - nuclear radiation detectors - GM counter. Principle and applications of NMR, ESR, X-ray spectroscopy and diffractometer.

**FURTHER READING**

Energy storage devices - conventional batteries and modern batteries.

**1** **4 Hours**

**EXPERIMENT 1**

Determination of molecular weight of given polymer by Ostwald Viscometer

**2** **4 Hours**

**EXPERIMENT 2**

Identification of polymer compounds using IR spectroscopy

**3** **4 Hours**

**EXPERIMENT 3**

Preparation of conducting polymer by electrodeposition method

**4** **3 Hours**

**EXPERIMENT 4**

Interpretation of DTA curve analysis of ceramic materials

**5** **4 Hours**

**EXPERIMENT 5**

Estimation of Zn in ceramics using EDTA method

**6** **4 Hours**

**EXPERIMENT 6**

Determination of strength in the given dye solution by the spectrophotometric method

**7** **4 Hours**

**EXPERIMENT 7**

Determination of iron (thiocyanate method) in the given solution by UV-Visible radiation

**8** **3 Hours**

**EXPERIMENT 8**

Interpretation of structural details based on the given data obtained by XRD

**Total: 60 Hours**

**Reference(s)**

1. Jain and Jain, Engineering Chemistry, 16th Edition, Dhanpat Rai Publishing Company, New Delhi, 2013.
2. S. Vairam, Engineering Chemistry, John Wiley & sons, 2014.
3. Hobart H. Willard, Lynne L. Merritt Jr., John A. Dean, Frank A. Settle Jr., Instrumental method of analysis, 7th Edition, CBS Publisher & Distributors Pvt. Ltd., New Delhi, 2013.
4. William Kemp, Organic spectroscopy, 3rd Edition, Macmillan Publisher, 2010
5. S. B. Lang and S. Muensit, Review of some lesser - known applications of piezoelectric and pyroelectric polymers, Appl. Phys. A 85, 125 - 134 (2006)

**18EC204 CIRCUIT ANALYSIS****3 1 0 4****Course Objectives**

- ✓ To study the basic laws on Circuits and calculate the voltages and current in circuit using basic theorems.
- ✓ To apply the concept of transients and resonance in series and parallel circuit
- ✓ To explore two port networks and analysis different types of two port network.

**Course Outcomes (COs)**

1. Apply Voltage-Current laws and transformation techniques to solve linear electric circuits and analyze the phase relationships of circuits with RLC components
2. Determine the electrical parameters of the circuits by using network theorems
3. Analyze the steady state and transient response of RLC circuit using Laplace transform
4. Analyze the frequency response of an electric circuit.
5. Determine driving point and transfer function of two port network and classify different two port network.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2											2	
2	3	2											2	
3	3	2											2	
4	3	2											2	
5	3	2											2	

**UNIT I****10 Hours****CIRCUIT LAWS AND ANALYSIS TECHNIQUES**

Basic electrical components, Voltage - current laws, Divider theorem, Short and Open Circuits, Phase relationship for R, L and C, Impedance and Admittance for R, L and C, Mesh and Nodal Analysis for AC and DC circuits, Source transformation techniques, Star delta transformation techniques.

**UNIT II****9 Hours****NETWORK THEOREMS FOR DC AND AC CIRCUITS**

Superposition theorem - Thevenin's theorem - Norton's theorem - Maximum power transfer theorem - Reciprocity theorem.

**UNIT III****8 Hours****STEADY STATE AND TRANSIENT ANALYSIS OF AC AND DC CIRCUITS**

Steady state and Transient analysis of RL, RC, RLC circuits using Laplace Transform for both AC and DC input.

**UNIT IV****9 Hours****RESONANCE AND MAGNETICALLY COUPLED CIRCUITS**

Resonance: Natural frequency and Damping Ratio - Series Resonance - Parallel Resonance - Quality Factor. Coupled Circuits: Self-inductance- Mutual inductance - Dot conversion - Ideal Transformer.

## UNIT V

9 Hours

### LINEAR TWO PORT NETWORK PARAMETERS

Driving point and transfer function of two port network, Z, Y, T, inverse T, Hybrid, Inverse Hybrid Parameters and its conversion.

### FOR FURTHER READING

Simulation of Circuits and Evaluation of its parameters: Basic Concepts and Definitions, Analysis of Simple Circuits, Nodal and Mesh Equations - Circuit Theorems, Natural Response, Forced and Total Response in RL and RC Circuits.

**Total: 60 Hours**

### Reference(s)

1. William Hayt, J.V. Jack, E. Kemmerly and Steven M. Durbin, Engineering Circuits Analysis, Tata McGraw-Hill, 2013.
2. Joseph Edminister and Mahmood Nahri, Theory and Problems of Electric Circuits Tata McGraw-Hill, 2008.
3. A. Sudhakar, S. Shyam Mohan and Palli, Circuits and Network (Analysis and synthesis) Tata McGraw-Hill, 2010.
4. L. Robert Boylestad, Experiments in Circuit Analysis to Accompany Introductory Circuit Analysis, PHI, 2002.
5. M. Russell, Mersereau and Joel R. Jackson, Circuit Analysis- A System Approach, Pearson Education, 2009.
6. Steven T. Karris, Circuit Analysis I with MATLAB Applications, Orchard Publications, 2004

**18EC206 ANALOG ELECTRONICS I****3 0 0 3****Course Objectives**

- ✓ To Analyze the modelling, characteristics and electrical parameters of Diode, BJT and MOSFET
- ✓ To illustrate the applications of Diode in designing rectifier and wave shaping circuits
- ✓ To illustrate the applications of BJT and MOSFET in designing electronic switch and amplifier

**Course Outcomes (COs)**

1. Analyze the characteristics and operation of ideal and practical diode
2. Apply the concepts of diode operation to design rectifier circuits and wave shaping circuits
3. Apply the concepts of BJT operation to design electronic switch and amplifier
4. Analyze the modelling and characteristics of MOSFET
5. Apply the concepts of MOSFET operation to design electronic switch and amplifier

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2											2	
2	3	2	1										2	
3	3	2	1										2	
4	3	2	1	2									2	
5	3	2	1	2									2	

**UNIT I****9 Hours****THEORY OF PN JUNCTION**

Factors affecting the conductivity of intrinsic and extrinsic semiconductors, Drift and Diffusion of charge of charge carriers in semiconductors, Static characteristics of ideal and practical diode, Junction Capacitance, Zener and Avalanche breakdown.

**UNIT II****9 Hours****APPLICATIONS OF PN JUNCTION DIODE**

Half Wave Rectifier, Full Wave Rectifier, Bridge Rectifier, Power Supply Design, Zener Diode based voltage regulator, Clipper, Clamper.

**UNIT III****10 Hours****BIPOLAR JUNCTION TRANSISTOR**

Characteristics and Operation of NPN and PNP Transistor - Transistor Configuration: CB, CE, CC, BJT as a Switch and Amplifier - DC and AC Operating Point - Transistor Biasing: Fixed Bias, Emitter Bias, Collector Feedback Bias, Voltage Divider Bias.

**UNIT IV****10 Hours****MOSFET MODELLING**

Operation of JFET - Construction and Operation of Enhancement and Depletion type MOSFET, Expression of Drain Current Equation of MOSFET (Linear, Saturation and Cut-off), Transconductance, Input Impedance, Channel Length Modulation and its effect in MOSFET, Small Signal Model of MOSFET, Internal Capacitance of MOSFET.

**UNIT V**

**7 Hours**

**APPLICATIONS OF MOSFET**

Biasing of MOSFET - MOSFET as an Amplifier and Switch, Common Source and Common Drain Configuration, Power MOSFET.

**FOR FURTHER READING**

Voltage Multiplier using Diode - Transistor Categories and Packaging - Emitter Feedback bias

**Total: 45 Hours**

**Reference(s)**

1. Thomas L. Floyd ,Electronic Devices: Electron Flow Version, Ninth Edition, Prentice Hall, 2012.
2. J Millman, C. Halkias & Satyabrata JIT, Electronic Devices and Circuits, Tata McGraw-Hill, 2007.
3. L Robert Boylestead, Louis Nashelsky, Electronic Devices and Circuit Theory, Pearson Education 2006.
4. David A. Bell, Electronic Devices and Circuits, Prentice Hall of India, 2003.
5. Adel S. Sedra & Kenneth C. Smith, Micro Electronic Circuits Theory and Applications, Sixth Edition, Oxford University Press, 2013.
6. Behzad Razavi, Microelectronics, Wiley India Pvt. Ltd.; 2nd edition (2018).

**18EC207 COMPUTER PROGRAMMING II****2023****Course Objectives**

- ✓ Understand the basics of C++ primitives, operators and expressions.
- ✓ Gain knowledge about the different primitive and user defined data types.
- ✓ Impart knowledge about the object oriented programming concepts.

**Course Outcomes (COs)**

1. Implement C++ programs using operators, type conversion and input-output functions.
2. Develop C++ programs using the concepts of Arrays and Functions.
3. Apply the concepts of classes and objects in writing C++ programs.
4. Design applications using inheritance in C++.
5. Apply the concepts of pointers and polymorphism in writing C++ programs.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3		1	3				2	2		2		2
2	2	3	1	2	3				2	2		3		2
3	2	3	2	2	3				2	2		2		2
4	1	3	2	2	3				2	2		2		2
5	1	3	2	2	3				2	2		2		2

**UNIT I****6 Hours****INTRODUCTION TO OOP AND C BASICS**

Procedural vs. Object Oriented Programming, Overview of C++, Program structure, Exploring the basic components of C++, Type casting in C++, Preprocessor Directives, Operators in C++, Namespace, Control Structures.

**UNIT II****6 Hours****ARRAYS AND FUNCTIONS**

Introduction to Arrays, Multidimensional Arrays, Strings, String related Library Functions, Explore functions, Inline Functions, Overloading of Functions and Operators, Recursive Functions.

**UNIT III****6 Hours****CLASSES AND OBJECTS**

Basics of Object and class in C++, Constructor and their types, Destructors, Friend classes and Functions, Passing Objects as Function parameters, Returning objects from functions.

**UNIT IV****6 Hours****INHERITANCE**

Concept of Inheritance, Access specifier, Base and derived class constructors, Types of inheritance, Overriding, Virtual functions, Destructor overriding.

**UNIT V****6 Hours****POINTERS AND POLYMORPHISM**

Pointers in C++, Pointers and Objects, Dynamic Memory Management using Operators, This Pointer, Polymorphism, Pure Virtual functions, Virtual Base class, Abstract classes.

### FOR FURTHER READING

Concept of streams, The cin and cout objects, C++ stream classes, Unformatted I/O, Formatted I/O, Manipulators, Stream error states, File stream, C++ file Stream classes, File management functions, Command line arguments, Class templates, Exception Handling.

**1**

**10 Hours**

#### EXPERIMENT 1

Implementation of operator overloading with class and objects.

1. Write a C plus plus program to find the square and cube of a number using class and object.
2. Write a C plus plus program to find the area of rectangle and circle using class and object.
3. Write a C plus plus program to find whether the given number is an Armstrong number using classes and objects.

**2**

**8 Hours**

#### EXPERIMENT 2

Implementation of types of Inheritance.

1. Write a C plus plus program to generate employee payroll using inheritance.
2. Write a C plus plus program to student details using multilevel inheritances.
3. Write a C plus plus program to employee details using multiple inheritance.

**3**

**6 Hours**

#### EXPERIMENT 3

Implementation of two different classes for adding a private data member using friend function.

1. Write a C plus plus program to multiply two matrices using static member function with friend function.
2. Write a C plus plus program to perform complex number subtraction by overloading an operator using friend function.
3. Write a C plus plus program to perform arithmetic operations using friend function

**4**

**6 Hours**

#### EXPERIMENT 4

Implementation of operator and function overloading.

1. Write a C plus plus program to perform conversion from integer to complex number by operator overloading.
2. Write a C plus plus program to perform from complex number to integer using operator overloading.
3. Write a C plus plus program to perform addition of two numbers using function overloading.

**Total: 60 Hours**

#### Reference(s)

1. E.Balagurusamy, Object Oriented Programming with C++, Tata McGraw Hill Publishing, New Delhi, 2011.
2. Robert Lafore, Object Oriented Programming in C++, Galgotia Publication, 2010.
3. B. Trivedi, Programming with ANSI C++, Oxford University Press, 2010.
4. H.M Deitel and P.J Deitel, C++ How to Program, Seventh Edition, Prentice Hall, 2010.
5. Herbert Schildt, C++: The Complete Reference, Fourth Edition, Tata McGraw-Hill, 2010.
6. K.R. Venugopal, Rajkumar and T.Ravishankar, Mastering C++, Tata McGraw Hill Publishing, New Delhi, 2010.



**18EC208 BASIC ELECTRONICS LABORATORY****0 0 2 1****Course Objectives**

- ✓ To analyze the laws and theorems in electrical circuits
- ✓ To design electronics circuits using Diodes
- ✓ To design switch and amplifier circuits using Transistors

**Course Outcomes (COs)**

1. Analyze the Current-Voltage Laws and Circuit Theorems
2. Design and analyze the practical diode circuits
3. Apply the operation of BJT for switching and Amplification applications
4. Apply the operation of MOSFET for switching and Amplification applications
5. Analyze the usage of BJT and MOSFET circuit

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2			2				2	2		1	2	
2	3	2	1		2			1	2	2		1	2	
3	3	2	1		2	1		2	2	2	1	1	2	
4	3	2	1	1	2	1	1	2	2	2	1	1	2	
5	3	2	1	1	2	1	1	1	2	2	1	1	2	

**1** **4 Hours****EXPERIMENT 1**

Verification of Current and Voltage Laws (Ohms Law, KVL, KCL)

**2** **4 Hours****EXPERIMENT 2**

Verification of Circuit Theorems (Mesh, Node, Superposition)

**3** **2 Hours****EXPERIMENT 3**

Design of Half wave and Full wave rectifiers

**4** **4 Hours****EXPERIMENT 4**

Design of power supply unit for electronic gadgets

**5** **4 Hours****EXPERIMENT 5**

Design of wave shaping circuits

**6** **4 Hours****EXPERIMENT 6**

Application of BJT as a switch and an amplifier

**7**

**4 Hours**

**EXPERIMENT 7**

Application of MOSFET as a switch and an amplifier

**8**

**4 Hours**

**EXPERIMENT 8**

Design of H Bridge motor driver using MOSFET

**Total: 30 Hours**

**Reference(s)**

1. Thomas L. Floyd ,Electronic Devices: Electron Flow Version, Ninth Edition, Prentice Hall, 2012
2. J Millman, C. Halkias & Satyabrata JIT, Electronic Devices and Circuits, Tata McGraw-Hill, 2007
3. William Hayt, J V Jack, E Kemmerly and Steven M Durbin, Engineering Circuits Analysis, Tata McGraw-Hill, 2013.

**18EC301 ENGINEERING MATHEMATICS III****3 1 0 4****Course Objectives**

- Understand the concepts of Fourier series, Transforms and Boundary Conditions, which will enable the students to model and analyze the physical phenomena
- Implement the Fourier analysis, an elegant method in the study of heat flow, fluid mechanics and electromagnetic fields.
- Develop enough confidence to identify and model mathematical patterns in real world and offer appropriate solutions, using the skills learned in their interactive and supporting environment

**Course Outcomes (COs)**

- Classify a partial differential equation and find the solution for wave equations.
- Identify the periodicity of a function and formulate the same as a combination of sine and cosine using Fourier series
- Formulate a function in frequency domain whenever the function is defined in time domain.
- Apply Z-transform to convert a discrete-time signal, which is a sequence of real or complex numbers, into a complex frequency domain representation.
- Apply basic statistical inference techniques, including confidence intervals, hypothesis testing to science/engineering problems.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2											2	
2	1	2		2									2	
3	2	2		2									2	
4	1	2		3									2	
5	2	2		3									2	

**UNIT I****11 Hours****PARTIAL DIFFERENTIAL EQUATIONS**

Introduction to partial differential equations. One-dimensional wave equation. Method of separation of variables. D Alemberts solution of the wave equation. Heat equation. Laplaces equation. Telegraph equations. Laplace transform method of solution.

**UNIT II****10 Hours****FOURIER ANALYSIS**

Fourier series for periodic functions. Orthogonal functions. The Euler coefficients. Fourier transforms. Properties of Fourier transform. Applications of Fourier series and transform analysis.

**UNIT III****9 Hours****LAPLACE TRANSFORMS**

Properties and theorems of Laplace transform. Shifting theorems. Convolution. Applications to ordinary differential equations. Applications to linear system analysis

**UNIT IV**

**8 Hours**

**Z TRANSFORM**

Z-Transform, Elementary Properties, Inverse Z-Transform, Convolution Method- Partial fraction method, Solution of Difference Equations using Z-Transform.

**UNIT V**

**7 Hours**

**MATHEMATICAL STATISTICS**

Sample mean and variance. Sampling distributions. Statistical estimation of parameters, confidence intervals. Testing of hypotheses, one-sample and two-sample inferences. Applications to statistical quality control and reliability analysis.

**Total: 60 Hours**

**Reference(s)**

1. Kreyszig Erwin, Advanced Engineering Mathematics, 7th Edition, John Wiley, 1993.
2. Johnson Richard A. and Bhattacharyya Gouri K., Statistics, Principles and Methods, 3rd Edition, John Wiley, 1996.
3. O Neil Peter V., Advanced Engineering Mathematics, 4th Edition, PWS-Kent, 1995.
4. James Glyn, Advanced Modern Engineering Mathematics, Addison-Wesley, 1993.

**18EC302 BASICS OF ELECTRICAL ENGINEERING****2023****Course Objectives**

- ✓ Understand the basic concepts of power generation and transmission.
- ✓ Illustrate the construction and operation of DC machines.
- ✓ Illustrate the construction and operation of AC machines
- ✓ Illustrate the construction and operation of special machines
- ✓ Understand the various components used in electrical installations.

**Course Outcomes (COs)**

1. Apply the basic concepts of electrical engineering involved in power generation and transmission.
2. Select the suitable DC motor based on its characteristics
3. Select the suitable AC machines based on its applications
4. Analyze the operation of various special electrical machines used in industrial applications
5. Analyze the functions of various protective devices used in electrical installations

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2		2									2	
2	3	2		2									2	
3	3	2		2									2	
4	3	2		2									2	
5	3	1		2									2	

**UNIT I****7 Hours****POWER GENERATION AND TRANSMISSION**

Main parts and working of a Thermal power station, Hydro power station, Single line diagram of power transmission and distribution system- Skin and proximity effects- Hollow conductors- Bundled conductor.

**UNIT II****6 Hours****DC MACHINES**

Basic concepts of magnetic circuits, Faradays law, Lenz law, Construction and operation of DC shunt and series motor, characteristics and applications.

**UNIT III****7 Hours****AC MACHINES**

Construction and principle of operation: Transformer, Alternator, Three phase induction motor, Single phase induction motors, Star-Delta starter for three-phase induction motor.

**UNIT IV****5 Hours****SPECIAL MACHINES**

Construction and principle of operation: Stepper motor, Servomotor, Permanent magnet DC motor, Brushless DC motor.

## UNIT V

5 Hours

### ELECTRICAL INSTALLATIONS

Types of Protection devices: Fuses, MCB, Relays, Components of House Wiring, Simple house wiring and stair case wiring, UPS, Earthing and grounding.

### FOR FURTHER READING

High voltage DC transmission, Braking of DC motor, Induction generator, Universal motor, Earth leakage circuit breaker.

1

6 Hours

### EXPERIMENT 1

Analysis of generating capacity of different types of power plants.

2

6 Hours

### EXPERIMENT 2

Prototype Development of DC motor and measuring of voltage and speed.

3

6 Hours

### EXPERIMENT 3

Dismantling and assembling of ceiling fan and Grinder.

4

6 Hours

### EXPERIMENT 4

Controlling the speed of Stepper Motor and Servo Motor

5

6 Hours

### EXPERIMENT 5

Developing model of simple house wiring and Stair Case Wiring

**Total: 60 Hours**

### Reference(s)

1. C.L .Wadhwa, Electrical Power Systems, New Age International Edition, New Delhi 2010.
2. T. K. Nagsarkar and M. S. Sukhija, Basic of Electrical Engineering, Oxford University Press, 2011.
3. Smarjith Ghosh, Fundamentals of Electrical and Electronics Engineering, Prentice Hall (India) Pvt. Ltd., 2012
4. B. L. Theraja, A. K. Theraja, A Text Book of Electrical Technology Volume II, S.Chand &Company Ltd, New Delhi, 2016.
5. V. D. Toro, Electrical Engineering Fundamentals, Prentice Hall India, 2014

**18EC303 DIGITAL LOGIC CIRCUIT DESIGN****3 1 0 4****Course Objectives**

- ✓ To acquire the basic knowledge of digital logic levels and applications to understand digital electronic circuits
- ✓ To design the various digital logics using combinational circuits.
- ✓ To perform the design and analysis of various sequential circuits.

**Course Outcomes (COs)**

1. Understand the various number systems and codes for error detection and correction.
2. Design logic circuits with minimum gates using Boolean laws and techniques
3. Design and analyze the combinational logic circuits with its applications.
4. Design and analyze sequential logic circuits with its applications.
5. Design synchronous, asynchronous counters and hazard free digital circuits.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	2										2	
2	2	3	3	2									3	
3	2	3	3	2									3	2
4	2	2	3	2									3	2
5	2	2	3	2									3	2

**UNIT I****8 Hours****NUMBER SYSTEMS AND CODE**

Introduction to Digital Systems, Number Systems- Binary, Octal, Decimal and Hexadecimal, Methods of base conversions, Representation of signed numbers; Fixed and floating point numbers, Binary Arithmetic - Addition, Subtraction, Complementary numbering systems: 1s and 2s Complements, Codes- Binary coded decimal codes; Gray codes; Error detection and correction codes - parity check codes and Hamming code

**UNIT II****9 Hours****BOOLEAN THEOREMS AND LOGIC REDUCTION**

Basic Theorems and Properties Of Boolean Algebra, Boolean Functions, Canonical and Standard Forms- Sum of Products Form, Product of Sum Form, Gate level minimization - Karnaugh-Map Method, Logic expression simplification with grouping cells: Quine McClusky Method (Upto 4 variable); Prime implicants, Prime implicant chart, NAND And NOR Implementation.

**UNIT III****9 Hours****COMBINATIONAL LOGIC CIRCUIT AND DESIGN**

Binary adders- Half adder, Full adder, Binary Subtractor-Half subtractor, Full subtractor, Parallel Binary Adders, BCD Adders, Encoder, Decoder, Comparator, Code convertor, Multiplexers, Demultiplexers, Parity Generator and Checker

**UNIT IV**

**10 Hours**

**SEQUENTIAL LOGIC CIRCUITS**

Gated Latches & Flip Flops- Level triggered and Edge triggered Flip-Flops, Flip Flop Conversion. Shift registers, General model of sequential circuits- Mealy/Moore models -Excitation table- State table- State diagram

**UNIT V**

**9 Hours**

**DESIGN OF SEQUENTIAL LOGIC**

Design of Asynchronous & Synchronous sequential circuits - Binary Counter, Ring counters, Johnson counters, Up/Down counter, Asynchronous counter- Hazards logic circuits- Hazard free realization. Logic Families-RTL, DTL, ECL, TTL, CMOS

**Total: 60 Hours**

**Reference(s)**

1. M.Morris Mano, Michael D Ciletti Digital Design 4th edition Pearson, 2011
2. Thomas L.Floyd, Digital Fundamentals, Prentice Hall, 11th Edition, 2015
3. A.Anand Kumar, Fundamentals of Digital Circuits, 4th Edition PHI Learning Private Limited, 2016



**18EC304 ANALOG ELECTRONICS II****3 1 0 4****Course Objectives**

- ✓ To learn the fundamental concepts behind transistor biasing and to differentiate small signal and large signal circuit models
- ✓ To study the performance metrics of Multistage and Power amplifiers
- ✓ To understand the working of signal generating and wave shaping circuits

**Course Outcomes (COs)**

1. Analyze different biasing methods for Bipolar Junction Transistors and Field Effect Transistors
2. Compare and model different Transistor configurations for Bipolar Junction Transistors and Field Effect Transistors
3. Analyze the behaviour of Bipolar Junction Transistors and Field Effect Transistors at different frequency conditions
4. Design multistage and feedback amplifier circuits using Bipolar Junction Transistors and Field Effect Transistors
5. Design Oscillator and Multivibrator circuits using Bipolar Junction Transistors

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	2										3	
2	3	2	2										3	
3	3	2	2										3	
4	3	2	2	1									3	2
5	3	2	2	1									3	2

**UNIT I****7 Hours****TRANSISTOR BIASING**

BJT: Bias Stability, Bias Compensation- Thermistor and Sensistor and Diode compensation- Thermal Runaway, Mobility and Lifetime of electrons and holes in BJT, FET: Biasing by Fixing V<sub>GS</sub>, Biasing by connecting Resistance, Biasing by Drain to Gate Feedback Resistor, and Biasing using Constant Current Source.

**UNIT II****8 Hours****SMALL SIGNAL LOW FREQUENCY MODEL AND CURRENT MIRROR STAGE**

BJT: Analysis of transistor amplifier CE, CC & CB Configuration using h parameters, Simplified Hybrid Model for CB, CE & CC configurations, Comparison of transistor amplifier configurations, Darlington Pair. FET: Voltage Gain, Small Signal Equivalent Circuit model.

**UNIT III****10 Hours****SMALL SIGNAL HIGH FREQUENCY MODELS AND DIFFERENTIAL PAIR**

BJT: Behaviour of Transistor at High Frequency, The High Frequency T Model, The Hybrid  $\pi$  Common Emitter Transistor Model, - CB & CE Short Circuit Current Frequency response, Frequency Response of the CE Amplifier.

#### UNIT IV

11 Hours

##### MULTI STAGE AND FEEDBACK AMPLIFIERS

BJT: CE-CC Amplifier, Cascade Amplifier, RC coupled amplifier, Millers Theorem, High input resistance transistor circuits, Difference Amplifier- Step response and Frequency Response of Multistage Amplifiers.

Feedback amplifiers - Current Series, Voltage Shunt, Current shunt and Voltage Series. Power Amplifiers: Class A, Class B, Class C, Class AB and Class D Power Amplifiers, Distortion in Amplifier.

#### UNIT V

9 Hours

##### SIGNAL GENERATORS AND WAVE SHAPING CIRCUITS

Basic Principles of Sinusoidal Oscillators, Classification of Oscillator- Barkhausen Criterion- RC Phase Shift ,Wien Bridge , General Form of LC- Hartley, Colpitts, Clapp Tuned Collector and Crystal Oscillators. Monostable , Astable and Bistable Multivibrators.

##### FOR FURTHER READING

Collector Emitter Feedback Bias, Bootstrap Darlington Circuit, Effect of Emitter or a Source Bypass Capacitor on Low frequency response, Comparison of Power Amplifiers, BJT Digital Logic Inverter, CMOS Digital Logic Inverter, BiCMOS Cascade Amplifier, Current Mirror Circuits, CMOS Logic Gate Circuits, Power BJTs, Power MOSFETs.

**Total: 60 Hours**

##### Reference(s)

1. Adel. S. Sedra , Kenneth C. Smith, Microelectronic Circuits Theory an Applications ,7th Edition, Oxford University, 2017.
2. Jacob Millman, C. Halkias and Satyabrata Jit Electronic Devices and Circuits, 4<sup>th</sup> Edition, Tata McGraw-Hill, 2015
3. Electronic Circuits Analysis and design, Donald A Neaman, 7th Edition
4. Muhammad H. Rashid , Microelectronic Circuits: Analysis and Design, 3rd Edition, Cengage Learning
5. David A. Bell, Electronic Devices and Circuits, Prentice Hall of India, 5th edition

**18EC305 LINEAR INTEGRATED CIRCUITS****3 0 0 3****Course Objectives**

- ✓ Understand the classification of IC and basic building blocks of operational amplifiers.
- ✓ Design and analyse the linear and non-linear applications of operational amplifiers.
- ✓ Illustrate the operating principle of PLL, Data Converters and various special function ICs.

**Course Outcomes (COs)**

1. Understand the working of operational amplifiers and its characteristics.
2. Design and analyze the closed loop applications of operational amplifiers.
3. Design comparator and waveform generator circuits using operational amplifier.
4. Analyze the principle and operation of PLL and Data converters.
5. Analyze special function ICs and its application in modern electronic equipment.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	1										2	
2	3	3	3										2	2
3	2	3	2										2	2
4	2	2	2	1									3	2
5	2	2	2	2		2	2					2	3	2

**UNIT I****8 Hours****OPERATIONAL AMPLIFIER**

Introduction to Integrated Circuits- Classification of ICs - Operational Amplifier: Basic Information of Op-Amp, Ideal Op Amp- Operational Amplifier Internal Circuit- Differential Amplifier - Characteristics of Op-Amp - DC Characteristics, AC Characteristics - Frequency Response- Frequency Compensation - Slew Rate.

**UNIT II****10 Hours****OP- AMP APPLICATIONS**

Closed Loop Op Amp Configuration - Inverting and Non inverting Amplifiers- Inverter- Voltage Follower-Summing Amplifier, Averaging Circuits - Subtractor-Differential Amplifier- Multiplier-Differentiator- Integrator- Instrumentation amplifier, Precision rectifier-log and antilog amplifiers- 1st Order LPF, HPF and all pass filters.

**UNIT III****8 Hours****COMPARATORS AND WAVEFORM GENERATORS**

Comparators: Open Loop Op Amp Configuration - Inverting, Non-Inverting Comparator- Applications of Comparator- Regenerative Comparator (Schmitt trigger) - Waveform Generators: Multivibrators - Astable, Monostable - Triangular wave generator- Principles of Sine wave Oscillator- RC Phase Shift, Wien Bridge Oscillator.

**UNIT IV****11 Hours****PHASE LOCKED LOOP AND DATA CONVERTER**

Block Diagram of PLL- Principles-Types- Phase Detector- Voltage Controlled Oscillator-IC 566 and IC 565 Internal Block Diagram- PLL Applications - Data Converter and Applications- Sample and Hold

circuits D/A Techniques: Binary Weighted Resistor- R-2R and Inverted R-2R Ladder DAC- A/D converter: Flash - Successive Approximation Converter -Dual Slope ADC.

**UNIT V**

**8 Hours**

**SPECIALIZED ICS**

IC 555 Timer Internal Architecture- Astable and Monostable Multivibrators using 555 Timer - Applications-Voltage regulator, Fixed and Adjustable Voltage Regulators, Dual Power supply - Switch Mode Power Supply - Single power supply for opAmp.

**Total: 45 Hours**

**Reference(s)**

1. Sergio Franco, Design with operational amplifiers and analog integrated circuits, McGraw-Hill, 2002.
2. Ramakant A.Gayakwad, OP-AMP and Linear IC's , Prentice Hall of India, 2002.
3. D.RoyChoudhry, Shail Jain, Linear Integrated Circuits, New Age International Pvt. Ltd., 2000.
4. William D.Stanely, Operational Amplifiers with Linear Integrated Circuits. Pearson Education, 2004.
5. David L.Terrell,Op Amps-Design, Application, and Troubleshooting, Elsevier publications 2005.
6. Taub and Schilling, Digital Integrated Electronics, McGraw-Hill, 1997.

**18EC306 DATA STRUCTURES AND ALGORITHMS****2023****Course Objectives**

- ✓ Understand the basics of datastructures
- ✓ Gain knowledge about the implementation of datastructures.
- ✓ Impart knowledge about techniques for analyzing the efficiency of algorithms

**Course Outcomes (COs)**

1. Identify the model of Abstract Data Type, calculation of algorithm efficiency and designing of recursive algorithms.
2. Design algorithms to solve real life problems using data structures.
3. Analyze various sorting and searching algorithms.
4. Apply Non-Linear Data structures such as Binary Search tree, AVL search tree and Heap tree in different applications.
5. Evaluate real life problems using minimum spanning tree and shortest path algorithms.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1	1	3	3			2	2	2		2	1	2
2	2	2	2	2	2			2	2	2		2	1	2
3	1	2	2	3	3			2	3	2	3	2	1	2
4	1	2	2	3	2			2	3	2	3	2	2	2
5	1	3	1	3	3			2	3	2	3	2	2	2

**UNIT I****6 Hours****INTRODUCTION**

Pseudo code-Abstract Data types-Model for an ADT-ADT Implementations-Algorithm Efficiency-Designing Recursive Algorithms-Recursive Examples.

**UNIT II****6 Hours****LINEAR DATASTRUCTURES**

Stack-Queue-List-Application of Stack, Queue, List.

**UNIT III****6 Hours****SORTING AND SEARCHING**

Insertion, Selection, Bubble, Quick, Heap sorting algorithms, Sequential search, Binary Search, Hashing, Hash function, Separate Chaining, Open Addressing, Linear Probing.

**UNIT IV****6 Hours****NON LINEAR DATASTRUCTURES**

Trees, Binary Trees, Binary Tree Traversal, Expression Tree, AVL Tree, Priority Queue.

**UNIT V** **6 Hours**

**GRAPHS**

Graph Representation, Adjacency matrix, Adjacency List, Depth First Traversal, Breadth First Traversal, Kruskal, Prims, Dijkstra Algorithm.

**1** **2 Hours**

**EXPERIMENT 1**

Program to perform various operations such as creation, insertion, deletion, search of node and display on singly linked list.

**2** **2 Hours**

**EXPERIMENT 2**

Linked List Implementation of stack and queue.

**3** **2 Hours**

**EXPERIMENT 3**

Array Implementation of stack and queue with pre and post conditions.

**4** **2 Hours**

**EXPERIMENT 4**

Program to sort the elements in ascending order using selection sort and bubble sort.

**5** **2 Hours**

**EXPERIMENT 5**

Program to sort the elements in ascending order using quick, heap sort.

**6** **2 Hours**

**EXPERIMENT 6**

Develop a program to perform linear and binary search.

**7** **2 Hours**

**EXPERIMENT 7**

Implementation of binary tree traversals.

**8** **2 Hours**

**EXPERIMENT 8**

Write a program to perform infix into postfix expression, prefix to postfix expression.

**9** **2 Hours**

**EXPERIMENT 9**

Implementation of breadth first search and depth first search techniques.

**10** **2 Hours**

**EXPERIMENT 10**

Design a postfix calculator (So 1 3 2 4 \* - should calculate 1 - (3 \* (2 4)).) using stack.

**11** **2 Hours**

**EXPERIMENT 11**

Design a Palindrome Checker using Dequeue.

**12** **2 Hours**

**EXPERIMENT 12**

Implementation Text Editor using two stacks.

**13** **2 Hours**

**EXPERIMENT 13**

Implementation of Expression Tree.

**14** **2 Hours**

**EXPERIMENT 14**

Implementation of Media Player Playlist using List.

**15** **2 Hours**

**EXPERIMENT 15**

Implementation of Binary Tree Traversal.

**Total: 60 Hours**

**Reference(s)**

1. F.RichardGilberg, A.Behrouz. Forouzan, Data Structures, A Pseudocode Approach with C, Thomson,2007.
2. M. A. Weiss, Data Structures and Algorithm Analysis in C, Pearson Education, 2009.
3. Y.Langsam, M. J.Augenstein and A. M.Tenenbaum, Data Structures using C, Pearson Education,2004.
4. A. M.AhoHopcroft and J.D. Ullman, Data Structures and Algorithms, Pearson education,2000.

**18EC307 ANALOG ELECTRONICS AND IC  
LABORATORY**

**0 0 2 1**

**Course Objectives**

- ✓ To gain knowledge on large signal power amplifiers, feedback amplifiers and oscillators
- ✓ To study the characteristics of operational amplifier and special function ICs.
- ✓ To gain knowledge on different types of Multivibrators

**Course Outcomes (COs)**

1. Design and analyze the performance of differential and power amplifiers using BJT
2. Design an oscillator for the given specifications using BJT and OP AMP.
3. Design and analyze open loop and closed loop circuits using OP AMP
4. Design and analyze signal generator circuits using OP AMP
5. Design and Analyze data converter using OP AMP

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2	2	2			2	2	2	2	3	3	2
2	2	3	2	2	2			2	2	2	2	2	3	2
3	2	3	2		2			2	2	2	2	1	2	3
4	2	2	2		2			2	2	2	2	1	2	2
5	2	2	2		2			2	2	2	2	1	3	2

**1** **2 Hours**

**EXPERIMENT 1**

Effect of hfe of transistors in Voltage divider bias.

**2** **2 Hours**

**EXPERIMENT 2**

Design of Darlington pair

**3** **2 Hours**

**EXPERIMENT 3**

Differential Amplifiers

**4** **2 Hours**

**EXPERIMENT 4**

Frequency Response of Class-B Complementary symmetry Power Amplifier

**5** **3 Hours**

**EXPERIMENT 5**

Feedback amplifier circuits-current series and voltage shunt

**6** **2 Hours**

**EXPERIMENT 6**

Transistor based design of Hartley/Colpitts Oscillator circuit



<b>7</b> <b>EXPERIMENT 7</b> Design of Inverting and Non-inverting Amplifiers, Voltage Follower, Differentiator and Integrator.	<b>4 Hours</b>
<b>8</b> <b>EXPERIMENT 8</b> Zero crossing detector and Schmitt trigger using IC741.	<b>2 Hours</b>
<b>9</b> <b>EXPERIMENT 9</b> Design of butterworth active LPF and HPF.	<b>3 Hours</b>
<b>10</b> <b>EXPERIMENT 10</b> Astable and Monostable Multivibrator using IC 555.	<b>2 Hours</b>
<b>11</b> <b>EXPERIMENT 11</b> RC-phase shift oscillator and Wien bridge oscillator using IC741.	<b>3 Hours</b>
<b>12</b> <b>EXPERIMENT 12</b> Analog to Digital converter and Digital to Analog Converter.	<b>3 Hours</b>

**Total: 30 Hours**

**Reference(s)**

1. Adel. S. Sedra , Kenneth C. Smith, Microelectronic Circuits Theory and Applications ,7th Edition, Oxford University, 2017.
2. Jacob Millman, C. Halkias and Satyabrata Jit Electronic Devices and Circuits, 4TH Edition, Tata McGraw-Hill, 2015
3. Electronic Circuits Analysis and design, Donald A Neaman, 7th Edition
4. RamakantA.Gayakwad, OP-AMP and Linear IC's , Prentice Hall of India, 2002.
5. D.RoyChoudhry, Shail Jain, Linear Integrated Circuits, New Age International Pvt. Ltd., 2000.
6. Sergio Franco, Design with operational amplifiers and analog integrated circuits, McGraw-Hill, 2002.

**18EC308 DIGITAL ELECTRONICS LABORATORY****0 0 2 1****Course Objectives**

- ✓ To learn and understand the basics of digital circuits using logic gates.
- ✓ To design a various types of combinational digital logic circuits.
- ✓ To design a various types of sequential digital logic circuits.

**Course Outcomes (COs)**

1. Implement boolean expressions using universal gates.
2. Design combinational circuits using logic gates.
3. Apply conversion of flip-flops using logic gates.
4. Design different types of shift registers for data transfer using flip-flops
5. Design up/down counters to count the sequence of input pulses using flip flops

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	2	1				2	2	2	2		2	2
2	2	3	3	2				2	2	2	2	2	3	2
3	2	2	2	2				2	2	2	2	1	2	2
4	2	2	3	2		2	2	2	2	2	2	2	3	2
5	2	3	3	2		2	2	2	2	2	2	2	3	2

**1** **3 Hours****EXPERIMENT 1**

Design and implementation of Boolean logic functions using universal gates.

**2** **3 Hours****EXPERIMENT 2**

Implementation of binary adder and subtractor using logic gates.

**3** **2 Hours****EXPERIMENT 3**

Design and implementation of encoder and decoder using logic gates.

**4** **2 Hours****EXPERIMENT 4**

Design and implementation of multiplexer and demultiplexer logic gates.

**5** **3 Hours****EXPERIMENT 5**

Design and implementation of standard boolean function using data selector and data decoder.

**6** **2 Hours****EXPERIMENT 6**

Design and implementation of 2 bit magnitude comparator using logic gates.

**7** **3 Hours**

**EXPERIMENT 7**

Design and implementation of odd/even parity generator and checker using logic gates.

**8** **3 Hours**

**EXPERIMENT 8**

Design and implementation of code converters using logic gates.

(i) BCD to excess-3 code and vice versa

(ii) Binary to gray and vice-versa

**9** **3 Hours**

**EXPERIMENT 9**

Conversion of flip-flops.

**10** **3 Hours**

**EXPERIMENT 10**

Design and implementation of Shift register (SISO, SIPO,PIPO) using Flip flops.

**11** **3 Hours**

**EXPERIMENT 11**

Design and implementation of Up, Down and Up/down counter using flip flops.

**Total: 30 Hours**

**Reference(s)**

1. M.Morris Mano, Michael D Ciletti Digital Design 4th edition Pearson, 2011
2. Thomas L.Floyd, Digital Fundamentals, Prentice Hall, 11th Edition, 2015
3. A.Anand Kumar, Fundamentals of Digital Circuits, 4th Edition PHI Learning Private Limited, 2016
4. Ronald J Tocci, Neal S Widmer, Gregory L Moss Digital Systems: Principles and Applications, 10th edition, Person , 2009.
5. Tokheim Digital Electronics: Principles and Applications, 7th edition Tata McGraw-Hill, 2010.

**18GE301 SOFT SKILLS - VERBAL ABILITY****0 0 2 0****Course Objectives**

- ✓ To help students gain adequate proficiency in vocabulary
- ✓ To read and understand unabridged text
- ✓ To help students become proficient in basic writing skills related to work place communication

**Course Outcomes (COs)**

1. Take up verbal ability part of the placement tests with confidence
2. Write with confidence in professional and workplace communication
3. Distinguish fact from opinion by reading passages from a text

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										1				
2										2	2			
3									2	2				

**UNIT I****15 Hours****INTRODUCTION**

Synonyms - Antonyms - Word Groups - Verbal Analogies - Etymology - Critical Reasoning - Cloze Test - One Word Substitution - Idioms and Phrases - Text & Paragraph Completion.

**UNIT II****15 Hours****BASICS OF VERBAL APTITUDE**

Sentence Formation - Paragraph Formation - Change of Voice - Change of Speech - Reading Comprehension - Sentence Equivalence - Jumbled Sentences - Spotting Errors -Homophones Homonyms - Commonly Mispronounced/Misspelt Words.

**Total: 30 Hours****Reference(s)**

1. Murphy, Raymond. English Grammar in Use A Self-Study Reference and Practice Book for Intermediate Learners of English. IV Edition. United Kingdom: Cambridge University Press. 2012.
2. Lewis, Norman. Word Power Made Easy. New York: Pocket Books. 1991.
3. Baron's The Official Guide for New GMAT Review, New Jersey: John Wiley & Sons, Inc. 2015.

**18EC401 PROBABILITY AND RANDOM PROCESS****3 1 0 4****Course Objectives**

- ✓ Understand the basic concepts of probability and the distributions with characteristics and also two dimensional random variables.
- ✓ Summarize and apply the methodologies of probability for the data analysis using statistical notions.
- ✓ It provides insight into the classifications of random processes

**Course Outcomes (COs)**

1. Demonstrate and apply the basic probability axioms and concepts in their core areas. of random phenomena.
2. Apply the concepts of probability distributions in an appropriate place of science and Engineering.
3. Calculate the relationship of two dimensional random variables using correlation techniques and to study the properties of two dimensional random variables.
4. Apply Random Process techniques the problem of random input signals.
5. Analyze the response of random inputs to linear time invariant systems.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1		2									2	
2	2	1		1									2	
3	2	2		2									2	
4	2	2		2									2	
5	2	2		2									2	

**UNIT I****9 Hours****PROBABILITY AND RANDOM VARIABLES**

Axioms of probability, Conditional probability, Total probability, Bayes theorem, Random variables, Probability mass function, Probability density functions, Properties, Moments, Moment generating functions and their properties.

**UNIT II****9 Hours****STANDARD DISTRIBUTIONS**

Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions and their properties. Functions of a random variable.

**UNIT III****9 Hours****TWO DIMENSIONAL RANDOM VARIABLES**

Joint distributions - Marginal and conditional distributions - Covariance - Correlation and regression - Transformation of random variables - Central limit theorem (without proof).

**UNIT IV****9 Hours****CLASSIFICATION OF RANDOM PROCESSES**

Definition and examples - first order, second order, strictly stationary, wide sense stationary and Ergodic processes - Markov process - Poisson and Normal processes - Sine wave process.

## UNIT V

9 Hours

### CORRELATION AND SPECTRAL DENSITIES

Auto correlation - Cross correlation - Properties - Power spectral density - Cross spectral density - Properties - Wiener-Khintchine relation - Relationship between cross power spectrum and cross correlation function - Linear time invariant system - System transfer function - Linear systems with random inputs - Auto correlation and cross correlation functions of input and output.

**Total: 60 Hours**

#### Reference(s)

1. T. Veerarajan. , Probability, Statistics and Random process , Tata McGraw Hill Publications, New Delhi, 2003
2. JR . Peyton. Z. Peebles, Probability, Random Variables and Random Signal Principles, Tata McGraw Hill Publications, New Delhi, 2002.
3. Johnson Richard A. and Bhattacharyya Gouri K., Statistics, Principles and Methods, 3rd Edition, John Wiley, 1996.
4. Henry Stark and John W. Woods , Probability and Random Processes with Applications to Signal Processing , Pearson Education, Delhi, 2002..
5. Athanasios Papoulis, S. UnniKrishna Pillai, Probability , Random Variables and Stochastic Processes, Tata McGraw Hill Publications, New Delhi, 2002.

**18EC402 SIGNALS AND SYSTEMS****3 1 0 4****Course Objectives**

- ✓ Understand the Mathematical Representation of Signals and Systems
- ✓ Understand the concept of Linear Time Invariant System and its property
- ✓ Represent a given Continuous Time signal in frequency domain using Fourier Series and Fourier Transform
- ✓ Represent a given Discrete Time signal in frequency domain using Fourier Series and Fourier Transform
- ✓ Understand Spectrum Analysis of Continuous Time signals and Discrete Time signals

**Course Outcomes (COs)**

1. Classify the given signal based on its nature and analyze the properties of the system.
2. Analyze the properties and the response of Linear Time Invariant System.
3. Analyze the frequency domain behaviour of a given Continuous Time signal using Fourier and Laplace Transform.
4. Analyze the frequency domain behavior of a given Discrete Time signal using Discrete Time Fourier Transform and Z Transform.
5. Analyze the Spectrum of Continuous and Discrete Time Signals.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2		1									2	1
2	3	2		1									2	1
3	3	3		2									2	2
4	3	3		2									2	2
5	3	3		2									2	2

**UNIT I****10 Hours****INTRODUCTION TO SIGNALS AND SYSTEMS**

Introduction to Signals and Systems, Classification of Signals based on Independent Variable, Elementary Signals, Amplitude and Time Operation on Signals, Types of Systems, Properties of Systems

**UNIT II****8 Hours****ANALYSIS OF LINEAR TIME INVARIANT SYSTEMS**

Concept of Impulse Response, Convolution Integral and Convolution Sum, Causality and Stability of LTI Systems, Interconnection of LTI Systems, Correlation of Signals, Orthogonality of Signals

**UNIT III****9 Hours****FREQUENCY DOMAIN REPRESENTATION OF CT SIGNALS**

Fourier Series, Properties of CTFS, Fourier Transform, Properties of CTFT, Gibbs Phenomena, Dirichlet Conditions, Laplace Transforms, Properties of Laplace Transforms

**UNIT IV**

**9 Hours**

**FREQUENCY DOMAIN REPRESENTATION OF DT SIGNALS**

Discrete Time Fourier Series, Properties of DTFS, Discrete Time Fourier Transform, Properties of DTFT, Z Transform, Properties of Z Transforms

**UNIT V**

**9 Hours**

**SPECTRUM ANALYSIS OF LTI SYSTEMS**

Spectrum Analysis of Continuous-Time Systems, Spectrum Analysis of Discrete-Time Systems, Sampling Theorem with Proof

**Total: 60 Hours**

**Reference(s)**

1. Signals and Systems, Alan V. Oppenheim, Alan S. Willsky, Syed Hamid Nawab, 2nd Edition, Pearson, 2013
2. Signals and Systems, Simon Haykin, Barry Van Veen, 2nd Edition, John Wiley & Sons, 2007
3. Principles of Linear Systems and Signals, B. P. Lathi, 2nd Edition, Oxford University Press, 2009
4. Signals, Systems, Transforms, and Digital Signal Processing with MATLAB, Michael Corithios, CRC Press. 2018
5. Signals and Systems, Tarun Kumar Rawat, Oxford University Press, 2010



**18EC403 ANALOG COMMUNICATION****3 0 0 3****Course Objectives**

- ✓ To provide knowledge on different analog modulation and demodulation systems.
- ✓ To study noise performance of various techniques of AM and FM receivers.
- ✓ To understand the concept of Pulse analog modulation.

**Course Outcomes (COs)**

1. Analyze the performance of generation and detection of various AM techniques in terms of time domain and frequency domain and apply this concept in AM transmitter and receiver.
2. Analyze the performance of various FM generation and detection methods and compare it with AM techniques.
3. Analyze the types of random process and noises in communication receivers.
4. Compare the noise performance of AM and FM receivers with respect to Figure of merit.
5. Analyze the sampling process of band-limited signals and determine the characteristics of Analog Pulse Modulation schemes.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	2	2		2	1						3	2
2	3	3	2	2		2	1						3	2
3	2	2											3	1
4	2	3		2									3	1
5	2	2				1	1						3	1

**UNIT I****12 Hours****AMPLITUDE MODULATION**

Introduction to communication system, Need for modulation, Introduction to Amplitude Modulation, Generation of AM wave, Double sideband suppressed carrier modulation (DSBSC), Generation of DSB-SC waves, Detection of DSB-SC Modulated waves, Generation of Single Side Band (SSB), Demodulation of SSB Waves, Generation of Vestigial Sideband (VSB) Modulated wave, Comparison of AM Techniques, Applications of different AM Systems, AM transmitter and receiver.

**UNIT II****8 Hours****ANGLE MODULATION**

Theory of Frequency Modulation: Single tone frequency modulation, Spectrum Analysis of Sinusoidal FM Wave, Narrow band FM, wide band FM, Transmission bandwidth of FM waves, Generation of FM waves: Direct FM Methods, Indirect FM, Methods; The Armstrong Method, FM Stereo Transmission and Demodulation of FM waves: FM stereo multiplexing, Phase-locked loop. Comparison of FM and AM Phase, Modulation - Comparison of AM FM and PM.

**UNIT III****10 Hours****RANDOM VARIABLE AND RANDOM PROCESS FOR COMMUNICATION SYSTEMS**

Review of random process, Response of LTI systems to random process, Gaussian random process: Filtered Gaussian random process, White Gaussian Noise, Noise: Sources of noise, thermal noise, shot noise and flicker noise. Filtered White noise, Narrow Band Noise, Noise Figure, Noise Bandwidth, Noise Temperature.

**UNIT IV**

**7 Hours**

**NOISE IN COMMUNICATION SYSTEMS**

Noise in AM receivers, Noise in DSB-SC receiver, Noise in SSB receiver, Noise in FM receivers, Pre-emphasis and de-emphasis in FM, Comparison of noise performance of AM and FM systems

**UNIT V**

**8 Hours**

**PULSE MODULATION**

Sampling process: sampling theorem for band limited signals, ideal and practical sampling, Anti aliasing and reconstruction filters, Generation and detection of Pulse Amplitude Modulation (PAM), Generation and detection of Pulse Width Modulation (PWM), Generation and detection of Pulse Position Modulation (PPM), Generation and detection of Pulse Time Modulation (PTM), Time division Multiplexing, Crosstalk effect.

**FUTURE READING**

communication system design

**Total: 45 Hours**

**Reference(s)**

1. Communication Systems by Simon Haykins John Wiley & Sons , 4th Edition, 2016.
2. Analog and Digital Communication - K. Sam Shanmugam, Wiley, 2005.
3. Communication Systems- B.P. Lathi, BS Publication, 2004.
4. Principles of Communication Systems - H Taub & D. Schilling, Gautam Sahe, TMH, 2007, 3rd Edition
5. Electronic Communications- Dennis Roddy and John Coolean , 4th Edition , PEA, 2004
6. Electronics Communication systems, Wayne Tomasi, 4th edition, Pearson Publishers.

**18EC404 PRINCIPLES OF VLSI DESIGN****3 0 0 3****Course Objectives**

- To acquire the basic knowledge about CMOS fabrication process
- To understand the operating principle of CMOS circuit design and styles to represent VLSI circuits
- To understand the design of VLSI components and the ways to test the logic circuits.

**Course Outcomes (COs)**

1. Classify various fabrication technologies and understand the CMOS circuit representation
2. Infer the MOS circuits concepts and analyze the factors influencing the operation of CMOS transistor.
3. Construct CMOS logic circuits using different logic styles.
4. Design and Analyze digital adders and multiplier modules for VLSI system design
5. Analyze the different clocking styles and the methods to test VLSI circuits

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	1										2	
2	2	3		3									2	
3	1	3	3	3									3	2
4	2	3	3	3									3	2
5	1	2	2	3									3	2

**UNIT I****9 Hours****FABRICATION OF CMOS IC AND PHYSICAL DESIGN**

Silicon Semiconductor technology: Wafer processing, Oxidation, Epitaxy, Diffusion and Silicon gate process - NMOS fabrication - CMOS fabrication: n-well, p-well, Twin tub and SOI Process - Layout design rules - Stick Diagrams - CMOS Logic Gates - Implementation of given logic function using CMOS logic.

**UNIT II****9 Hours****MOS CIRCUIT DESIGN PROCESS**

Basic MOS transistors: Symbols, Enhancement mode - Depletion mode transistor operation - Threshold voltage - Body effect - Regions of operation - NMOS inverter- Determination of pull up to pull down ratio - CMOS inverter: DC Characteristics, Switching Characteristics, Power dissipation.

**UNIT III****9 Hours****CMOS LOGIC STYLES**

Static CMOS design - Pass Transistor - Transmission Gate - Tri-State Circuits- Pseudo Nmos- Clocked CMOS logic - Dynamic CMOS logic: Domino logic, Charge Keeper Circuits - Dual Rail logic networks: Cascode Voltage Switch Logic.

**UNIT IV**

**9 Hours**

**VLSI SYSTEM COMPONENTS**

Ripple Carry Adder - Carry Look Ahead Adder - Carry Skip Adder - Carry select Adder - Carry save Adder - Multiplier - Array, Booth, Baugh Wooley

**UNIT V**

**9 Hours**

**CLOCKING AND TESTING OF VLSI CIRCUITS**

CMOS clocking styles: Clocked logic cascades, Dual non-overlapping clocks, Dynamic logic cascades - CMOS testing: Fault models in CMOS - Test pattern generation methods: Path sensitization, Boolean Difference, Built in self test.

**FUTURE READING**

CMOS Logic Gates - Equality detector-Pipelining.

**Total: 45 Hours**

**Reference(s)**

1. Neil.H.E Weste David Harris CMOS VLSI Design: A Circuits and Systems Perspective, 4th edition, Pearson Addison Wesley, 2015.
2. John P.Uyemura, "Introduction to VLSI circuits and systems", John Wiley, 2016
3. Kamran Eshraghian, Douglas A. Pucknell, Essentials of VLSI Circuits and Systems Prentice Hall of India, 2015
4. Keng,Lable bick,"CMOS Digital Integrated Circuits", Tata McGraw Hill, 2014
5. Rabaey, Chandrakasan and Nikolic, Digital Integrated Circuit: A design Perspective, PHI, Second Edition ,2016

## 18EC405 ELECTROMAGNETIC FIELDS AND WAVEGUIDES

**3 1 0 4**

### Course Objectives

- ✓ To study the characteristics of static electric and magnetic fields in free space.
- ✓ To understand the behaviour of electromagnetic fields in materials.
- ✓ To analyze the behaviour of electromagnetic waves in waveguides.

### Course Outcomes (COs)

1. Apply vector calculus to static electromagnetic fields and analyse the behaviour of static electric field of various geometries and its scalar potential using Coulomb's Law and Gauss Law.
2. Analyze the behaviour of static magnetic field of various geometries and its vector potential using Biot-Savart Law and Ampere's Circuital Law.
3. Analyze the boundary conditions of electric and magnetic field and determine the capacitance and inductance of various geometries.
4. Analyze Maxwell's equations in differential, and integral forms and apply these equations to determine wave motion in free space and different mediums.
5. Analyze the waves between parallel plates and rectangular waveguides in TE, TM and TEM mode configurations.

### Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3		2									1	
2	2	3		2									1	
3	2	3		2			1						2	
4	2	2		3									2	
5	2	2		3			1						2	

### UNIT I

#### ELECTROSTATIC FIELDS

Vector Calculus - Scalar and Vector fields - Coordinate Systems and Transformation, Del -Gradient of a Scalar-Divergence of a Vector and Divergence Theorem-Curl of a Vector and Stokes Theorem, Coulombs Law - Coulombs Law in Vector Form -Electric Field Intensity -Electric Field due to discrete charges - Electric Fields due to Continuous Charge Distributions Electric Field due to charges distributed uniformly on a finite line - Electric Field on the axis of a uniformly charged circular disc and uniformly charged sheet.Electric Potential -Electric Scalar Potential - Relationship between potential and electric field-electric flux density- Gauss Law-Maxwells Equation -Applications of Gauss Law-Point Charge -Infinite Line Charge-Infinite Sheet of Charge -Uniformly Charged Sphere.

### UNIT II

**9 Hours**

#### MAGNETOSTATICS FIELDS

Biot- Savart Law and Field Intensity - Magnetic Field intensity due to a finite and infinite wire carrying a current I - Magnetic field intensity on the axis of a circular loop carrying a current I - Amperes Circuital Law -Applications -infinite line current-infinite sheet of current-infinitely long coaxial transmission line. Magnetic Potential-Magnetic Scalar and Vector Potentials-Magnetic Flux Density -

Force due to magnetic field- Lorentz force equation for a moving charge Force on a Current Element- Force between Two Current Elements.

### UNIT III

9 Hours

#### ELECTROMAGNETIC FIELDS IN MATERIAL SPACE AND BOUNDARY VALUE

##### PROBLEMS

Materials - Properties of materials- convection and conduction current-conductors- polarization in dielectrics- types of dielectrics- continuity equation and relaxation time- Boundary Condition - Boundary conditions for electric fields. Capacitance - Capacitance of various geometries using Laplaces equation- Magnetic materials - classifications - magnetic boundary conditions- Inductors-inductances - magnetic energy stored in inductors.

### UNIT IV

9 Hours

#### TIME VARYING ELECTROMAGNETIC FIELDS

Maxwells Equations -Faradays Law -Displacement Current -Maxwells Equations in integral form and differential form -Time-Varying Potentials. Wave Propagation-Helmholtz wave Equation-wave motion in free space- perfect dielectric- lossy dielectric and good conductor- skin effect. Poynting vector and power considerations.

### UNIT V

9 Hours

#### WAVEGUIDES

Plane Waves- Waves between parallel planes of perfect conductors, Transverse electric and transverse magnetic waves - characteristics of TE and TM Waves, Transverse Electromagnetic waves, Velocities of propagation  
Rectangular waveguides-Transverse Magnetic (TM) Modes -Transverse Electric (TE) Modes - characteristic of TE and TM Waves, Impossibility of TEM waves in waveguides, Dominant mode in rectangular wave guide.

**Total: 60 Hours**

#### Reference(s)

1. Matthew Sadiku, Elements of Electromagnetics, Oxford University 7/e Press
2. Edward C. Jordon, Keith G. Balmain, Electromagnetic Waves and Radiating Systems, Pearson, prentice hall.
3. Joseph A. Edminister, Theory and Problems of Electromagnetics-Schaum series-TMH-1993
4. William H Hayt, John A Buck, Engineering Electromagnetics, McGraw-Hill Higher Education, 8th edition, 2011
5. J.D. Kraus and D.A Fleisch, Electromagnetics with applications, 5/e-Tata McGraw-Hill- 1999.
6. Bhag Guru and Huseyin Hizirolu, Electromagnetic Field Theory Fundamentals, Cambridge University Press, 2nd edition, 2004

**18EC406 MICROPROCESSORS AND MICROCONTROLLERS****3 0 0 3****Course Objectives**

- To acquire the basic knowledge of Microprocessor & Microcontroller and its applications.
- To perform the analysis and design of system design using microprocessor, microcontroller and peripherals.
- To develop the programming skills of processor and controller.

**Course Outcomes (COs)**

1. Understand the internal architecture and organization of 8085 microprocessor
2. Develop assembly language programming and interfacing techniques of 8085 microprocessors.
3. Analyze the basic concepts and programming of PIC microcontrollers.
4. Analyze ON & OFF-CHIP peripheral interfacing between the peripheral devices and PIC microcontroller.
5. Implement the design using Embedded C programming that interfaces the OFF-chip peripherals with PIC microcontroller.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2										2	2
2	2	3	3	2		2	1					1	3	2
3	2	2	2	1									2	2
4	2	3	3									1	3	2
5	2	3	3	2		2	1					1	3	2

**UNIT I****9 Hours****8085 MICROPROCESSOR**

8085 Architecture - 8085 Instruction set -8085 Addressing modes - 8085 Timing diagrams

**UNIT II****9 Hours****8085 PROGRAMMING**

8085 Assembly language programming - 8085 Interrupts - Memory &amp; I/O device interfacing with 8085 - Serial Communication.

**UNIT III****9 Hours****PIC MICROCONTROLLER**

Introduction - PIC 16F family block diagram, Memory organization: Program Memory, Data Memory, I/O Ports, Timer modules: Timer0, Timer 1, Timer 2, Capture/ Compare and PWM module, Counter

**UNIT IV****9 Hours****PIC ON - CHIP PERIPHERAL INTERFACING AND PROGRAMMING**

UART: Registers, modes, ADC: Registers, operation, DAC, EEPROM, I2C, SPI

**UNIT V****9 Hours****PIC OFF-CHIP PERIPHERAL INTERFACING AND PROGRAMMING**

RTC Interfacing, SD card interfacing, RFID module interfacing, Microcontroller, and PC communication, Analog Sensor interfacing.

**Total: 45 Hours**

**Reference(s)**

1. Ramesh S. Goankar, "Microprocessor Architecture: Programming and Applications with the 8085", Fourth edition, Penram International, 2002
2. Muhammed Ali Mazidi, Rolind D Mckinlay, Danny Causey "PIC Microcontroller and Embedded Systems", Pearson Edition 2008.
3. Krishna Kant, "Microprocessors and Microcontrollers- Architecture, programming and system design 8085, 8086, 8051,8096", Prentice Hall of India, New Delhi, 2007
4. John B.Peatman, Design with PIC Microcontrollers, Pearson Education Asia, 2002
5. [www.microchip.com](http://www.microchip.com)



## 18EC407 ANALOG COMMUNICATION LABORATORY

0 0 2 1

### Course Objectives

- ✓ To provide knowledge on different analog modulation and demodulation systems.
- ✓ To understand the concepts of Pre-emphasis and de-emphasis in FM systems.
- ✓ To provide a knowledge on different pulse modulation and demodulation systems.

### Course Outcomes (COs)

1. Design the modulator and demodulator circuits for DSB-FC Amplitude modulation techniques.
2. Design the modulator and demodulator circuits for Frequency modulation technique.
3. Design Pre-emphasis and de-emphasis in FM systems
4. Analyze the concept of Pulse Modulation techniques through ideal and practical cases.
5. Analyze the spectrum of different AM and FM schemes using MATLAB.

### Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	3	2	2	2	1	2	2	2	2	1	3	1
2	1	2	3	2	2	2	1	2	2	2	2	1	3	2
3	1	2	3	2	2	2		2	2	2			3	
4	1	2	1	2	2	2		2	2	2	1		2	
5	1	2	1	2	2	1		2	2	2			2	

**1** **4 Hours**

#### EXPERIMENT 1

Development of Amplitude modulator and demodulator using non linear device.

**2** **4 Hours**

#### EXPERIMENT 2

Development of Frequency modulator and demodulator using IC 8308.

**3** **3 Hours**

#### EXPERIMENT 3

Design Pre-emphasis and de-emphasis in FM.

**4** **3 Hours**

#### EXPERIMENT 4

Design of Mixer circuits.

**5** **4 Hours**

#### EXPERIMENT 5

Analysis of AM and FM signals using Spectrum analyzer.

**6** **4 Hours**

**EXPERIMENT 6**

Development of Pulse Amplitude Modulation using GNU Radio.

**7** **4 Hours**

**EXPERIMENT 7**

Development of FM Modulation using GNU Radio.

**8** **4 Hours**

**EXPERIMENT 8**

Simulation of PAM, PPM and PWM

**Total: 30 Hours**

**Reference(s)**

1. Communication Systems by Simon Haykins John Wiley & Sons , 4th Edition,2016.
2. Communication Systems -B.P. Lathi, BS Publication, 2004.
3. Principles of Communication Systems - H Taub & D. Schilling, Gautam Sahe, TMH, 2007, 3rd Edition.
4. Electronic Communications - Dennis Roddy and John Coolean , 4th Edition , PEA, 2004
5. Communication Systems,Proakis,Communication Systems, 4th Edition, McGraw-Hill Publications.
6. Fundamentals of Communication System,P.Michael Fitz, , Tata McGraw-Hill -2008.

## 18EC408 MICROPROCESSORS AND MICROCONTROLLERS LABORATORY

**0 0 2 1**

### Course Objectives

- ✓ To understand and analyze instruction set of 8085 microprocessor.
- ✓ To gain hands-on experience in doing experiments on microprocessors (8085) & PIC microcontroller.
- ✓ To interface the microprocessor/microcontroller with various peripherals for various applications.

### Course Outcomes (COs)

1. Develop an assembly language program on 8085 microprocessors to perform arithmetic, and sorting operations.
2. Develop an assembly language program on 8085 microprocessors to perform maximum and minimum numbers operation.
3. Analyze the programming of PIC Microcontroller by interfacing LEDs and Switches.
4. Implement the concepts of interfacing by connecting LCD, keypad and 7 segment display with PIC microcontroller.
5. Develop assembly language programming on a PIC microcontroller to perform device communication using serial protocol.

### Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2		2			2	2	2			2	2
2	2	3	3	2	2	2	1	2	2	2		1	3	2
3	2	2	2	1	2	2	2	2	2	2	2		2	2
4	2	3	3		2			2	2	2	2	1	3	2
5	2	2	2	2	2	2	1	2	2	2	2	1	3	2

**1** **2 Hours**

#### EXPERIMENT 1

Addition and subtraction of two numbers using 8085

**2** **2 Hours**

#### EXPERIMENT 2

Multiplication and division of two numbers using 8085

**3** **2 Hours**

#### EXPERIMENT 3

Sorting of numbers using 8085

**4** **3 Hours**

#### EXPERIMENT 4

Maximum and Minimum numbers using 8085

**5** **3 Hours**

#### EXPERIMENT 5

LED Blinking using PIC

<b>6</b> <b>EXPERIMENT 6</b> Interfacing switch and LED with PIC	<b>3 Hours</b>
<b>7</b> <b>EXPERIMENT 7</b> Interrupt programming using PIC	<b>3 Hours</b>
<b>8</b> <b>EXPERIMENT 8</b> Interfacing LCD with PIC	<b>3 Hours</b>
<b>9</b> <b>EXPERIMENT 9</b> Interfacing 7 segment with PIC	<b>3 Hours</b>
<b>10</b> <b>EXPERIMENT 10</b> Interfacing keypad with PIC	<b>3 Hours</b>
<b>11</b> <b>EXPERIMENT 11</b> USART programming using PIC	<b>3 Hours</b>
<b>Total: 30 Hours</b>	

**Reference(s)**

1. Muhammed Ali Mazidi, Rolind D Mckinlay, Danny Causey "PIC Microcontroller and Embedded Systems", Pearson Edition 2008
2. Ramesh S. Goankar, "Microprocessor Architecture: Programming and Applications with the 8085", Fourth edition, Penram International, 2002
3. Barry B Brey, "The Intel Microprocessors: Architecture, Programming and Interfacing", Prentice Hall of India, Eighth Edition, 2009.
4. Krishna Kant, " Microprocessors and Microcontrollers- Architecture, programming and system design 8085, 8086, 8051,8096", Prentice Hall of India, New Delhi, 2007

**18HS001 ENVIRONMENTAL SCIENCE****2 0 0 0****Course Objectives**

- ✓ Understand the interdisciplinary and holistic nature of the environment
- ✓ Identify the significance of natural resources and environment on the quality of life and stimulate the quest for sustainable development
- ✓ Assess the socio-economic, political and ethical issues in environmental science

**Course Outcomes (COs)**

1. Explain the importance of interdisciplinary nature of environment studies, uses and exploitation of natural resources
2. Analyze the different types of ecosystems and biodiversity, its values and also role of professionals in protecting the environment from degradation
3. Identify the existing environmental challenges related to pollution and its management
4. Select suitable strategies for sustainable management of components of environmental science
5. Correlate the impacts of population and human activities on environment

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2												
2	1	1												
3	2	2					1							
4	1													
5	2													

**UNIT I****6 Hours****NATURAL RESOURCES**

Forest resources: Use - over exploitation - deforestation - case studies. Water resources: Use - over utilization of surface and ground water - conflicts over water. Mineral resources: Use - exploitation - environmental effects of extracting and using mineral resources - case studies. Food resources: Effects of modern agriculture - fertilizer-pesticide problems (eutrophication, blue baby syndrome, biomagnification). Energy resources: renewable (solar, wind, and hydro).

**UNIT II****6 Hours****ECOSYSTEMS AND BIODIVERSITY**

Concept of an ecosystem: Structure and function of an ecosystem - producers - consumers - decomposers - food chains - food webs and ecological pyramids - Types of ecosystem: Introduction - characteristic features: desert ecosystem. Biodiversity - value of biodiversity - threats to biodiversity - endangered and endemic species - Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

**UNIT III****6 Hours****ENVIRONMENTAL POLLUTION**

Pollution: Definition - causes - effects - control measures of air pollution - water pollution: (Sewage water treatment by activated sludge and trickling filter process) - noise pollution- thermal pollution. Disaster management: causes - effects - control measures of floods and Earthquake

#### **UNIT IV**

**7 Hours**

##### **SOCIAL ISSUES AND ENVIRONMENT**

Sustainable development : Definition - Unsustainable to sustainable development - solid waste management - causes - effects - 5R Principles (landfills, incineration, composting). Water conservation - rain water harvesting - watershed management. Climate change - global warming - acid rain - ozone layer depletion. E-waste.

#### **UNIT V**

**5 Hours**

##### **HUMAN POPULATION AND ENVIRONMENT**

Human population: Population growth - characteristics - variation among nations - population explosion - value education - HIV / AIDS. Role of information technology in environment and human health - occupational safety and health administration (OSHA)

##### **FOR FURTHER READING**

Human rights: Biomedical waste - Identification of adulterants in food materials

**Total: 30 Hours**

##### **Reference(s)**

1. Anubha Kaushik, C.P. Kaushik, Environmental Science and Engineering , 4th Multi Colour Edition, New Age International Publishers, New Delhi, 2014
2. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012. Environment. 8th edition. John Wiley & Sons
3. T. G. Jr. Miller, S. Spoolman, New Environmental Science, 14th Edition, Wadsworth Publishing Co, New Delhi, 2014
4. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press
5. A. K. De, Environmental Chemistry, 7th Edition , New age international publishers, New Delhi, 2014

**18GE401 SOFT SKILLS-BUSINESS ENGLISH****0 0 2 0****Course Objectives**

- ✓ To acquire command of both the receptive skills (Listening, Reading) and the productive skills (Writing and Speaking) of English language
- ✓ To understand and make effective use of English language in business contexts

**Course Outcomes (COs)**

1. Listen, Read, Speak, and Write Business English at the level of independent users
2. Appear for the Business English Certificate (BEC) Vantage level examination conducted by the Cambridge Assessment English

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									3	1				
2									3	2				

**UNIT I****15 Hours****LISTENING AND READING**

Listening for writing short answers - filling gaps in sentences - identifying topic, context and function - identify different functions of language in business situations - identify prompts - identify paraphrases of required information Scanning - reading for gist - understanding sentence structure - error identification - identify paraphrases - cohesive words and phrases - understand the importance of analysing the distractors - identify grammatical and semantic relationships

**UNIT II****15 Hours****WRITING AND SPEAKING**

Business emails - notes - memos to colleagues or friends - giving instructions - explaining a development - asking for comments - requesting information - agreeing to requests - explaining - apologising - reassuring - complaining - describing - summarising - recommending - persuading turn - taking - sustaining interaction - initiating - responding - giving personal information - talking about present circumstances, past experiences and future plans - expressing opinion - speculating - organising a larger unit of discourse - giving information - expressing and justifying opinions - speculating - comparing and contrasting - agreeing and disagreeing

**Total: 30 Hours****Reference(s)**

1. Whitehead, Russell and Michael Black. Pass Cambridge BEC Vantage Self - study Practice Tests with Key, Heinle - a part of Cengage Learning, Delhi, 2003.

**21EC501 DIGITAL COMMUNICATION****3 1 0 4****Course Objectives**

- ✓ To study the basics of different Digital communication techniques
- ✓ To impart knowledge on information theory
- ✓ To understand the concepts of error control coding techniques

**Course Outcomes (COs)**

1. Analyze Pulse Modulation schemes for digitizing analog signals and compare the performance of various pulse modulation schemes.
2. Design a system that transmits baseband signals with minimum distortion and analyze the level of ISI using eye pattern and its practical implementation.
3. Analyze the performance of various digital modulation /demodulation techniques and their systems.
4. Evaluate the efficiency of source coding for data compression of digital data transmission.
5. Analyze channel coding for error detection/controlling of digital data.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	2	1									2	1
2	3	3	2	2		1	1	1					2	2
3	2	3	3	2		1	1						2	2
4	2	2		2		1		2					2	1
5	2	2		2		1		2					2	1

**UNIT I****11 Hours****PULSE MODULATION**

Sources and Signals, Basic Signal Processing Operations in Digital Communication, Channels for Digital Communication. Review of Sampling process (Qualitative): Low pass and Band pass sampling, Aliasing, Signal Reconstruction Quantization: Uniform & non-uniform quantization, quantization noise, Logarithmic Companding of speech signal Waveform coding: Pulse Code Modulation (PCM) - Differential pulse code modulation - Adaptive differential pulse code modulation - Delta modulation

**UNIT II****9 Hours****BASEBAND TRANSMISSION**

Line codes: Need for line shaping of signals, Properties of Line codes, Power Spectral Density of Unipolar / Polar RZ & NRZ, Bipolar NRZ, Manchester Matched Filter, Intersymbol Interference- Nyquist criterion for distortionless transmission. Pulse shaping and raised cosine filter, Correlative coding, M-ary schemes, Eye pattern, Equalization

**UNIT III****9 Hours****CARRIER MODULATION**

Signal Representation :Orthogonality, Representation of Signals, Generation and detection of Amplitude Shift Keying (ASK) Modulation, Generation and detection of Frequency Shift Keying (FSK) Modulation, Generation and detection of Binary Phase Shift Keying (BPSK) Modulation, Generation and detection of Quaternary Phase Shift Keying QPSK) and QAM Performance of BPSK, QPSK and QAM in AWGN channel structure of Non-coherent Receivers, Principle of DPSK.



**UNIT IV**

**8 Hours**

**INTRODUCTION TO INFORMATION THEORY**

Measure of information, entropy. Channel capacity and Shannons theorems, source coding techniques: Prefix code, Huffman Coding, Shannon-Fano-Elias Coding, Arithmetic Coding, Runlength code. channel capacity, channel coding theorem, Information capacity theorem

**UNIT V**

**8 Hours**

**ERROR CONTROL CODING**

Channel coding theorem, Linear Block codes, Hamming codes, Cyclic codes, Convolutional codes, Viterbi Decoder, Turbo Codes.

**Total: 60 Hours**

**Reference(s)**

1. Communication Systems by Simon Haykins John Wiley & Sons, 4th Edition, 2016.
2. Communication Systems B.P. Lathi, BS Publication, 2004.
3. Analog and Digital Communication - K. Sam Shanmugam, Wiley, 2005.
4. Digital Communications, Proakis, J.G., Salehi, M., 5th Ed., McGraw-Hill International, 2008.
5. Digital and Analog Communication Systems, Couch II, L.W., 7th Ed., Pearson, 2009.
6. Digital Communications, Sklar, B., 2nd Ed., Pearson, 2001.

**21EC502 DIGITAL SIGNAL PROCESSING****3 1 0 4****Course Objectives**

- ✓ To Analyze the frequency domain behaviour of a given Discrete Time signal using Discrete Fourier Transform
- ✓ To design IIR filters for given specifications by following the suitable design procedures
- ✓ To design FIR filters for given specifications by following the suitable design procedures
- ✓ To analyze the finite word length effect in the design of digital signal processing systems
- ✓ To understand the architectural overview and addressing modes in DSP processors

**Course Outcomes (COs)**

1. Analyze the frequency domain behaviour of a given Discrete Time signal using Discrete Fourier Transform
2. Design and realize an Infinite Impulse Response filter.
3. Design and realize a Finite Impulse Response filter.
4. Analyze the effect of finite word length in Digital filters.
5. Develop an algorithm using TSM320C6X Processor for simple signal processing applications.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2										2	
2	2	3	3	2			2		2				2	2
3	2	3	3	2			2		2				2	2
4	2	2	3										2	
5	1	1	2										2	

**UNIT I****9 Hours****DISCRETE FOURIER TRANSFORM: PROPERTIES, APPLICATIONS AND COMPUTATION**

Review on DTFT- Spectrum limitations, The Discrete Fourier Transform- Need for DFT, DFT as a linear transformation. Properties of DFT- Periodicity, Linearity, Symmetry, Multiplication-Circular Convolution, Time Reversal Circular shifts in time and frequency. Linear Filtering based on DFT- Circular Convolution- Overlap add and Overlap save method, Efficient Computation of DFT-FFT algorithm-Implementation of Radix 2 FFT algorithm(DIT and DIF)-Applications of FFT algorithm.

**UNIT II****9 Hours****DESIGN OF IIR FILTERS**

LTI systems as frequency selective filters-ideal filter characteristics, LPF, HPF, BPF, notch and Comb filters Invertibility of LTI systems Minimum phase, Maximum phase and mixed phase systems. Introduction to FIR and IIR filters -difference and basic representation-General consideration in the design of digital filters.Design of analogue Butterworth and Chebyshev Filters. Design of IIR digital filters using impulse invariance technique, bilinear transform Realization of IIR filters using direct, cascade and parallel forms.

### **UNIT III**

**9 Hours**

#### **DESIGN OF FIR FILTERS**

Linear phase FIR filters Design using Frequency sampling techniques using Windows- Hamming, Hanning, Blackman and Kaiser Window. Design of FIR Differentiators Realization of FIR filters- Direct, Linear phase realization structures.

### **UNIT IV**

**9 Hours**

#### **FINITE WORD LENGTH EFFECT IN DIGITAL FILTERS**

Number representation-Fixed and Floating point Quantization Noise-Finite Word Length Effects in Digital filters- Input Quantization, Product Quantization, Coefficient quantization error, Limit Cycle Oscillations, Overflow and Signal Scaling Introduction to Multirate Signal Processing-Interpolation, Decimation.

### **UNIT V**

**9 Hours**

#### **DIGITAL SIGNAL PROCESSORS**

Introduction to Digital Signal Processors- Basic Classification-Features TMS320C6713 Architecture- Functional Unit-Pipelining- Addressing Modes -Instruction set Simple Assembly Language Program.

**Total: 60 Hours**

#### **Reference(s)**

1. Digital Signal Processing by John G. Proakis and Dimitris K. Manolakis, 4th edition, Pearson Education India
2. Chassaing, Rulph, DSP applications using C and the TMS320C6x DSK. Vol 13. John Wiley and Sons, 2003
3. Discrete-Time Signal Processing by Alan V. Oppenheim and Ronald W. Schaffer, 3rd edition, 2010, Prentice Hall
4. Digital Signal Processing by Sanjit Mitra, 4th edition, 2011, McGraw-Hill, New York, NY.
5. Understanding Digital Signal Processing, Lyons, Richard G., 3/e, Pearson Education India, 2004
6. Digital Signal Processing: A Practical Approach, Barrie W. Jervis and Emmanuel C. Ifeachor 2/e, Pearson Education India, 2009

**21EC503 TRANSMISSION LINES AND ANTENNAS****3 1 0 4****Course Objectives**

- ✓ To understand the different types of transmission lines at radio frequencies
- ✓ To determine the radiation field of different wire antennas and analyze its parameters.
- ✓ To analyze and design travelling wave antennas and derive the radiation fields of aperture and slot antennas
- ✓ To understand the characteristics of signals in sky wave, space wave and ground wave propagation mechanisms.

**Course Outcomes (COs)**

1. Determine the voltage, current and impedance of the transmission line as a function of its characteristics impedance and propagation constant.
2. Analyze the characteristics of the transmission line at radio frequencies and apply smith chart for impedance matching
3. Determine the radiation fields of different wire antennas, array antennas and analyze its fundamental parameters
4. Analyze the fields of different travelling wave antennas and compute the radiation fields of the Huygens source, aperture, slot and complementary dipole antennas
5. Analyze the refractive, reflection and attenuation characteristics of the sky wave, space wave and ground wave propagations and explain the gain and directivity measurements of the antenna.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2		2		1							2	
2	2	2		2		2							2	
3	2	2		3		3	2	2					3	2
4	2	2		3		3	2	2					3	2
5				3									2	

**UNIT I****9 Hours****TRANSMISSION LINE THEORY**

Different types of transmission lines-open wire line, cables, co-axial line, waveguides. Properties of symmetrical network- characteristic impedance and Propagation Constant - Infinite line and short line, the transmission line as a cascade of T Sections. General Solution of the transmission line- physical significance of the equation, wavelength and velocity of propagation, reflection on a line not terminated by  $Z_0$ . Distortion -Waveform Distortion-Distortion due to  $Z_0$  varying with frequency, Frequency Distortion, Phase Distortion, Distortion less transmission line. The telephone cable- Inductance loading of telephone cables.

**UNIT II****7 Hours****THE LINE AT RADIO FREQUENCIES**

Input impedance of lossless lines. Standing waves and standing wave ratio on a line-Relation between SWR and magnitude of reflection coefficient. Input impedance of a lossless line terminated by impedance. One eighth wave line, The Quarter waveline, The Half wave line. The Smith chart- Application of the Smith Chart, single stub matching, Double stub matching.

### UNIT III

10 Hours

#### ANTENNA FUNDAMENTALS AND RADIATION FIELDS OF WIRE ANTENNAS

Concept of retarded vector potential- Fields from an oscillating dipole Current Distribution on a thin wire antenna- Half-wave dipole, quarter-wave monopole and folded dipole. Antenna Parameters- Radiated Power Density, Radiation Intensity, Power radiated, Gain, Directivity, efficiency, bandwidth, polarization, Reciprocity theorem and Friis transmission formula. Linear arrays- Expression for electric field from two element array, Principle of pattern multiplication, N-element Uniform linear array. Broadside and End-fire array- Array synthesis: Binomial array.

### UNIT IV

10 Hours

#### TRAVELING WAVE ANTENNAS

Radiation from a travelling wave on a wire.-Analysis of V antenna. Analysis and Design of Rhombic antenna- Broadband antennas. Aperture concept- Effective aperture, Huygens principle, Uniqueness theorem, Field Equivalence principle and Duality theorem, Radiation from an elemental area of a plane wave (Huygens Source). Radiation from a rectangular aperture treated as an array of Huygens sources. Babinet's principle- Equivalence of fields of a slot and complementary dipole, Horn antennas, parabolic reflector antennas.

### UNIT V

9 Hours

#### PROPAGATION AND ANTENNA MEASUREMENTS

Sky wave propagation: Structure of the ionosphere. Effective dielectric constant of ionized region, Mechanism of refraction. Refractive index, Critical frequency. Skip distance. Effect of earth's magnetic field. Maximum usable frequency. Fading and Diversity reception. Space wave propagation: Reflection from ground for vertically and horizontally polarized waves. Reflection characteristics of earth. Duct propagation - Ground wave propagation: Attenuation characteristics for ground wave propagation. Antenna measurements: Gain Measurement and Directivity Measurement.

**Total: 60 Hours**

#### Reference(s)

1. Antenna Theory Analysis and Design, Constantine A. Balanis, Antenna Theory, John Wiley, 3rd Edition, 2005
2. Antenna and Wave Propagation K.D. Prasad., Antennas and wave propagation, Sathya Praksham, 2001
3. E.C. Jordan & K.G. Balmain "Electromagnetic Waves and Radiating Systems" Prentice Hall of India 2nd edition 2003.
4. J.D. Ryder, "Networks, Lines and Fields", PHI, 2nd Edition, 2010.

**21EC504 CONTROL SYSTEMS****3 1 0 4****Course Objectives**

- ✓ To understand the control system representation
- ✓ To analyse the control system in terms of time domain specifications
- ✓ To determine the stability of a control system from its transfer function
- ✓ To analyse the control system in terms of frequency domain specifications
- ✓ To understand the state space analysis of control systems

**Course Outcomes (COs)**

1. Understand the mathematical modeling of physical systems.
2. Analyze the time response of a control system using time domain specifications.
3. Apply the Routh's stability criterion and the root locus method for stability of LTI systems.
4. Analyze the frequency response of a control system using frequency domain specifications.
5. Analyze a control system using a state space analysis method.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	2	1	2					1		2	2	2
2	2	3	2	1	2					2		2	2	2
3	2	2	3	1	2					3		3	2	3
4	2	2	3	2	2					3		3	2	3
5	2	2	3	2	2					3		3	2	3

**UNIT I****10 Hours****CONTROL SYSTEMS REPRESENTATION**

Introduction to Control systems-Classification of Control Systems - Open loop and Closed loop control systems-Effects of Feedback-Transfer function-Modelling of Physical systems - Electrical systems-System representation using Block diagram and Signal flow graph-Block diagram reduction techniques-Signal flow graph reduction using Masons gain formula.

**UNIT II****9 Hours****TIME RESPONSE ANALYSIS OF CONTROL SYSTEMS**

Standard test signals-Time response of First order control systems for step input-Time response of Second order control systems for step input-Time domain specifications-Effects of poles and zeros-Steady state error-Controllers- PI, PD, PID controllers.

**UNIT III****8 Hours****STABILITY ANALYSIS OF CONTROL SYSTEMS**

Introduction to stability-Stability and the roots of characteristic equation-Routh Hurwitz stability criterion-Range for parameters -conditionally stable systems-Root locus plot-Control system design using root locus plot.

**UNIT IV****9 Hours****FREQUENCY RESPONSE ANALYSIS OF CONTROL SYSTEMS**

Closed loop frequency response-Frequency domain specifications-Polar plot-Bode Plot-Nyquist Stability Criterion- Nyquist Plot-Gain and Phase Margins.

**UNIT V**

**9 Hours**

**COMPENSATORS AND STATE SPACE ANALYSIS**

Compensators-Lead, Lag and Lag-Lead Compensation-Introduction to state space analysis-State model of linear systems-State phase representation using physical variables, phase variable and canonical variables-State transition matrix-Concept of Controllability and Observability.

**Total: 60 Hours**

**Reference(s)**

1. Ogata K, Modern Control Engineering, 5th edition, PHI, 2010.
2. D.RoyChoudhury, Modern Control Engineering, 2nd edition, PHI, 2006.
3. I.J.Nagrath, and M.Gopal, Control Systems Engineering, 6th edition, New Age International, 2016.

## 21EC507 DIGITAL SIGNAL PROCESSING LABORATORY

0 0 2 1

### Course Objectives

- ✓ To Analyze the frequency domain behaviour of a given Discrete Time signal using Discrete Fourier Transform
- ✓ To design IIR and FIR filters for given specifications with suitable design procedures
- ✓ To understand the architectural overview and addressing modes in DSP processors

### Course Outcomes (COs)

1. Analyze the sampling process and convolution of the given signal.
2. Analyze the frequency domain behaviour of the Discrete signal using DFT and FFT.
3. Design and analyze IIR filters using Impulse Invariance and Bilinear Transformation techniques.
4. Design and analyze FIR filters using frequency sampling and Windowing techniques.
5. Develop an algorithm using TSM320C6X Processor for simple signal processing applications.

### Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1				1	3				2				2	1
2				1	3		2		2				2	1
3			2	2	3	2	2		2	2	2		3	2
4			2	2	3	2	2		2	2	2		3	2
5			1	1	3				2				2	1

**1****2 Hours****EXPERIMENT 1**

Introduction to Matlab for Signal Processing

**2****3 Hours****EXPERIMENT 2**

Sampling of Continuous time Signals

**3****3 Hours****EXPERIMENT 3**

Linear and Circular Convolution (with and without functions)

**4****4 Hours****EXPERIMENT 4**

Computation of DFT of a signal using basic equation,FFT algorithms

**5****4 Hours****EXPERIMENT 5**

Design and Simulation of IIR and FIR filters

**6****4 Hours****EXPERIMENT 6**

Design and Simulation of IIR and FIR filters using Filter design ToolBox



**7** **2 Hours**

**EXPERIMENT 7**

Linear Convolution using Simulink

**8** **2 Hours**

**EXPERIMENT 8**

Generation of Signals using DSP Kit

**9** **3 Hours**

**EXPERIMENT 9**

Convolution Operation using DSP Kit

**10** **3 Hours**

**EXPERIMENT 10**

Implementation of FFT algorithms using DSP Kit

**Total: 30 Hours**

**Reference(s)**

1. Digital Signal Processing by John G. Proakis and Dimitris K. Manolakis, 4th edition, 2007, Prentice Hall, Upper Saddle River, NJ
2. Discrete-Time Signal Processing by Alan V. Oppenheim and Ronald W. Schaffer, 3rd edition, 2010, Prentice Hall, Upper Saddle River, NJ
3. Digital Signal Processing: A Practical Approach, Barrie W. Jervis and Emmanuel C. Ifeakor2/e, Pearson Education India,2009

**21EC508 DIGITAL COMMUNICATION AND ANTENNAS LABORATORY****0 0 2 1****Course Objectives**

- ✓ To learn the different digital modulation techniques and their detection
- ✓ To provide knowledge on Software defined radio and GNU Radio software.
- ✓ To study various antennas, arrays and radiation patterns of antennas.
- ✓ To understand the antenna parameter measurement techniques and the propagation of radio waves.

**Course Outcomes (COs)**

1. Analyze the characteristics of Pulse Code Modulation and Delta Modulation schemes in digital communication
2. Design and analyze the performance of digital modulation and demodulation schemes using GNU Radio.
3. Analyze the characteristics of AWGN and Rayleigh fading channel in Digital communication system.
4. Measure the Radiation pattern of Horn Antenna and Parabolic Antenna and compute the impedance matching networks and transmission lines.
5. Design and simulate the microstrip patch and slot antennas.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2	1	2	1	1	2	2	2	1	1	3	2
2	2	2	3	1	2	1	1	2	2	2	1	2	3	2
3	2	1	2	1	2	1	1	2	2	2			3	2
4	1	2	1		2	1	1	2	2	2			2	1
5	1	1	3	2	2	1	2	2	2	2	1	2	3	2

**1****2 Hours****EXPERIMENT 1**

Design and development of PCM modulator and demodulator.

**2****2 Hours****EXPERIMENT 2**

Design and development of Delta modulator.

**3****3 Hours****EXPERIMENT 3**

Design and development of Amplitude Shift keying and Phase Shift keying Modulator.

**4****2 Hours****EXPERIMENT 4**

Development of Quadrature Phase Shift keying signal Modulator and demodulator using GNU Radio.

**5** **2 Hours**

**EXPERIMENT 5**

Development of Binary Phase Shift keying signal Modulator and demodulator using GNU Radio.

**6** **2 Hours**

**EXPERIMENT 6**

Simulation of BPSK and QPSK modulation and demodulation using MATLAB.

**7** **2 Hours**

**EXPERIMENT 7**

Design and analysis BER performance of BPSK/QPSK in AWGN and Rayleigh fading channel.

**8** **3 Hours**

**EXPERIMENT 8**

Simulation of Impedance Matching Networks.

**9** **3 Hours**

**EXPERIMENT 9**

Simulation of transmission lines.

**10** **3 Hours**

**EXPERIMENT 10**

Simulation of array factor of linear array - Broadside, End-fire array and Binomial Array.

**11** **3 Hours**

**EXPERIMENT 11**

Measurement of Radiation pattern of Horn antenna and Parabolic Antenna.

**12** **3 Hours**

**EXPERIMENT 12**

Design and simulation of Microstrip Patch Antenna.

**Total: 30 Hours**

**Reference(s)**

1. Communication Systems by Simon Haykins John Wiley & Sons , 4th Edition,2016.
2. Communication Systems - B.P. Lathi, BS Publication, 2004.
3. Analog and Digital Communication - K. Sam Shanmugam, Wiley, 2005.
4. Digital Communications, Proakis, J.G., Salehi, M.,5th Ed., McGraw-Hill International,2008.
5. C A Balanis, Antenna Theory Analysis and Design, 3rd Edition, John Wiley Publishers, 2005
6. K.D.Prasad, Antennas and Wave Propagation, Sathya Prakasan, 3rd Edition, New Delhi, 2001.

**18GE501 SOFT SKILLS - APTITUDE I****0 0 2 0****Course Objectives**

- Expose the undergraduate students to such methods and practices that help, develop and nurture qualities such as character, effective communication, aptitude and holding ethical values. It will provide a lot of activities and examples for a student to learn and develop these life skills.

**Course Outcomes (COs)**

1. Explain various concepts of number systems and their techniques in solving the percentage, average and age problems.
2. Analyse the profit and loss of real time situations and the relation between ratio, proportion and variation.
3. Apply different techniques to find the distance, speed and time of various moving objects.
4. Understand the concepts of coding, sequences and series, data interpretation and critical reasoning to solve real time logical reasoning problems.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2												
2	2	2												
3	2	2												
4	2	2												

**1****2 Hours****NUMBER SYSTEMS**

Introduction - Definition - Classification on Numbers- Power cycles and remainders - Short cut process- Concept of Highest Common Factor-Concept of Least Common Multiple- Divisibility- Number of zeros in an expression.

**2****2 Hours****PERCENTAGE**

Introduction - Definition and Utility of Percentage - Importance of base/denominator for percentage calculations-Concept of percentage values through additions-Fraction to percentage conversion table.

**3****3 Hours****AVERAGES AND AGES**

Introduction-Average of different groups-Addition or removal of items and change in average- Replacement of some of the items.

**4****3 Hours****RATIO, PROPORTIONS AND VARIATION**

Introduction- Ratio- Properties-Dividing a given number in the given ratio-Comparison of ratios- Proportions-Useful results on proportion- Continued proportion-Relation among the quantities more than two-Variation.

**5** **2 Hours**

**PROFIT AND LOSS**

Gain/Loss and percentage gain or percentage loss-Multiplying equivalents to find sale price-Relation among cost price, sale price, gain/loss and percentage gain or percentage loss-An article sold at two different selling price-Two different articles sold at same selling price-Percentage gain or percentage loss on selling price-Percentage gain or percentage loss on whole property.

**6** **2 Hours**

**TIME AND WORK**

Introduction-Basic concepts-Concepts on working with different efficiencies-Pipes and Cisterns-Work Equivalence (Man Days) -Alternative approach.

**7** **2 Hours**

**TIME, SPEED AND DISTANCE**

Definition-Basics of Time, Speed and Distance - Relative speed-Problems based on Trains-Problems based on Boats and Streams-Problems based on Races-Time taken with two difference modes of transport-Time and distance between two moving bodies.

**8** **3 Hours**

**CODING AND DECODING**

Introduction-Description of Coding method-Coding patterns - Concepts of Coding and Decoding-Problems involving Coding and Decoding methods.

**9** **2 Hours**

**SEQUENCE AND SERIES**

Introduction-Sequences of real numbers - Number and Alphabet series-Description of Number and Alphabet series-Analogy-Odd man out-Power series.

**10** **3 Hours**

**DATA SUFFICIENCY**

Introduction to Data Sufficiency - Overview of the wide variety of Data Sufficiency problems - Basic introduction on how to determine what information is sufficient to solve a given problem - Common pitfalls to avoid.

**11** **3 Hours**

**DIRECTION**

Introduction to Direction - sense test - Overview of the wide variety of Direction problems-Direction-Plotting diagrams.

**12** **3 Hours**

**CRITICAL REASONING**

Introduction-Basic concept of critical reasoning- Weaken the argument-Strengthen the argument-Flaw in the argument-Evaluate the conclusion.

**Total: 30 Hours**

**Reference(s)**

1. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Fourth Edition, Mc Graw Hill Publications.
2. U. Mohan Rao, Quantitative Aptitude for Competitive Examinations, Scitech Publications Pvt Ltd, India.

3. Dinesh Khattar, The Pearson Guide to Quantitative Aptitude for Competitive Examinations, Third Edition, Pearson Education Pvt Ltd, India, 2016.
4. Dr. R S Aggarwal, A Modern Approach to Verbal and Non Verbal Reasoning, Revised Edition, S Chand Publications.
5. Arun Sharma, How to prepare for Logical Reasoning for CAT & other Management Exams, Fifth Edition, Mc Graw Hill Publications.
6. Jaikishan and Premkishan, How to Crack Test of Reasoning in all Competitive Examinations, Revised Edition, Arihant Publications.

**21EC602 COMPUTER NETWORKS AND PROTOCOLS****3 0 0 3****Course Objectives**

- ✓ To understand the fundamental concept of networks and issues involved in it.
- ✓ To acquire an insight view and knowledge to design various layer protocols on the set of rules and procedures that mediates the exchange of information between communicating devices.
- ✓ To understand the basic concepts of application layer protocol design including client/server models.

**Course Outcomes (COs)**

1. Interpret OSI and TCP/IP models, Layers, transmission media and basic topologies with emerging computer networks.
2. Apply the appropriate random access protocols, flow and error control schemes to solve the MAC and data link layer issues.
3. Analyze the network layer impairments by giving solutions, with an understanding of the underlying switching techniques, router architectures, algorithms and protocols.
4. Analyze the performance of transport layer protocols and the beneficial effects of adopting suitable congestion control schemes.
5. Apply the existing network technologies to enable the design and development of energy-efficient network technologies in near future.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	2			1		1					2	
2	2	2	2	2				1				1	2	1
3	1	3	3	1		1		1				2	2	1
4	1	2	1	1				1				1	2	
5	2	3	2	1	2			2				2	2	2

**UNIT I****9 Hours****INTRODUCTION TO NETWORKS**

Network architecture - Topology - Types (LAN, MAN, WAN & PAN) - Network Switching Types: Circuit and packet switching - OSI Reference Model - TCP/IP model - Comparison. Different types of transmission media - Errors in transmission: attenuation, noise - Repeaters - Encoding (NRZ, NRZI, Manchester, 4B/5B, etc.).

**UNIT II****10 Hours****MAC AND DATA LINK LAYER**

MAC Layer: Aloha - CSMA - CSMA/CD - CSMA/CA protocols -Examples: Ethernet, including Gigabit Ethernet and WiFi (802.11), Token Ring, Bluetooth, VLAN and WiMax - Bridges and its types. Data Link Layer: Error detection (Parity, CRC, Checksum) - Sliding Window - Stop and Wait protocols.

**UNIT III****9 Hours****NETWORK LAYER**

Internet Protocol - IPv6 - ARP - DHCP - ICMP - Routing algorithms: Distance vector, Link state, Metrics, Inter domain routing - Subnetting - Classless addressing - Network Address Translation.

#### **UNIT IV**

**9 Hours**

##### **TRANSPORT LAYER**

Connectionless: UDP - Stop and Wait - Pipelined - Go back N - Selective repeat. Connection Oriented: TCP Connection establishment and termination, sliding window revisited, flow and congestion control, timers, retransmission, TCP extensions.

#### **UNIT V**

**8 Hours**

##### **APPLICATION LAYER**

Architecture: Client server & P2P - Protocols: HTTP, SMTP, DNS - Video streaming and Content Distribution Networks:Types, Case study - Socket Programming.

**Total: 45 Hours**

##### **Reference(s)**

1. Kurose and Ross, "Computer Networking - A top-down approach", Seventh Edition, Pearson, 2017.
2. Andrew S. Tanenbaum, "Computer Networks", Fifth Edition, Pearson Education India, 2013.
3. Srinivasan Keshav, "Mathematical Foundations of Computer Networking ", Addison-Wesley Professional, 2012.
4. Peterson and Davie, "Computer Networks, A Systems Approach", 5th ed., Elsevier, 2011.
5. Fred Halsall, "Computer Networking and the Internet ", (5th Edition), Addison Wesley, 2005.



**21EC603 DIGITAL VLSI SYSTEM DESIGN****3 1 0 4****Course Objectives**

- ✓ To model the digital logics using Verilog HDL.
- ✓ To understand the FPGA fundamentals, design and implementation of circuits
- ✓ To understand the concepts of ASIC Front and Backend Design.

**Course Outcomes (COs)**

1. Understand the concepts of Verilog HDL data types, operators and modeling.
2. Design digital logics using Verilog HDL and verify using test bench
3. Design various digital systems using Verilog HDL
4. Analyze the programmable IC technologies and FPGA implementation process
5. Analyze the ASIC implementation process and physical design algorithms

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2										2	
2	2	2	3	2									3	
3	2	2	3	3		2							2	2
4	1	2	2	2			2				2	1	2	2
5	2	2	1	3			2				2	1	2	2

**UNIT I****9 Hours****BASICS OF VERILOG HDL**

Importance of HDL - Design Methodologies - Basic Concepts - Data Types - Dataflow Modeling - Verilog Operators - Gate Level Modeling - Behavioural Modeling: if, else, case statement

**UNIT II****8 Hours****ADVANCED VERILOG HDL AND TEST BENCHES**

Switch Level Modeling - Tasks - Functions - User Defined Primitives (UDP) - Timing and Delays - Verilog Test Benches for Combinational Logic Modules and Sequential Digital Circuits

**UNIT III****10 Hours****SYSTEM DESIGN USING VERILOG HDL**

ALU - Magnitude Comparator - Multiplication Unit - Adder/Subtractor - MAC Unit - FIR Filter - Barrel Shifter - Random Number Generator - Traffic Light Controller - Vending Machine Controller- Single Port RAM

**UNIT IV****9 Hours****PROGRAMMABLE IC TECHNOLOGIES**

PROM, PLA, PAL ,CPLD Programmable IC Technologies - Introduction to FPGA - FPGA Implementation Process - FPGA EDA Tools - FPGA Internal Architectures - Logic Implementation using LUTs - Programmable Interconnections

## **UNIT V**

**9 Hours**

### **ASIC TECHNOLOGIES**

ASIC Design Flow - Types of ASICs - VLSI Design Automation tools - Design Synthesis- Constructive & Iterative Partition and Placement Algorithm - Clock Tree Synthesis - Lee Maze Routing Algorithm - Static Timing Analysis - Physical Verification - File Formats

### **FURTHER READING**

FIFO - Actel ACT - Floor Plan - Power Planning

**Total: 60 Hours**

### **Reference(s)**

1. Stephen Brown and Zvonko Vranesic, Fundamentals of Digital Logic with Verilog Design, 3rd Edition, Tata McGraw Hill, 2014.
2. Samir Palnitkar, Verilog HDL, Pearson Education, 2nd Edition, 2004.
3. Ion Grout, Digital Systems Design with FPGAs and CPLDs, Elsevier, 2008.
4. M.J.S.Smith, Application Specific Integrated Circuits, Pearson Education, 2008.
5. Bob Zeidman, Designing with FPGAs and CPLDs, Elsevier, CMP Books, 2002.
6. Ming-Bo Lin, Digital System Designs and Practices using Verilog HDL and FPGAs, Wiley, 2012.

**21EC607 COMPUTER NETWORKS LABORATORY****0 0 2 1****Course Objectives**

- ✓ To understand the fundamental concept of networks and issues involved in it.
- ✓ To provide an insight view and knowledge to design various layer protocols on the set of rules and procedures that mediates the exchange of information between communicating devices.
- ✓ To understand the fundamental concepts of application layer protocol design including client/server models.

**Course Outcomes (COs)**

1. Design a point-to-point network using connection-oriented and connection-less links.
2. Analyze the performance metrics for different network topologies in computer networks.
3. Analyze the performance metrics evaluation for Ethernet LAN at sparse and dense network conditions with congestion.
4. Design the simple ESS and Wireless LAN using Leaky bucket algorithms.
5. Analyze the performance metrics of the routing protocol algorithm for effective transmission

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2	2	1			2				2	2	
2	2	2	2	2	1			2				2	2	
3	2	3	3	3	2			2				1	2	1
4	2	3	3	3	2			2				2	2	1
5	3	3	3	3	2			2				2	3	2

**1****3 Hours****EXPERIMENT 1**

Simulate a three nodes point-to-point network with duplex links between them. Set the queue size and vary the bandwidth and find the number of packets dropped.

**2****3 Hours****EXPERIMENT 2**

Simulate a four node point-to-point network and connect the links as follows: n0-n2, n1-n2 and n2-n3. Apply TCP agent between n0-n3 and UDP n1-n3. Apply relevant applications over TCP and UDP agents changing the parameter and determine the number of packets sent by TCP / UDP.

**3****3 Hours****EXPERIMENT 3**

Simulate the transmission of ping messages over a network topology consisting of 6 nodes and find the number of packets dropped due to congestion.

**4****3 Hours****EXPERIMENT 4**

Write a program for error detecting code using CRC-CCITT (16-bits).

**5** **3 Hours**

**EXPERIMENT 5**

Simulate an Ethernet LAN using N nodes (6-10). Change error rate and data rate and compare throughput.

**6** **3 Hours**

**EXPERIMENT 6**

Simulate an Ethernet LAN using N nodes and set multiple traffic nodes and plot congestion window for different source / destination.

**7** **3 Hours**

**EXPERIMENT 7**

Simulate simple ESS and with transmitting nodes in wireless LAN by simulation and determine the performance with respect to transmission of packets.

**8** **3 Hours**

**EXPERIMENT 8**

Write a program for congestion control policies/algorithms

**9** **3 Hours**

**EXPERIMENT 9**

Using TCP/IP sockets, write a client server program to make client sending the file name and the server to send back the contents of the requested file if present.

**10** **3 Hours**

**EXPERIMENT 10**

Write a program for distance vector algorithm to find suitable path for transmission.

**Total: 30 Hours**

**Reference(s)**

1. Ying-Dar Liu, Ren-Hung Hwang, Fred Baker, "Computer Networks: An Open Source Approach", McGraw-Hill, 2011.
2. W Stallings, Cryptography and Network Security, Principles and Practice, 5th Ed., Prentice-Hall, 2010
3. Srinivasan Keshav - Mathematical Foundations of Computer Networking-Addison-Wesley Professional (2012)
4. Andrew S. Tanenbaum, "Computer Networks", Fifth Edition, Pearson Education India, 2013.
5. Michael Donahoo, Ken Calvert, Pocket Guide to TCP/IP Socket Programming in C, Morgan Kaufmann Series in Networking, 2000.
6. W. Richard Stevens, Bill Fenner and Andrew Rudoff, "Unix Network Programming", Volumes 1 and 2, Third Edition, Addison-Wesley Professional, 2003.

**21EC608 VLSI DESIGN LABORATORY**

**0 0 2 1**

**Course Objectives**

- ✓ To apply HDL programming for implementation of digital circuits in FPGA and ASIC Technologies
- ✓ To design a digital system using System generator and IP core generator
- ✓ To develop the VLSI layout using ASIC EDA tools

**Course Outcomes (COs)**

1. Design and simulate digital module using IP Core and system generator.
2. Design and simulate digital logic circuits using Verilog HDL
3. Implement the logic modules into FPGA Boards
4. Synthesize the Digital Logic using ASIC EDA tools
5. Construct the Layout of CMOS circuits using ASIC EDA Tool

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		2	3	2	3	1	1	2	2	2			2	2
2		2	3	1	3	3	1	2	2	2	1	1	2	2
3			2	2	3	1	1	1	2	2	1	1	2	3
4			2	3	3	2	2	2	2	2	1	2	2	2
5			2	1	3	2	2	2	2	2	2	2	2	2

**1** **2 Hours**

**EXPERIMENT 1**

Model a Random Access Memory (RAM) using IP Core Generator

**2** **4 Hours**

**EXPERIMENT 2**

Simulate the following Digital Circuits using HDL

- a. Ripple Carry Adder
- b. Flip Flops

**3** **6 Hours**

**EXPERIMENT 3**

Simulate the following Digital Systems using HDL

- a. Real Time Clock
- b. Traffic Light Controller using FSM

**4** **4 Hours**

**EXPERIMENT 4**

Implement the following Digital Circuits on FPGA

- a. Magnitude Comparator
- b. ALU

**5** **2 Hours**

**EXPERIMENT 5**

Implement a MAC Unit using System Generator

**6** **6 Hours**

**EXPERIMENT 6**

Synthesize 4 bit parallel multiplier using 90nm technology file. Evaluate area, power and delay performance using ASIC EDA tool.

**7** **6 Hours**

**EXPERIMENT 7**

Design, Simulate and Generate the GDSII/CIF File for the following using ASIC EDA Tool also report the performance parameters.

- a.CMOS Inverter
- b.CMOS NAND
- c.CMOS NOR

**Total: 30 Hours**

**Reference(s)**

1. Stephen Brown and Zvonko Vranesic, Fundamentals of Digital Logic with Verilog Design, 3rd Edition, Tata McGraw Hill, 2014.
2. Samir Palnitkar, Verilog HDL, Pearson Education, 2nd Edition, 2004.
3. Ion Grout, Digital Systems Design with FPGAs and CPLDs, Elsevier, 2008.
4. M.J.S.Smith, Application Specific Integrated Circuits, Pearson Education, 2008.
5. Ming-Bo Lin, Digital System Designs and Practices using Verilog HDL and FPGAs, Wiley, 2012.
6. Bob Zeidman, Designing with FPGAs and CPLDs, Elsevier, CMP Books, 2002.

**18GE601 SOFT SKILLS-APTITUDE II****0 0 2 0****Course Objectives**

- Expose the undergraduate students to such methods and practices that help, develop and nurture qualities such as character, effective communication, aptitude and holding ethical values. It will provide a lot of activities and examples for a student to learn and develop these life skills.

**Course Outcomes (COs)**

1. Apply the concepts of probability, Sets, Permutation and Combinations in estimating data for real time problems.
2. Understand the concept of logarithms, progressions and Simple and Compound interest to solve various practical problems.
3. Analyse objects involving cubes and cuboids in determining the number of sides colored.
4. Interpret various data from graphs and tables to determine ratio, percentage and averages.
5. Apply the logical reasoning skills for identifying age, relations, visual relations and puzzles.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2												
2	2	2												
3	2	2												
4	2	2												
5	2	2												

**1****4 Hours****PERMUTATION AND COMBINATION**

Definition-Fundamental rules-Theorems on Permutation-Theorems on Combination.

**2****3 Hours****PROBABILITY**

Concept and Importance of Probability-Underlying factors for real Life estimation of probability-Basic facts about probability-Some important consideration while defining event.

**3****3 Hours****SYLLOGISM AND VENN DIAGRAM**

Concepts on Syllogisms-Venn diagram-Interpretation-Venn diagram-solving.

**4****2 Hours****SIMPLE INTEREST AND COMPOUND INTEREST**

Introduction-Definition - Effect of change of P, R, T on simple interest-Amount-Amount becomes N times the principle-Repayment of debt in equal installments-Rate and time are numerically equal-Compound Interest-Conversion period-Basic formula-Special cases-To find the principle / Time /Rate-Difference between Compound Interest and Simple Interest-Equal annual installment to pay the borrowed amount.

**5** **2 Hours**

**MIXTURES AND ALLIGATION**

Definition-Alligation rule-Mean value (cost price) of the mixture-Some typical situations where allegation can be used.

**6** **2 Hours**

**CUBE AND LOGARITHM**

Introduction-Basic Concepts of Cube and Cuboid-Problems involving cubes and cuboids of various dimensions-Problems involving coloured cubes and cuboids - Basic concepts of Logarithm-Laws of Logarithms including change of base-Common logarithm (base 10) - Properties of Logarithms to solve equations involving logarithmic expressions.

**7** **2 Hours**

**DATA INTERPRETATION**

Introduction-Ratio-Percentage-Average-Tables - Graphs and Charts.

**8** **2 Hours**

**PROGRESSION AND LOGICAL REASONING**

Arithmetic progression-Geometric progression-Harmonic progression-Theorems related with progressions.

**9** **2 Hours**

**PROBLEM ON AGES**

Introduction-Basic concept-Usage of Percentage and Averages -Applications.

**10** **2 Hours**

**ANALYTICAL REASONING**

Introduction-Basic concept-Non verbal Analytical Reasoning -Arrangements.

**11** **2 Hours**

**BLOOD RELATION**

Introduction-Basic concept-Kinds of relation-Tree diagram -Relations.

**12** **2 Hours**

**VISUAL REASONING**

Introduction-Basic concepts-Odd man out-Next series-Mirror image and water image

**13** **2 Hours**

**SIMPLIFICATIONS**

Introduction-Basic concepts-Arithmetic operations-Equation solving methods-Puzzles.

**Total: 30 Hours**

**Reference(s)**

1. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Fourth Edition, Mc Graw Hill Publications.
2. U. Mohan Rao, Quantitative Aptitude for Competitive Examinations, Scitech Publications Pvt Ltd, India.
3. Dinesh Khattar, The Pearson Guide to Quantitative Aptitude for Competitive Examinations, Third Edition, Pearson Education Pvt Ltd, India, 2016.



4. Dr. R S Aggarwal, A Modern Approach to Verbal and Non Verbal Reasoning, Revised Edition, S Chand Publications.
5. Arun Sharma, How to prepare for Logical Reasoning for CAT & other Management Exams, Fifth Edition, Mc Graw Hill Publications.
6. Jaikishan and Premkishan, How to Crack Test of Reasoning in all Competitive Examinations, Revised Edition, Arihant Publications.

**21EC701 RF AND MICROWAVE ENGINEERING****3 0 0 3****Course Objectives**

- ✓ To enhance the student knowledge in various parameters of microwave networks
- ✓ To equip the students with sound technical knowledge in microwave tubes
- ✓ To understand the fundamental concepts about microwave semiconductor devices

**Course Outcomes (COs)**

1. Analyze the Characteristics of RF and Microwave Passive Devices.
2. Design and analyze various high-frequency circuits with their characteristics.
3. Understand the working principles of Microwave signal generators.
4. Analyze the working of high frequency semiconductor devices.
5. Analyze the parameters of microwave devices using various measurement techniques.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2		2		1							3	2
2	1	2	2	2		2	2						2	2
3	1	2	1	1		1							2	
4		2	3	2		2	2						3	2
5	1	1	2	2		1							3	2

**UNIT I****11 Hours****HIGH FREQUENCY NETWORK CHARACTERIZATION AND PASSIVE DEVICES**

Basic Definitions of Networks; Interconnecting Networks; Scattering Parameters: Definition, Chain Scattering Matrix, Conversion of S-parameters, Generalized S-parameters and Practical Measurements; S parameter representation of N port networks, properties -S Matrix of a Directional Coupler-waveguide tees and rat race coupler-Qualitative discussion on: Waveguide Corners- Bends- Twists-Matched loads and movable shorts.RF Passive Components: Resistor, Inductor and Capacitor at High Frequency; Chip Resistor, Chip Capacitor and Surface Mounted Inductors, Microstrip lines.

**UNIT II****10 Hours****HIGH FREQUENCY CIRCUITS**

Filter Design: Basic Resonator and Filter Configuration: Filter Types and Parameters; LPF, HPF, BPF, BSF, Insertion Loss; Filter Realization: Butterworth, Chebyshev type Filters, Denormalization of standard LPF; Filter Implementation: Unit Elements, Kurodas Identities, Microstrip Filter Design; Amplifier Design: Characteristics, Power Relations, Stability considerations, Constant Gain, Noise Figure and Constant VSWR circles.

**UNIT III****9****Hours****MICROWAVE SIGNAL GENERATOR**

Two cavity Klystron amplifier - Transit time effect- Velocity modulation - current modulation-bunching - Reflex Klystron-Slow-Wave structures - Helix Traveling-Wave Tubes- Convection Current- Axial Electric Field- Wave Modes- Bandwidth, Power and Gain Considerations - cross field device. Magnetron - power and frequency considerations.

#### **UNIT IV**

**8 Hours**

##### **HIGH FREQUENCY SEMICONDUCTOR DEVICES**

Gunn-Effect -Gunn Diode- Differential Negative Resistance- Modes of Operation-Amplification- Microwave Generation Read Diode- Physical Description- Avalanche Multiplication IMPATT Diodes- TRAPATT Diode- BARITT Diode-Principles of Operation- Physical Structures; RF Bipolar Junction Transistor, RF Field Effect Transistor: Construction, High Electron Mobility Transistor: Functionality, Frequency Response, Temperature Behaviour and Noise Performance.

#### **UNIT V**

**7 Hours**

##### **MICROWAVE MEASUREMENTS**

Slotted line VSWR measurement- impedance measurement- insertion loss and attenuation measurements-measurement of scattering parameters - Return loss measurement using directional coupler-Introduction to vector network analyzer and its uses- return loss and insertion loss- Measurement of return loss and Insertion loss using Spectrum analyzer.

**Total: 45 Hours**

##### **Reference(s)**

1. David.M.Pozar, Microwave Engineering, John Wiley, 2003
2. Samuel.Y.Liao, Microwave Devices and Circuits, PHI, 2000.
3. Reinhold Ludwig, Gene Bogdanow, RF Circuit Design-Theory and Applications, Pearson, 2011
4. Annapurna Das and SisirK.Das, Microwave Engineering, Tata Mc Graw-Hill, 2000.
5. R.E.Collin, Foundations for Microwave Engineering - IEEE Press 2002. International, 1999.
6. Sushrut Das, Microwave Engineering, Oxford university Press, 2014

**21EC702 WIRELESS COMMUNICATION****3 0 2 4****Course Objectives**

- ✓ To impart the fundamentals concepts of wireless communication systems.
- ✓ To introduce various technologies and protocols involved in wireless cellular communication.
- ✓ To understand the concepts of signalling schemes for fading channels and analyze its channel capacity.

**Course Outcomes (COs)**

1. Assess and select the appropriate multiple accessing methods and propagation path loss model depending on the channel characteristics.
2. Analyze the structure of cellular systems for various channel assignment schemes and management techniques in wireless cellular communication.
3. Compare the various Network Architecture of wideband systems with signaling and mobility analysis.
4. Analyze the performance of various equalizers in communication receivers and compare the performance of various diversity techniques.
5. Analyze the capacity of various channel models in wireless communication

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	2	3								1	1	
2	3	3	2	3		2	2	2				2	2	2
3	3	2	2	2		1	1					1	1	
4	3	3	3	3		1	2	1				2	2	2
5	3	3	2	3		2	1					3	2	2

**UNIT I****9 Hours****PROPAGATION AND MULTIPLE ACCESS TECHNIQUES**

Fading - Multipath propagation mechanisms - Propagation Models: Free space model, Two ray ground reflection model, Macro cell and Micro cell propagation models.  
Multiple Access Techniques: FDMA, CDMA, TDMA, SDMA.

**UNIT II****9 Hours****CELLULAR MOBILE WIRELESS SYSTEMS**

Cellular Systems: Structure - Cell Cluster - Frequency reuse - Channel Interference - Cell splitting and sectoring - Channel Assignment schemes: Fixed, Dynamic and Hybrid - Network Architecture - Mobility Management - Location Management - Resource Management: Microcell Concept.

**UNIT III****9 Hours****WIDEBAND SYSTEMS**

GSM Network Architecture - GPRS: Network Architecture, Signaling, Mobility management, Location Management, Roaming. CDMA: IS95 systems, Forward link, Reverse Link, PN sequence related to CDMA - UMTS: Network Architecture and Interface.

**UNIT IV** **9 Hours**

**EQUALIZATION AND DIVERSITY TECHNIQUES**

Fundamentals of equalization - Equalizers in communication receivers: Linear equalization, Non-linear equalization: DFE, MLSE Equalizer, Adaptive Equalizer. Diversity Techniques: Time diversity, Antenna diversity, Frequency diversity: Single carrier with ISI, DSSS, OFDM.

**UNIT V** **9 Hours**

**CAPACITY OF WIRELESS CHANNELS**

AWGN channel capacity- Resources of the AWGN channel- Linear time invariant Gaussian channels- Single input multiple output (SIMO) channel, Multiple input single output (MISO) channel -Capacity of fading channels.

**EXPERIMENT 1** **4 Hours**

Performance analysis of two ray ground reflection model for Walkie-Talkie system.

**EXPERIMENT 2** **4 Hours**

Real-time Image Transmission process for health care system.

**EXPERIMENT 3** **4 Hours**

TDMA Frame Parameterization for Waveform Generation for Mobile applications.

**EXPERIMENT 4** **4 Hours**

Performance analysis of transmit diversity and receive diversity for 4G Airtel networks.

**EXPERIMENT 5** **4 Hours**

Performance analysis of DSSS system over for secure military communication systems.

**EXPERIMENT 6** **5 Hours**

Performance of OFDM transmitter and receiver system for 4G mobile applications.

**EXPERIMENT 7** **5 Hours**

Performance of error analysis of the received signal in fading channels for 5G cellular networks.

**Total: 75 Hours**

**Reference(s)**

1. Cory Beard and William Stallings, "Wireless Communication Networks and Systems" Pearson, 2015.
2. ITI Saha Misra, "Wireless Communication and Networks: 3G and beyond", McGraw Hil Education Pvt Ltd., Second edition, 2013.
3. K. Daniel Wong, "Fundamentals of Wireless Communication Engineering Technologies" Wiley, 2012.
4. David Tse and Pramod Viswanath, Fundamentals of Wireless Communication, Cambridge University Press, 2005
5. T.S.Rappaport, Wireless Communications: Principles and Practice, Second Edition, Pearson Education/ Prentice Hall of India, Third Indian Reprint 2003.
6. Mischa Schwartz, "Mobile Wireless Communications", Cambridge University Press, 2005.

## 21EC707 HIGH FREQUENCY COMMUNICATION LABORATORY

0021

### Course Objectives

- To understand the importance of various microwave components in several communication applications
- To study the performance of microwave components using certain performance estimation parameters
- To study the characteristics like attenuation and bandwidth of a given optical fiber cable.

### Course Outcomes (COs)

1. Analyze the mode characteristics of Reflex Klystron and Gunn Diode.
2. Compute the power distribution in microwave components and the scattering parameters of various Tees.
3. Understand the network parameters of rectangular waveguides
4. Analyze the optical communication system and losses occurred in fiber optical cable.
5. Analyze the characteristics of filters and couplers.

### Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2			2		1		2	2	2			2	
2	2	2	1	2		1		2	2	2			3	2
3	2		1	2		1		1	2	2			2	
4	2	2	1	2	2	2	2	1	2	2			3	2
5	2	2	3	3	2	2	2	2	2	2		2	2	2

### EXPERIMENT 1

4 Hours

Performance analysis of various Television broadcast signal generators in Television broadcasting Transmitter.

### EXPERIMENT 2

4 Hours

Performance Analysis of Television signal Transmission Medium (Waveguides) used in Television Broadcasting Transmitter.

### EXPERIMENT 3

4 Hours

Performance Analysis of FM Radio signal Transmission Medium (Waveguides) used in FM Radio Broadcasting Transmitter.

### EXPERIMENT 4

4 Hours

Function Evaluation of Electronic Components used in fiber optic communication in Wired Telephone Network.

### EXPERIMENT 5

4 Hours

Measurement of Message error and power loss in Transcontinental Wired Telephone service.

### EXPERIMENT 6

5 Hours

Simulate the Design of Radio Station Selector in Radio Receiver

### **EXPERIMENT 7**

**5 Hours**

Simulate the Design of FM Radio signal Transmission Medium used in FM Radio Transmitter.

**Total: 30 Hours**

#### **Reference(s)**

1. David.M.Pozar, Microwave Engineering, John Wiley, 2003.
2. Annapurna Das and SisirK.Das, Microwave Engineering, Tata Mc Graw-Hill, 2000
3. R.E.Collin, Foundations for Microwave Engineering- IEEE Press 2002.
4. BharathiBhat, ShibanK.Koul, Stripline-like transmission lines for microwave integrated circuits, New Age International, 1999

**21EC708 PROJECT WORK I****0 0 6 3****Course Objectives**

- ✓ Work in teams to propose, formulate, and solve a challenging open-ended design problem of significant scope, depth, and breadth.
- ✓ Understand and incorporate engineering standards and multiple realistic constraints, within realistic design time, budget, and performance objectives.
- ✓ Develop a prototype of the proposed design and demonstrate the prototype in accordance with the specifications.
- ✓ Effectively communicate information relating to all aspects of the design process in written, oral, and graphical form.

**Course Outcomes (COs)**

1. Formulate a real world problem, identify the requirement and develop the design solutions.
2. Identify technical ideas, strategies and methodologies.
3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
5. Prepare report and present the oral demonstrations.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	3	3	1	3	3	3	3	3		2	3	3
2	2	2	3	3	1	3	3	3	3	3		2	3	3
3	2	2	3	3	3	3	3	3	3	3	3	2	3	3
4	2	2	3	3	3	3	3	3	3	3	3	2	3	3
5	2	2			2			3	3	3		2	3	3



**21EC801 PROJECT WORK II****0 0 18 9****Course Objectives**

- ✓ Work in teams to propose, formulate, and solve a challenging open-ended design problem of significant scope, depth, and breadth.
- ✓ Understand and incorporate engineering standards and multiple realistic constraints, within realistic design time, budget, and performance objectives.
- ✓ Develop a prototype of the proposed design and demonstrate the prototype in accordance with the specifications.
- ✓ Effectively communicate information relating to all aspects of the design process in written, oral, and graphical form.

**Course Outcomes (COs)**

1. Formulate a real world problem, identify the requirement and develop the design solutions.
2. Identify technical ideas, strategies and methodologies.
3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
5. Prepare report and present the oral demonstrations.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	3	3	1	3	3	3	3	3		2	3	3
2	2	2	3	3	1	3	3	3	3	3		2	3	3
3	2	2	3	3	3	3	3	3	3	3	3	2	3	3
4	2	2	3	3	3	3	3	3	3	3	3	2	3	3
5	2	2			2			3	3	3		2	3	3

**18HS201 COMMUNICATIVE ENGLISH II****1 0 2 2****Course Objectives**

- ✓ Read and understand ideas of complex text on both concrete and abstract topics
- ✓ Listen and understand technical discussions in his/her field of specialisation
- ✓ Produce clear, detailed text on a wide range of subjects and explain a viewpoint on a topical issue giving the advantages and disadvantages of various options
- ✓ Interact with a degree of fluency and spontaneity that makes regular interaction without strain

**Course Outcomes (COs)**

1. Use appropriate grammar and vocabulary that is expected at the BEC Vantage exam level.
2. Understand the general meaning of non-routine letters, and of a report of predictable / unpredictable topic
3. Write simple reports of factual nature and factual non-routine letters
4. Ask for factual information and understand the answer; and take/pass on workplace messages
5. Express opinions and present arguments to a limited extent; and give simple, prepared presentations on familiar topics

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									2	3				
2									2	3				
3									2	3	2			
4									2	3				
5									2	3	2			

**UNIT I****9 Hours****GRAMMAR**

Tenses - Future continuous, Future perfect, Future perfect continuous, Past perfect, Past perfect continuous - Adjectives and adverbs - Mixed conditionals - Modals - can't have, needn't have - Modals of deduction and speculation - Narrative tenses - Passives - Phrasal verbs, extended - Relative clauses - Reported speech - Will and going to, for prediction - Wish - Would expressing habits, in the past.

**UNIT II****9 Hours****READING**

Scanning and reading for gist - Understanding text structure - Reading for gist and specific information - Vocabulary and structure - Understanding sentence structure and error identification

**UNIT III****9 Hours****WRITING**

A message, memo or email, Giving instructions, explaining a development, asking for comments, requesting information, agreeing to requests - Business correspondence: explaining, apologising, reassuring, complaining, short report: describing, summarising - proposal: describing, summarising, recommending, persuading.

#### **UNIT IV**

**9 Hours**

##### **LISTENING**

Listening for and noting specific information - Listening to identify topic, context, Function - Following the main points and retrieving specific information from the text.

#### **UNIT V**

**9 Hours**

##### **SPEAKING**

Giving personal information: Talking about present circumstances, past experiences and future plans, expressing opinions, speculating - Organising a larger unit of discourse: Giving information and expressing and justifying opinions - Turn-taking: negotiating, collaborating, exchanging information, expressing and justifying opinions, agreeing/disagreeing, suggesting, speculating, comparing and contrasting, and decision-making. 1.A Horse and Two Goats - R K Narayan 2.My Lord the Baby - Rabindranath Tagore 3.Twist in the Tale - Jeffery Archer.4.The Third and Final Continent - Jhumpa Lahiri

5.The Gift of the Magi - O Henry

**Total: 45 Hours**

##### **Reference(s)**

1. Guy Brook-Hart, "BEC Vantage: Business Benchmark Upper-Intermediate- Student's Books" 1st Edition, Cambridge University Press, New Delhi, 2006.
2. Ian Wood, Paul Sanderson, Anne Williams with Marjorie Rosenberg, "Pass Cambridge BEC Vantage- Student's Book" 2nd Edition, Cengage Learning, New Delhi, 2014
3. Michael Handford, Martin Lisboa, Almut Koester, Angela Pitt, "Business Advantage - Student's Book Upper-Intermediate" Cambridge University Press, New Delhi, 2014.
4. Cambridge Examinations Publishing, "Cambridge BEC VANTAGE - Self-study Edition", Cambridge University Press, UK, 2005.

**18HSH01 HINDI****1 0 2 2****Course Objectives**

- ✓ To help students acquire the basics of Hindi
- ✓ To teach them how to converse in Hindi on simple day-to-day situations
- ✓ To help students acquire the ability to understand a simple technical text in Hindi

**Course Outcomes (COs)**

1. Construct simple sentences and use vocabulary required for day-to-day conversation.
2. Distinguish and understand the basic sounds of Hindi language.
3. Appear for Hindi examinations conducted by Dakshin Bharat Hindi Prachar Sabha.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										3				
2										3				
3										3				

**UNIT I****9 Hours**

Hindi Alphabet: Introduction - Vowels - Consonants - Plosives - Fricatives - Nasal sounds - Vowel Signs - Chandra Bindu & Visarga - Table of Alphabet - Vocabulary.

**UNIT II****9 Hours**

Nouns: Genders (Masculine & Feminine Nouns long vowels and short vowels - Masculine & Feminine - Reading Exercises.

**UNIT III****9 Hours**

Pronouns and Tenses: Categories of Pronouns - Personal Pronouns - Second person (you & honorific) - Definite & Indefinite pronouns - Relative pronouns - Present tense - Past tense - Future tense - Assertive & Negative Sentences - Interrogative Sentences.

**UNIT IV****9 Hours**

Classified Vocabulary: Parts of body - Relatives - Spices - Eatables - Fruit & Vegetables - Clothes - Directions - Seasons - Professions.

**UNIT V****9 Hours**

Speaking: Model Sentences and Rhymes - Speaking practice for various occasions.

**Total: 45 Hours****Reference(s)**

1. Hindi Prachar Vahini-1 by Dakshin Bharat Hindi Prachar Sabha Chennai
2. B.R. Kishore, Self Hindi Teacher for Non-Hindi Speaking People, Vee Kumar Publications(P)Ltd., New Delhi, 2009
3. Videos, Stories, Rhymes and Songs

**18HSG01 GERMAN****1 0 2 2****Course Objectives**

- ✓ To help students appear for the A1 level Examination
- ✓ To teach them how to converse fluently in German in day-to-day scenarios

**Course Outcomes (COs)**

1. listen and identify individual sounds of German
2. use basic sounds and words while speaking
3. read and understand short passages on familiar topics
4. use basic sentence structures while writing
5. understand and use basic grammar and appropriate vocabulary in completing language tasks

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										2				
2										2				
3										3				
4										2				
5										3				

**UNIT I****9 Hours**

Introduction to German language: Alphabet - Numbers - Greetings - Days and Seasons- Working with Dictionary.

**UNIT II****9 Hours**

Nouns - articles - Speaking about one self - Listening to CD supplied with the books, paying special attention to pronunciation

**UNIT III****9 Hours**

Regular & Irregular verbs - Personal pronouns - family - Introduction to types of sentences

**UNIT IV****9 Hours**

Question words-Types of Questions - Nominative case- Verb Conjugation - country - nationalities

**UNIT V****9 Hours**

Verbs - to be & to have - conjugation - Hobbys - Framing basic Questions and answers

**Total: 45 Hours****Reference(s)**

1. Kursbuch and Arbeitsbuch, NETZWERK A1 DEUTSCH ALS FREMDSPRACHE, Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2015
2. Langenscheidt Eurodictionary - German - English / English - German, Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2009
3. Grundkurs, DEUTSCH Lehrbuch Hueber Munichen, 2007.

**18HSJ01 JAPANESE****1 0 2 2****Course Objectives**

- ✓ To train students for N5 Level Examination
- ✓ To teach them use basic Japanese sentences in day-to-day conversation
- ✓ To make students familiar with the Japanese cultural facets and social etiquettes

**Course Outcomes (COs)**

1. Recognise and write Japanese alphabet
2. Speak using basic sounds of the Japanese language
3. Apply appropriate vocabulary needed for simple conversation in Japanese language
4. Apply appropriate grammar to write and speak in Japanese language
5. Comprehend the conversation and give correct meaning

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										2				
2										2				
3										2				
4										2				
5										2				

**UNIT I****9 Hours**

Introduction to Japanese - Japanese script- Pronunciation of Japanese(Hiragana)- (Katakana) Long vowels - Pronunciation of in,tsu,ga - Letters combined with ya,yu,yo - Daily Greetings and Expressions - Numerals. N1 wa N2 desu - N1 wa N2 ja arimasen - S ka N1 mo - N1 no N2 - san - Kore - Sore - Are - Kono N - Sono N - Ano N - Sou desu - Sou ja Arimasen - S1 ka - S2 ka - N1 no N2 - Sou desu ka - Koko - Soko - Asoko - Kochira - Sochira Achira - N1 wa N2 (place) desu - Doko - Dochira - N1 no N2 - Ko - So - A - Do ( Demonstrative words) - O kuni Kanji10 - Technical Japanese Vocabulary (30 Numbers)

**UNIT II****9 Hours**

Introduction to time - Ji - Fun - Pun - Introduction of verbs - V Masu - V Masen - V Mashita - V Masendeshita N (Time) Ni V - N1 Kara - N2 Made - N1 to N2 - S Ne - N (Place) e Ikimasu - Kimasu - Kaerimasu - Doko (e) Mo Ikimasen - Ikimasendeshita - N (Vehicle) de Ikimasu - Kimasu - Kaerimasu - N (Person / Animal) to V - Itsu - S Yo N o (transitive) - N o Shimasu - Nani o Shimasuka - Nan and Nani - N (place) de V - V Masenka - V Mashou - o - Kanji 10 - Technical Japanese Vocabulary (30 Numbers) .

**UNIT III****9 Hours**

N (tool/means) de V - Word/Sentence wa Go de Nani desu ka - N (person) Ni Agemasu, etc - N (person) Ni Moraimasu etc - Mou V Mashita - Introduction to Adjectives - N wa Na adj (Na) desu - N wa II adj (II) desu - Na adj Na n - II adj (II) N - Totemo - Amari - N wa Dou desuka - N1 wa Donna N2 desuka - S1 Ga S2 - Dore N ga Arimasu - Wakarimasu - N Ga Sukidesu - Kiraidesu - Jozu desu - Heta desu - Donna N - Yoku - Daitai - Takusan - Sukoshi - Amari - Zenzen - S1 kara S2 - Doushite - Kanji 10 - Technical Japanese Vocabulary (30 Numbers)

#### UNIT IV

**9 Hours**

N ga Arimasu - Imasu - N1 (place) Ni N2 ga Arimasu - Imasu - N1 (thing/person/place) no N2 (position) - N1 ya N2 - Word (s) desuka - Chirisosu wa Arimasuka - Saying numbers - Quantifier (period) Ni kai V - Quantifier Dake - N dake - Past tense of Noun sentences and Na adjective sentences - Past tense of ii adjective sentences - N1 wa N2 yori adjective desu - N1 to N2 to dochira ga adjective desu ka - N1/N2 no houga adjective desu - Kanji 10 - Technical Japanese Vocabulary (30 Numbers)

#### UNIT V

**9 Hours**

N ga hoshi desu - V masu form tai desu - N (place) e V masu form - N Ni - ikimasu - kimasu - kaerimasu N ni V - N o V - dou ko ka - nani ka - go chuu mon - Verb conjugation - Verb groups - Verb te form - V te form kudasai - V te form imasu - V masu from mashouka - S1 ga S2 - N ga V - V te form mo ii desu - V te form wa ikemasen - V te form imasu Shrimasen - Kanji 10 - Technical Japanese Vocabulary (30 Numbers)

**Total: 45 Hours**

#### Reference(s)

1. Japanese for Everyone: Elementary Main Textbook1-1, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.

**18HSC01 CHINESE****1 0 2 2****Course Objectives**

- ✓ To help students appear for HSK Level 1 Exam
- ✓ To help students acquire the basics of Chinese language
- ✓ To teach the students how to converse in Chinese in various situations

**Course Outcomes (COs)**

1. listen and identify individual sounds of Chinese
2. use basic sounds and words while speaking
3. read and understand short passages on familiar topics
4. use basic sentence structures while writing
5. understand and use basic grammar and appropriate vocabulary in completing language tasks

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										2				
2										2				
3										3				
4										2				
5										3				

**UNIT I****9 Hours**

Hello | 1.Initials and Finals of Chinese | b,p,m,f,d,,n,l,g,k,h,j,q,x | 2. Tones Four | 3.Chinese Syllables | 4.Tone S

**UNIT II****9 Hours**

Thank you | Initials and Finals of Chinese | The Neutral Tone | Rules of Tone Marking and Abbreviation

**UNIT III****9 Hours**

1. What's your name - In the school; -In the classroom; -In the school | The Interrogative Pronoun | 2 The Sentence | 3 Interrogative Sentences with

**UNIT IV****9 Hours**

She is my Chinese teacher | In the library | The Interrogative Pronouns | The Structural Particle | The interrogative Particle

**UNIT V****9 Hours**

Her daughter is 20 years old this year | 1.The Interrogative Pronoun | 2. Numbers below 100 | 3.Indicating a Change | The Interrogative Phrase

**Total: 45 Hours**



**18HSF01 FRENCH****1 0 2 2****Course Objectives**

- ✓ To prepare the students for DELF A1 Examination
- ✓ To teach them to converse fluently in French in day-to-day scenarios

**Course Outcomes (COs)**

1. To help students acquire familiarity in the French alphabet & basic vocabulary
2. listen and identify individual sounds of French
3. Use basic sounds and words while speaking
4. Read and understand short passages on familiar topics
5. Understand and use basic grammar and appropriate vocabulary in completing language tasks

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										2				
2										2				
3										3				
4										2				
5										3				

**UNIT I****9 Hours****ENTRER EN CONTACT**

La langue française, alphabets, les numeros, les jours, les mois. | Grammaire Les verbes s'appeler, être, avoir, les articles définis, indéfinis | Communication - Saluer, s'informer sur quelqu'un, demander de se présenter | Lexique - Les alphabets, les nationalités, âge, les pays, les couleurs, les jours de la semaine, les mois de l'année, les professions

**UNIT II****9 Hours****PARTAGER SON LIEU DE VIE**

Les français et leur habitat, des habitations insolites | Grammaire - Verbes - Conjugaison : Présent (Avoir / être / ER, IR, RE : Régulier et Irrégulier) - Adjectifs les propositions de lieu | Communication - Chercher un logement, décrire son voisin, s'informer sur un logement | Lexique - L'habitat, les pièces, l'équipement, la description physique

**UNIT III****9 Hours****VIVRE AU QUOTIDIEN**

Grammaire - Articles contractés, verbes vouloir, pouvoir, devoir, adjectifs interrogatifs, future proche | Communication - Exprimer ses goûts, parler de ses loisirs, justifier un choix, exprimer une envie | Lexique - le temps libre et les loisirs, les saisons, les activités quotidiennes, le temps (le matin, le soir, la nuit)

**UNIT IV****9  
Hours****COMPRENDRE SON ENVIRONNEMENT - OUVRIR-SE À LA CULTURE**

Grammaire - Verbes - Finir, Sortir, les adjectifs démonstratifs, le passé composé, l'imparfait | Communication - Proposer quelque chose, raconter une sortie au passé, parler d'un film | Lexique - Les sorties, la famille, art, les vêtements et les accessoires

**UNIT V**

**9 Hours**

**GOUTER A LA CAMPAGNE**

Grammaire La forme negative, les verbes acheter, manger, payer, articles partitifs, le pronom en de quantite | Communication Accepter et refuse une invitation, donner des instructions, commander au restaurant | Lexique Les services et les commerces, les aliments, les ustensiles, argent

**Total: 45 Hours**

**Reference(s)**

1. Saison A1, Methode de francais
2. Hachette FLE

**21EC001 ADVANCED PROCESSOR  
ARCHITECTURE****3 0 0 3****Course Objectives**

- To introduce the concept of RISC and CISC microcontrollers.
- To analyze the principles of parallel processing.
- To understand the concept of shared memory architecture in multiprocessing.

**Course Outcomes (COs)**

1. Indicate multiprocessor cache mapping techniques, cache coherence and memory consistency models.
2. Interpret the RISC processor and interface with PIC microcontroller and various peripherals.
3. Analyze 16bit microcontroller RL78 and design microcontroller based systems for a Real Time application.
4. Apply various types of pipelining methodologies.
5. Analyze the concept of parallel architecture and programming.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3											1	
2	1	2	3		1								2	2
3	2	3			1								3	1
4	3	2												2
5	1	3												

**UNIT I****9 Hours****PROCESSORS AND MEMORY HIERARCHY**

Advanced processor Technology, Super scalar and vector processor, Memory hierarchy technology, Virtual Memory Technology.

**UNIT II****9 Hours****RISC PROCESSOR**

RISC Vs CISC, RISC properties and evolution, Advanced RISC microcontrollers, PIC18xx microcontroller family, Architecture, Instruction set, ROM, RAM, Timer programming Serial port programming, Interrupt programming, ADC and DAC interfacing, CCP module and programming.

**UNIT III****9 Hours****CISC PROCESSORS**

RL78 16 BIT Microcontroller architecture, Addressing modes, On Chip memory, ADC, Interrupts, MAC unit, Barrel shifter, Internal and external clock generation, Memory CRC, On chip debug function and self programming.

**UNIT IV****9 Hours****PIPELINING AND SUPERSCALAR TECHNIQUES**

Linear Pipeline, Nonlinear pipeline, Instruction pipeline, Arithmetic pipeline, Superscalar and super pipeline design, Parallel and scalable architectures, Multiprocessor and Multicomputer.

**UNIT V**

**9 Hours**

**PARALLEL ARCHITECTURE AND PROGRAMMING**

Overview of parallelism, Basic concepts in parallel programming, Microprocessor design phases and trends, Categorizations of multicore architectures, Multicore parallel processing models, Parallelization of programs, Levels of parallelism: Instruction level parallelism and Data level parallelism.

**Total: 45 Hours**

**Reference(s)**

1. Hwang. K, Advanced computer Architecture, Parallelism, Scalability, Programmability, Tata McGraw Hill, 3rd Edition, 1993.
2. Alexander G, James M. Conard, Creating fast, Responsive and energy efficient Embedded systems using the Renesas RL78 microcontroller, Micrium press, USA, Reprinted by S.P Printers, 2011.
3. V.Rajaraman and C.Siva Ram Murthy, Parallel Computers Architecture and Programming, PHI, 2000.
4. Quinn, M.J., Designing Efficient Algorithms for Parallel Computers, McGraw - Hill, 2003.
5. Muhammad Ali Mazidi, Rolind D. Mckinlay and Danny Causey. PIC Microcontroller and Embedded Systems, Pearson Education, 2008.
6. Darryl Gove, Multicore Application Programming: for Windows, Linux, and Oracle Solari, Pearson Education Inc., 2011.

## 21EC002 COMMUNICATION PROTOCOLS AND STANDARDS

**3 0 0 3**

### Course Objectives

- ✓ To analyze the components and need for communication in ECU
- ✓ To analyze the functions and frame format of CAN protocols
- ✓ To analyze the concept of LINBus, MODbus and Flex Ray protocols
- ✓ To analyze the functions of OBD communication in inter vehicle communication
- ✓ To understand the Autosar Standard and its architecture

### Course Outcomes (COs)

1. Choose the suitable ECU components for different communication
2. Analyze the performance of CAN protocols
3. Analyze the performance of LINBus, MODbus and Flex Ray protocols
4. Illustrate the architecture of OBD communication
5. Illustrate the architecture of Autosar Standard

### Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	1	2	3								2	
2	2	3	2		2									3
3	2	3	2		2									3
4	2	2			1								2	
5	2	1		2	3								2	

### UNIT I

**9 Hours**

#### INTRODUCTION

Introduction to ECU Functions and Components , Need for Communication in ECU , Types of Communication Onboard Communication, Diagnostic Communication, Measurement and Calibration , Protocols and Comparison to ISO OSI, In Vehicle Cybersecurity Issues and Challenges

### UNIT II

**9 Hours**

#### CAN FUNDAMENTALS

Introduction to CAN , Electrical properties-CAN signaling and data rates,CAN data frame format, CAN controller block diagram and working,CAN driver configurations,Software for CAN controller interfacing-CAN development tools

### UNIT III

**9 Hours**

#### LINBUS, AND MODBUS, FLEX RAY

LIN bus , basics LIN bus protocol, master slave configuration , Basics of MODBUS , MODBUS protocol , MODBUS application , Flex ray and Automotive Ethernet Introduction and Usage, CAN vs Automotive Ethernet

**UNIT IV**

**9 Hours**

**HIGH-LEVEL COMMUNICATION PROTOCOLS**

Onboard Communication J1939, Introduction, Key Characteristics , J1939 Standard and Layer Model , J1939 PGN and SPN , J1939 Transport Protocol , OBD II , OBD vs ISO OSI Layers , OBD Connectors , OBD Services , OBD Parameter ID (PIDs) , OBD Connectors

**UNIT V**

**9 Hours**

**AUTOSAR ARCHITECTURE**

Introduction to Autosar Standard and Consortium, Need for Autosar Architecture , Virtual Function Bus , Layered Architecture Model, Microcontroller Abstraction Layer , ECU Abstraction Layer , Service layer , Autosar example

**Total: 45 Hours**

**Reference(s)**

1. Olaf Pfeiffer, Andrew Ayre and Christian Keydel, Embedded networking with CAN and CANopen, Copperhill Technologies Corporation, 2008
2. Reference: [www.can-cia.org](http://www.can-cia.org)
3. SGS-Thompson, Lin Application note AN1278, SGS Thompson Ltd. 2002
4. Modbus-IDA, MODBUS application protocol specification, ModbusIDA, 2006
5. Siemens, Profibus network manual, Siemens manual, 2009
6. Xiu Ji, Profibus in practice: System Architecture and Design, CRC press, 2015

**21EC003 EMBEDDED C PROGRAMMING****3 0 0 3****Course Objectives**

- ✓ To expose the students to the fundamentals of C Programming
- ✓ To familiarize the students with data structures concepts
- ✓ To introduce the students basic Linux concepts
- ✓ To involve the students to familiarize with SHELL programming
- ✓ To implement the device drivers in LINUX environment

**Course Outcomes (COs)**

1. Understand the fundamentals of C and Data Structures
2. Understand the basics of LINUX and SHELL programming
3. Analyze the basic concepts of Embedded Linux
4. Apply the concepts of Kernel Module Programming
5. Implement Device Drivers programs and hands on experience in using state-of-art hardware and software tools

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	2										1	
2	2	3	2		2								1	
3	2	3	2		2								1	
4	2	2	2		2								2	
5	2	1		3									3	

**UNIT I****9 Hours****C LANGUAGE AND DATA STRUCTURES OF KERNEL PROGRAMMING**

Basic Concepts of C, Embedded C Vs C, Embedded Programming aspects with respect to firmware and OS Functions, Arrays, Pointers, Structures and Inputs/Outputs. Linked List, Singly Linked List, Doubly Linked List, Queues.

**UNIT II****9 Hours****LINUX AND SHELL PROGRAMMING**

Command prompt, X windows basics, navigating file system, Finding Files, working with folders, Reading files, Text editing in Linux, Compression and archiving tools, Basic shell commands, File Management, I/O Handling, File Locking. Processes, Prioritizing and killing processes, Scheduling Commands, Pipes and redirection, Regular expression, Pattern Matching, Scripting using for, while, if and other commands.

**UNIT III****9 Hours****EMBEDDED LINUX**

Linux Basics, Booting process, Make files using SD card reader to transfer program. Introduction to Linux system calls, API's, device drivers, compiling and installing a device driver.

**UNIT IV**

**9 Hours**

**KERNEL MODULE PROGRAMMING**

Compiling kernel, configuring kernel and compilation, Kernel code, Browsers, Static linking, Dynamic linking of modules, User space, Kernel space concepts, writing simple modules, Writing, Make files for modules.

**UNIT V**

**9 Hours**

**DEVICE DRIVER CONCEPTS**

Driver concepts, Block and character driver distinction, Low level drivers, OS drivers etc, writing character drivers, Device major, minor number.

**Total: 45 Hours**

**Reference(s)**

1. Neil Mathew, Richard stones, Beginning Linux Programming, 2012 reprint, Wrox-Wiley Publishing, USA.
2. Eric Foster Johnson, John C. Welch, Micah Anderson, Beginning shell scripting, 2012, reprint, Wrox-Wiley Publishing, USA
3. Derek Molloy, Exploring BeagleBone: Tools and Techniques for Building with Embedded Linux, 2015, 1st Edition, Wiley Publications, USA



**21EC004 REAL TIME OPERATING SYSTEMS****3 0 0 3****Course Objectives**

- To expose the students to the fundamentals of interaction of OS with a computer and User computation.
- To teach the fundamental concepts of how process are created and controlled with OS.
- To study programming logic of modeling Process based on range of OS features.
- To compare types and Functionalities in commercial OS, application development using RTOS.
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired.

**Course Outcomes (COs)**

1. Understand Operating System structures and types.
2. Analyze the operating systems tasks and its assess to the resources.
3. Analyze the scheduling, disciplining of various processes execution.
4. Demonstrate commercial RTOS Suite features to work on real time processes design.
5. Develop Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in RTOS and embedded automation design.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2											2
2		2		2	2									2
3		2	2	3	2									2
4		2	2	3	2									2
5		2		2	2									2

**UNIT I****9 Hours****INTRODUCTION TO OPERATING SYSTEMS**

Basic Principles, Operating System structures, Operating Systems functions, System Calls, Files, Processes, Design and Implementation of processes, Communication between processes, Introduction to Distributed operating system, Embedded operating systems.

**UNIT II****9 Hours****OVERVIEW OF RTOS**

RTOS Task and Task state, Process Synchronization, Message queues, shared memory, Mail boxes, pipes, Critical section, Semaphores, mutex, priority inversion and ceiling, circular and swinging buffers.

**UNIT III****9 Hours****TASK MANAGEMENT AND RTOS SCHEDULING**

Process and Threads, Process Control Block, Process Attributes, Interrupt processing, memory management, Priority based scheduling, Rate-Monotonic scheduling, Earliest Deadline first scheduling

**UNIT IV****9 Hours****REALTIME KERNEL**

Principles, Kernel, Monolithic and Microkernel, Design issues, Polled Loop Systems, RTOS Porting to a Target, Comparison and Basic study of various RTOS like VX works Linux supportive RTOS.

**UNIT V**

**9 Hours**

**APPLICATION DEVELOPMENT**

Discussions on Basics of Linux supportive RTOS, uCOS-C Executive for development of RTOS Application, Case study.

**Total: 45 Hours**

**Reference(s)**

1. Herma K., Real Time Systems, Design for distributed Embedded Applications, 2011, 2nd edition, Springer, USA
2. Tanenbaum, Andrew, Modern Operating Systems, 2015, 4th ed., Pearson Prentice Hall, USA.
3. Ivan Cibrario Bertolotti, Politecnico di Torino and Gabriele Manduchi, Real-Time Embedded Systems: Open-Source Operating Systems Perspective, 2012, 1st ed., CRC Press, USA.
4. Lyla B. Das, Embedded Systems an Integrated Approach, 2012, 1st ed., Pearson Education, India.
5. Karim Yaghmour, Building Embedded Linux System, O reilly Pub,2003
6. MukeshSighal and N G Shi, Advanced Concepts in Operating System, McGraw Hill,2000

**21EC005 EMBEDDED LINUX****3 0 0 3****Course Objectives**

- ✓ To understand the concept of embedded linux and desktop linux
- ✓ To Configure Linux environment and Tool-Chain
- ✓ To Demonstrate Linux Booting Process and to configure Linux Kernels

**Course Outcomes (COs)**

1. Understand the concepts of embedded Linux development model.
2. Develop a Linux Board Support Package and storage for a hardware platform
3. Analyze the features and internal architecture of kernel and tool chain
4. Analyze the porting issues in Linux Environment.
5. Apply the various development tools to customize the embedded linux application.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2	2									2	
2	3	2	3										2	
3	2	3	3										2	
4	2	3	3	3									2	
5	1	2	3	2									2	

**UNIT I****9 Hours****INTRODUCTION**

History of Embedded Linux, Embedded Linux versus Desktop Linux, Embedded Linux Distributions, Architecture of Embedded Linux, Linux Kernel Architecture, Linux StartUp Sequence

**UNIT II****9 Hours****LINUX FUNDAMENTALS**

Board Support Package: Inserting BSP in Kernel Build Procedure, Boot Loader Interface, Memory Map, Interrupt Management, PCI Subsystem Embedded Storage: Flash Map, MTD : Memory Technology Device, MTD Architecture, MTD Block and Character devices, Optimizing Storage Space.

**UNIT III****9 Hours****ARCHITECTURE OF EMBEDDED LINUX**

Kernel Architecture, Kernel Functional Overview, Commands in Linux, Configuring the Linux Environment, Tool-chain: Configuration and Cross-Compilation, Linux Bootloader & U-Boot, Embedded Linux Kernel, Building Root File System.

**UNIT IV****9 Hours****PORTING APPLICATIONS**

Architectural Comparison, Application Porting Road Map, Programming with Pthreads, Operating System Porting Layer (OSPL), Kernel API Driver

## UNIT V

9 Hours

### DEVELOPMENT TOOLS

Embedded development environment, GNU debugger, tracing & profiling tools, binary utilities, kernel debugging, debugging embedded Linux applications, porting Linux, Linux and real time, SDRAM interface

### FOR FURTHER READING

Debugging with GDB - Profiling and Tracing - Managing Memory - Build System - Building Root File System

**Total: 45 Hours**

### Reference(s)

1. Chris Simmonds "Mastering Embedded Linux Programming", Second Edition, PACKT Publications Limited. 3rd Edition, 2021.
2. Derek Molloy, "Exploring Beagle Bone: Tools and Techniques for Building with Embedded Linux", Wiley, 1st Edition, 2014.
3. Karim Yaghmour, Jon Masters, Gillad Ben Yossef, Philippe Gerum, "Building embedded Linux systems", O'Reilly, 2008.
4. P Raghvan, Amol Lad, Sriram Neelakandan, "Embedded Linux System Design and Development", Auerbach Publications, 2019.
5. Christopher Hallinan, "Embedded Linux Primer: A Practical Real World Approach", Prentice Hall, 2nd Edition, 2010
6. Christopher Hallinan, "Embedded Linux Primer: A practical real world approach", Prentice Hall, 2007

## 21EC006 VIRTUAL INSTRUMENTATION IN EMBEDDED SYSTEMS

**3 0 0 3**

### Course Objectives

- To apply the concepts of LabVIEW in developing graphical programs.
- To develop skills in data acquisition, instrumentation and control.
- To develop Virtual Instruments system for the Real-Time applications

### Course Outcomes (COs)

1. Analyse the concepts of traditional instruments and virtual instruments
2. Understand the overview of modular programming and the structuring concepts in VI programming
3. Formulate the procedure to install DAQ in various OS and its interfacing methods
4. Develop virtual instrument using NI software and hardware
5. Analyse the performance of signal processing tool kits in virtual instrumentation

### Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	1	1									1	
2	3	3	2	2	2					2	2	2	1	
3	2	2	2	1										1
4	3	3	3	1	2					2	2	2	1	2
5	3	2	2	1	2					2	2	2	2	2

### UNIT I

**9 Hours**

#### INTRODUCTION

Virtual Instrumentation: Historical perspective, advantages, block diagram and architecture of a virtual instrument, Conventional Instruments versus Traditional Instruments, data-flow techniques, graphical programming in data flow, comparison with conventional programming.

### UNIT II

**9 Hours**

#### VI PROGRAMMING TECHNIQUES

VIs and sub-VIs, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, State machine, string and file I/O, Instrument Drivers, Publishing measurement data on the web.

### UNIT III

**9 Hours**

#### DATA ACQUISITION

Introduction to data acquisition on PC, Sampling fundamentals, Input/output techniques and buses. Latest ADCs, DACs, Digital I/O, counters and timers, DMA, Data acquisition interface requirements, Issues involved in selection of Data acquisition cards, Data acquisition cards with serial communication, VI Chassis requirements. SCSI, PCI, PXI system controllers, Ethernet control of PXI.

### UNIT IV

**9 Hours**

#### VI TOOLSETS

Use of Analysis tools, Fourier transforms, power spectrum, correlation methods, windowing and filtering. Application of VI in process control designing of equipments like oscilloscope, Digital

multimeter, Design of digital Voltmeters with transducer input Virtual Laboratory, Web based Laboratory.

**UNIT V**

**9 Hours**

**APPLICATIONS**

Distributed I/O modules- Application of Virtual Instrumentation: Instrument Control, Development of process database management system, Simulation of systems using VI, Development of Control system, Industrial Communication, Image acquisition and processing, Motion control. Development of Virtual Instrument using GUI, Real-time systems, Embedded Controller.

**Total: 45 Hours**

**Reference(s)**

1. Gary Johnson, LabVIEW Graphical Programming, Second edition, McGraw Hill, Newyork, 1997.
2. Behzad Ehsani , Data Acquisition Using LabVIEW, Packt Publishing, 2016
3. Lisa K. wells & Jeffrey Travis, LabVIEW for everyone, Prentice Hall, New Jersey,1997.
4. Nitesh Pradhan CLAD Preparation Book, Blue Rose Publishers, 2020.
5. Kevin James, PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control, Newness, 2000.

**21EC007/21ECH01/21ECM01 IoT PROTOCOLS AND INDUSTRIAL  
SENSORS**

**3 0 0 3**

**Course Objectives**

- ✓ Understand the basic principles, architectures, physical and logical designs of IOT
- ✓ Explain the IoT communication principles and their protocols.
- ✓ Explain the transport and application layer principles and their protocols.
- ✓ Understand the working principles of motion, proximity and ranging sensors
- ✓ Explain the principles of force, magnetic and heading sensors and its case studies with real time applications.

**Course Outcomes (COs)**

1. Apply the concepts of IoT Architecture, physical design, logical design and their technologies.
2. Analyze the working principles & concepts of IoT Communication Protocols.
3. Analyze the working principles & concepts of Transport and Application layer Protocols.
4. Apply the various sensors in the Automotive and Mechatronics applications
5. Analyze the working principles and characteristics of force, magnetic and heading sensors.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2												1
2	1	2	3	2										1
3	2	2	2	2										2
4	2	2	2	2										2
5	2	2	2	2										2

**UNIT I**

**9 Hours**

**INTRODUCTION TO IOT**

Architectural Overview- IoT applications- Sensing - Actuators -Basics of Networking - M2M and IoT Technology fundamentals - Devices and gateways - Design of Internet of Things: Physical Design of IoT, Logical Design of IoT - IoT Enabling Technologies.

**UNIT II**

**9 Hours**

**IOT COMMUNICATION PROTOCOLS**

IoT Data Link Layer & Network Layer Protocols, PHY/MAC Layer -3GPP MTC, IEEE 802.11, IEEE 802.15 - Wireless HART, ZWave, Bluetooth Low Energy, Zigbee Smart Energy, DASH7 - Network Layer-IPv4, IPv6, 6LoWPAN.

**UNIT III**

**9 Hours**

**TRANSPORT**

Transport Layer Protocols-Application Protocols for IoT: UPnP, CoAP, MQTT, XMPP, SCADA, Authentication Protocols; IEEE 802.15.4, REST and Websocket.

**UNIT IV**

**9 Hours**

**MOTION, PROXIMITY AND RANGING SENSORS**

Motion Sensors - Potentiometers, Resolver, Encoders - Optical, Magnetic, Inductive, Capacitive, LVDT, RVDT - Synchro, Microsyn, Accelerometer, GPS, Bluetooth, Range Sensors - RF beacons, Ultrasonic Ranging, Reflective beacons.

**UNIT V**

**9 Hours**

**CASE STUDIES/INDUSTRIAL APPLICATIONS**

IoT applications in home appliances, infrastructures, buildings, security, Industries 4.0

**Total: 45 Hours**

**Reference(s)**

1. Vijay Madiseti, Arshdeep Bahga, Internet of Things, A Hands on Approach, University Press.
2. 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.
3. Peter Waher, Learning Internet of Things, Packt Publishing, UK, 2015.
4. Adrian McEwen, Hakim Classically, Designing the Internet of Things, Wiley Publishing, 2015.
5. Dieter Uckelmann, Mark Harrison and Florian Michahelles, Architecting the Internet of Things, Springer, NewYork, 2011.



**21EC008/21ECH02/21ECM02 IoT PROCESSORS****3 0 0 3****Course Objectives**

- ✓ To learn embedded system architecture with its application software.
- ✓ To understand ARM and cortex-m3 Architecture
- ✓ To learn about various Cortex exception handling and interrupts
- ✓ To build simple cortex-m3/m4 programming.
- ✓ To understand cortex-m3/m4 development and debugging tools

**Programme Outcomes (POs)**

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 modelling to complex engineering activities with an understanding of the limitations.

PSO1: Able to apply the concepts of Electronics, Communication, Signal processing and VLSI in the design and implementation of application oriented engineering systems.

**Course Outcomes (COs)**

1. Understand the embedded system architecture with its application software.
2. Analyze ARM and cortex-M3 architecture and bus
3. Analysis cortex exception handling and interrupts
4. Apply concept of Cortex-M3/M4 Programming for a simple application
5. Analyze Cortex-M3/M4 Development and Debugging Tools.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	2										1	
2	2	3	2		2								2	
3	2	3	2		2								2	
4	2	2	2		2								1	
5	2	1		3									1	

## **UNIT I**

**9 Hours**

### **INTRODUCTION TO EMBEDDED CONCEPTS**

Introduction to embedded systems, Application Areas, Categories of embedded systems, Overview of embedded system architecture, Specialties of embedded systems, recent trends in embedded systems, Hardware architecture, Software architecture.

## **UNIT II**

**9 Hours**

### **OVERVIEW OF ARM AND CORTEX M3**

Background of ARM Architecture, Processor Naming, Instruction Set Development, Thumb-2 and Instruction Set Architecture. Cortex-M3 Instruction Sets. Cortex-M3 Implementation Overview: Pipeline, Block Diagram, Bus. Interfaces on Cortex-M3, I-Code Bus, D Code Bus, System Bus.

## **UNIT III**

**9 Hours**

### **CORTEX EXCEPTION HANDLING AND INTERRUPTS**

Exceptions: Exception Types, Priority, Vector Tables, Interrupt Inputs and Pending Behavior, Fault Exceptions, NVIC: Nested Vectored Interrupt Controller Overview, Basic Interrupt Configuration, Software Interrupts, Interrupt/Exception Sequences.

## **UNIT IV**

**9 Hours**

### **CORTEX M3/M4 PROGRAMMING**

Cortex M3/M4 Programming: Overview, Typical Development Flow, Using C, CMSIS (Cortex Microcontroller Software Interface Standard). Exception Programming: Using Interrupts, Exception/Interrupt Handlers. Memory Protection Unit, MPU Registers, Setting Up the MPU.

## **UNIT V**

**9 Hours**

### **CORTEX M3/M4 DEVELOPMENT AND DEBUGGING TOOLS**

STM32L15xxx ARM Cortex M3/M4 Microcontroller: Memory and Bus Architecture, Power Control. STM32L15xxx, Peripherals: GPIOs, System Configuration Controller, Comparators, USART. Development and Debugging Tools: Software and Hardware tools like Cross Assembler, Compiler, Debugger.

**Total: 45 Hours**

### **Reference(s)**

1. Joseph Yiu, The Definitive Guide to the ARM Cortex-M3, Second Edition, Elsevier Inc. 2010.
2. Andrew N Sloss, Dominic Symes, Chris Wright, ARM System Developers Guide Designing and Optimizing System Software, Elsevier Publications, 2006
3. Steve Furber, ARM System-on-Chip Architecture, 2nd Edition, Pearson Education, India ISBN: 9788131708408, 8131708403, 2015
4. Dr. K. V. K. Prasad, Embedded/Real Time Systems: Concepts, Design and Programming Black Book, New edition (MISL-DT) Paperback 12 Nov 2003
5. David Seal ARM Architecture Reference Manual Addison Wesley England Morgan Kaufmann Publishers 2001

**21EC009/21ECH03/21ECM03 IoT SYSTEM DESIGN****3 0 0 3****Course Objectives**

- ✓ To learn how to design and implement IoT applications that manage big data, streaming data, and/or distributed data.
- ✓ To understand Smart Objects and IoT Architectures.
- ✓ To learn about various IOT-related protocols.
- ✓ To build simple IoT Systems using Arduino and Raspberry Pi.
- ✓ To understand data analytics and cloud in the context of IoT.
- ✓ To develop IoT infrastructure for popular applications.

**Course Outcomes (COs)**

1. Understand the fundamentals of IoT and its architecture.
2. Analyze various protocols for IoT.
3. Design a PoC of an IoT system using Raspberry Pi/Arduino.
4. Apply data analytics and use cloud offerings related to IoT.
5. Analyze applications of IoT in real time scenario.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	2										1	
2	2	3	2		2								2	
3	2	3	2		2								3	2
4	2	2	2		2								3	2
5	2	1		3									3	2

**UNIT I****9 Hours****FUNDAMENTALS OF IOT**

Evolution of Internet of Things, Enabling Technologies, IoT Architectures: Simplified IoT Architecture and Core IoT Functional Stack, Fog, Edge and Cloud in IoT, Sensors, Actuators, Smart Objects and Connecting Smart Objects.

**UNIT II****9 Hours****IOT PROTOCOLS**

IoT Access Technologies: IEEE 802.15.4, 802.15.4e, Zigbee protocol, IP versions, CoAP and MQTT. Modern databases: No SQL, New SQL, MongoDB.

**UNIT III****9 Hours****DESIGN AND DEVELOPMENT**

Design Methodology, Embedded computing logic, Microcontroller, System on Chips, IoT system building blocks, Arduino Board details, IDE programming, Raspberry Pi and Interfaces.

**UNIT IV**

**9 Hours**

**DATA ANALYTICS AND SUPPORTING SERVICES**

Role of Machine Learning: Hadoop Ecosystem, Edge Streaming Analytics and Network Analytics, Google Spreadsheet for IoT & Analytics, ThingSpeak and Firebase, Cloud for IoT, Python Web Application Framework.

**UNIT V**

**9 Hours**

**CASE STUDIES/INDUSTRIAL APPLICATIONS**

Cisco IoT system, IBM Watson IoT platform, Power Utility in Industry, Smart and Connected Cities: Smart Lighting, Smart Parking Architecture and Smart Traffic Control.

**Total: 45 Hours**

**Reference(s)**

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. Arshdeep Bahga, Vijay Madisetti, Internet of Things - A hands-on approach, Universities Press, 2015
3. Olivier Hersent, David Boswarthick, Omar Elloumi , The Internet of Things Key applications and Protocols, Wiley, 2012
4. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand, DavidBoyle, From Machine-to-Machine to the Internet of Things Introduction to a New Age of Intelligence, Elsevier, 2014.
5. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), Architecting the Internet of Things, Springer, 2011.
6. Michael Margolis, Arduino Cookbook, Recipes to Begin, Expand, and Enhance Your Projects, 2nd Edition, O Reilly Media, 2011.

**21EC010/21ECH04/21ECM04 WIRELESS SENSOR NETWORK DESIGN 3 0 0 3****Course Objectives**

- ✓ To understand the fundamentals of wireless sensor networks and its application to critical real time scenarios
- ✓ To familiarize with learning of the Architecture of WSN
- ✓ To understand the concepts of Networking and Networking in WSN
- ✓ To study the design consideration of topology control and solution to the various problems.
- ✓ To introduce the hardware and software platforms and tool in WSN.

**Course Outcomes (COs)**

1. Understand basics and technologies for wireless networks
2. Analyze and compare various architectures of Wireless Sensor Networks
3. Understand Design issues and challenges in wireless sensor networks
4. Develop the infrastructure and its simulations
5. Explain the concept of programming in the WSN environment

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	2										1	
2	2	3	2	2	2								2	
3	2	3	2		2								2	
4	2	2	2	2	2								2	
5	2	1		3									2	

**UNIT I****10 Hours****OVERVIEW OF WIRELESS SENSOR NETWORKS**

Introduction: Fundamentals of wireless communication technology, SingleNode Architecture, Network Characteristics, characteristics of wireless channels, modulation techniques, Types of wireless sensor networks.

**UNIT II****10 Hours****ARCHITECTURES**

Network Architecture, Sensor Networks Scenarios, Design Principle, Physical Layer and Transceiver Design Considerations, Optimization Goals and Figures of Merit, Gateway Concepts, Operating Systems and Execution Environments, Internet to WSN Communication.

**UNIT III****9 Hours****NETWORKING SENSORS**

Routing protocols, MAC Protocols for Wireless Sensor Network, Low Duty Cycle Protocols And Wakeup Concept, SMAC IEEE 802.15.4 standar, Wakeup Radio Concepts, Address and Name Management Assignment of MAC Addresses, Routing Protocols Energy Efficient Routing, Geographic Routing.

**UNIT IV**

**8 Hours**

**INFRASTRUCTURE ESTABLISHMENT**

Topology Control, Clustering Time Synchronization Localization and Positioning Sensor Tasking and Control Real-time traffic support and security protocols.

**UNIT V**

**8 Hours**

**SENSOR NETWORK PLATFORMS AND TOOLS**

Sensor Node Hardware Berkeley Motes Programming Challenges, Nodelevel software platforms Node level Simulators, State-Äcentric programming.

**Total: 45 Hours**

**Reference(s)**

1. Holger Karl & Andreas Willig, "Protocols And Architectures for Wireless Sensor Networks", John Wiley, 2005.
2. Feng Zhao and Leonidas J.Guibas, Wireless Sensor Networks An Information Processing Approach, Elsevier, 2007.
3. Waltenegus Dargie , Christian Poellabauer, Fundamentals of Wireless Sensor Networks Theory and Practice, John Wiley and Sons Publications, 2011
4. K. Akkaya and M. Younis, A survey of routing protocols in wireless sensor networks, Elsevier Ad Hoc Network Journal, Vol. 3, no. 3, pp. 325--349
5. Philip Levis, TinyOS Programming
6. Anna Hac, Wireless Sensor Network Designs, John Wiley & Sons Ltd,

**21EC011/21ECH05/21ECM05 INDUSTRIAL IoT AND INDUSTRY 4.0****3 0 0 3****Course Objectives**

- ✓ To provide the overview about evolution and importance of Industrial IoT in the era of Industry 4.0
- ✓ To introduce the Industrial IoT reference architectures and Business models in industrial automation systems
- ✓ To understand the on-site key technologies for the requirement of a smart factory
- ✓ To get the knowledge of Industrial IoT data Analytics
- ✓ To apply the technologies of Industrial IoT in various Industries as case studies.

**Course Outcomes (COs)**

1. Understand about the evolution of Industry 4.0 in smart factories and cyber physical systems
2. Identify the process of industrial automation system network and control
3. Illustrate the reference architectural models and business models with key enabling technologies
4. Analyse the data of the industrial IoT systems with security
5. Apply the technologies to various sectors and case study the application of Industrial IoT in smart industries.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1						2						1	1
2	2	1	3										1	1
3	2	1	2										2	
4	1	2		3	2									2
5	1					2	2						2	

**UNIT I****9 Hours****INTRODUCTION AND KEY TECHNOLOGIES**

Industrial revolutions. Cyber physical systems and Next generation sensors. On-site key technologies in Industry 4.0, AR-VR, Big data Analytics, Smart factories and Lean Manufacturing system.

**UNIT II****9 Hours****INDUSTRIAL AUTOMATION AND IOT**

Evolution of IT and OT convergence. Industrial sensing, Industrial Processes and Industrial Network. Business models and IIRA Reference architecture of IIOT, Industrial internet Consortium (IIC).

**UNIT III****9 Hours****INDUSTRIAL DATA TRANSMISSION AND COMPUTING**

Foundation Fieldbus, Profibus, CC-link, MODBUS, DigitalSTROM, CAN, DeviceNet, ISA 100.11a, Wireless HART, NB-IoT. Edge and Fog Computing solutions. Cloud services.

**UNIT IV**

**9 Hours**

**DATA ANALYTICS AND SECURITY**

Necessity of Analytics and IIOT Data Analytics. Machine Learning and Data Science applications in Industries. Artificial Intelligence for IIOT, IoT Security- Vulnerabilities, Threat Analysis, Security model for IoT.

**UNIT V**

**9 Hours**

**APPLICATIONS OF IIOT**

Healthcare Applications, Inventory Management and Quality Control. Case studies in Manufacturing Industry, Automotive Industry, Mining Industry, Textile Industry.

**Total: 45 Hours**

**Reference(s)**

1. Industry 4.0: The Industrial Internet of Things, by Alasdair Gilchrist (Apress), 2017.
2. Industrial Internet of Things: Cybermanufacturing Systems, by Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer), 2017
3. Hands-On Industrial Internet of Things: Create a powerful Industrial IoT by Giacomo Veneri, Antonio Capasso, Packt, 2018.
4. Misra, Sudip, Chandana Roy, and Anandarup Mukherjee. Introduction to industrial Internet of Things and industry 4.0. CRC Press, 2021.
5. Ortiz, Jess Hamilton. "Industry 4.0: Current status and future trends." (2020).
6. Ustundag, Alp, and Emre Cevikcan. Industry 4.0: managing the digital transformation. Springer, 2017.



**21EC012/21ECH06/21ECM06 DATA ANALYTICS FOR IOT****3 0 0 3****Course Objectives**

- ✓ To understand the basics of nature of data
- ✓ To understand basic operation in data analysis using python
- ✓ To understand data manipulation using pandas library
- ✓ Data visualization using different types of charts
- ✓ To understand basic python program for IoT application

**Course Outcomes (COs)**

1. Analyze the nature of the data processing quantitatively and qualitatively using python
2. Analyze the various data operations performed using NumPy library
3. Analyze the data manipulation process using pandas library in python
4. Apply data visualization techniques to interpret the data with various parameters
5. Construct IoT projects using python and RaspberryPi

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	2										2	
2	2	3	2		3								2	2
3	2	3	2	3	3								2	2
4	2	2	2	3	3								3	
5	2	1		3	2								3	

**UNIT I****9 Hours****INTRODUCTION TO DATA ANALYSIS AND PYTHON**

Data Analysis, Knowledge Domains of the Data Analyst, Understanding the Nature of the Data, The Data Analysis Process, Quantitative and Qualitative, Data Analysis Python and Data Analysis, Installing Python, and writing Python Code, IPython, The IDEs for Python SciPy.

**UNIT II****9 Hours****BASIC OPERATIONS USING PYTHON**

The NumPy Library, The NumPy Installation, Basic Operations Indexing, Slicing, and Iterating Conditions and Boolean Arrays, Shape Manipulation, Array Manipulation, General Concepts, Structured Arrays, Reading and Writing Array Data on Files

**UNIT III****9 Hours****DATA ANALYSIS**

The Python Data Analysis, Library Pandas, Introduction to pandas, Data Structures, operations between data structures, Function application and mapping, Sorting and Ranking, Not a Number data, Reading and Writing data, Reading data in CSV or Text files, Excel files

**UNIT IV****9 Hours****DATA MANUPULATION**

Data Manipulation, Data Preparation, loading, assembling, merging, Concatenating, combining, reshaping, removing, Data Transformation, removing duplicates, mapping, Detecting and filtering

outliers, random sampling, String Manipulation, Data Aggregation, Group Iteration, Chain of Transformation, functions on groups

**UNIT V**

**9 Hours**

**DATA VISUALIZATION**

Matplotlib Installation, pyplot, using the Kwarg, Adding further elements to the chart, Handling Date Values, Line chart, Histogram, Bar Chart, Pie Charts, Advanced charts mplot3d, Multi panel plots, Case study, Meteorological data, Recognizing Handwritten Digits

**Total: 45 Hours**

**Reference(s)**

1. Fabio Nelli, Python Data Analytics, APRESS, 2015
2. Gary Smart, Practical Python Programming for IoT, PACKT Publishing, Birmingham, UK, 2020
3. Samir Madhavan, Mastering Python for Data Science, PACKT Publishing, Birmingham, UK, 2015
4. Peters Morgan, Data Analysis from Scratch with Python, AI Sciences, 2016
5. Charles Bell, MicroPython for the internet of Things, Apress, 2017
6. Agus kurniawan, Micropython for ESP8266 Development workshop, PE PRESS, 2016

**21EC013 ADVANCED DIGITAL SYSTEM DESIGN****3 0 0 3****Course Objectives**

- ✓ Understand the concepts of Synchronous and Asynchronous Sequential Circuit Design.
- ✓ Analyze the concepts of Fault Diagnosis and Testability Algorithms for digital circuits.
- ✓ Illustrate the concepts of programmable logic devices and system design Using VHDL.

**Course Outcomes (COs)**

1. Illustrate the design of synchronous sequential circuit
2. Analyse the design of asynchronous sequential circuit
3. Identify and analyze the fault diagnosis and testing
4. Design the PLD and ROM
5. Design and use programming tools for implementing digital circuits of industry standards.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	2										1	1
2	1	2	3	2									2	2
3	1	3	2	3									2	2
4	1	2	3	3	3								2	2
5	1	2	2	2									2	2

**UNIT I****9 Hours****SEQUENTIAL CIRCUIT DESIGN**

Analysis of Clocked Synchronous Sequential Networks (CSSN) Modeling of CSSN - State Stable Assignment and Reduction - Design of CSSN -Design of Iterative Circuits - ASM Chart -ASM Realization.

**UNIT II****9 Hours****ASYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN**

Analysis of Asynchronous Sequential Circuit (ASC) - Flow Table Reduction - Races in ASC - State Assignment -Problem and the Transition Table - Design of ASC - Hazards.

**UNIT III****9 Hours****FAULT DIAGNOSIS AND TESTING**

Fault Table Method - Path Sensitization Method - Boolean Difference Method - Tolerance Techniques - Fault in PLA - Test Generation - Built- in Self Test.

**UNIT IV****9 Hours****SYNCHRONOUS DESIGN USING PROGRAMMABLE DEVICES**

EPROM to Realize a Sequential Circuit- Programmable Logic Devices - Designing a Synchronous Sequential Circuit using a GAL - EPROM - Realization State machine using PLD.

**UNIT V**

**9 Hours**

**SYSTEM DESIGN USING VHDL**

VHDL Description of Combinational Circuits - Arrays -VHDL Operators - Compilation and Simulation of VHDL Code -Modeling using VHDL - Flip Flops - Registers - Counters - Sequential Machine - Combinational Logic Circuits - VHDL Code for - Serial Adder, Binary Multiplier - Binary Divider.

**Total: 45 Hours**

**Reference(s)**

1. G.Donald Givone, Digital principles and Design, Tata McGraw Hill 2003.
2. N.Nripendra Biswas, Logic Design Theory, Prentice Hall of India, 2001.
3. H.Charles Roth, Digital System Design using VHDL,Third Edition, Cengage Learning, 2016.
4. H.Charles Roth, Fundamentals of Logic design, Sventh Edition,Cengage Learning, 2014.
5. Stephen Brown and Zvonk Vranesic, Fundamentals of Digital Logic with VHDL Design, Tata McGraw Hill, 2008.

**21EC014 ANALOG VLSI DESIGN****3 0 0 3****Course Objectives**

- ✓ To understand the basics of analog integrated circuits
- ✓ To understand the basic building blocks like current sources, sinks and mirrors
- ✓ To comprehend the performance metrics of amplifier circuits and design single stage amplifiers
- ✓ To understand differential amplifiers and common mode rejection ratio
- ✓ To design an operational amplifier and operational transconductance amplifier

**Course Outcomes (COs)**

1. Design the MOSFET models at different frequencies
2. Analyze and design current sources and voltage references for given specifications
3. Analyze and design single stage MOS amplifiers
4. Analyze CMOS differential amplifiers
5. Analyze and design CMOS operational amplifiers

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2		3	1								2	
2	1	3	3	2									2	
3	1	2	3	2									2	
4	1	3		2									2	
5	1	2	2	3	1								2	

**UNIT I****9 Hours****INTRODUCTION TO ANALOG VLSI**

MOS design considerations in Analog Circuit Design, Recent Trends in Analog VLSI Circuits, Low Frequency MOSFET models, Temperature effects in MOSFET, Noise in MOSFET

**UNIT II****9 Hours****CMOS SUBCIRCUITS**

MOS Switch, MOS Diode/ Active Resistor, Simple Current Sinks and Sources, Basic Current Mirrors, Current and Voltage References, and Bandgap references

**UNIT III****9 Hours****CMOS AMPLIFIERS**

Performance Metrics of amplifier circuits, Common Source Amplifier, Common Gate Amplifier, Frequency Response of Amplifiers, Stability of Amplifiers

**UNIT IV****9 Hours****CMOS DIFFERENTIAL AMPLIFIER**

Differential Signaling, Source Coupled Pair, Current Source Load, Common Mode Rejection Ratio, CMOS Differential amplifier with Current Mirror Load, Differential to single-ended Conversion

**UNIT V**

**9 Hours**

**CMOS OPERATIONAL AMPLIFIER**

Block Diagram of Op-Amplifier, Ideal characteristics of Op-Amplifier, Design of two stages Op-Amplifier, Compensation and Frequency response of Op-Amplifier, Operational Transconductance Amplifier

**Total: 45 Hours**

**Reference(s)**

1. Behzad Razavi, Design of Analog CMOS Integrated Circuits, Second Edition, McGraw-Hill, 2000
2. R. Jacob Baker, CMOS: Circuit Design, Layout and Simulation, , Third Edition, Wiley Publication, 2010
3. Tony Chan Carusone, David A. Johns, Kenneth W. Martin, Analog Integrated Circuit Design, Second Edition, Wiley Publication, 2011
4. Behzad Razavi, Fundamentals of Microelectronics, Second Edition, Wiley Publication, 2013
5. Phillip Allen, Douglas Holmberg, CMOS Analog Circuit Design, Second Edition, Oxford University Press, 2004

**21EC015 ASIC DESIGN****3 0 0 3****Course Objectives**

- The course focuses on the semi-custom IC Design and introduces the principles of design logic cells, I/O cells and interconnect architecture, with equal importance given to FPGA and ASIC styles.
- The entire FPGA and ASIC design flow is dealt with from the circuit and layout design point of view.

**Course Outcomes (COs)**

1. Analyze different CMOS logics for ASIC library design
2. Analyze the different techniques available in programmable ASICs
3. Construct the programmable ASIC architecture
4. Demonstrate the different techniques available in logic synthesis, placement and routing
5. Apply high performance algorithms to design ASICs

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1												2	
2			2	3									1	
3	2				2								1	
4			2	3									1	
5					2								3	

**UNIT I****9 Hours****INTRODUCTION TO ASICs, CMOS LOGIC AND ASIC LIBRARY DESIGN**

Types of ASICs - Design flow - CMOS transistors - Combinational Logic Cell - Sequential logic cell - Data path logic cell - Transistors as Resistors - Transistor Parasitic Capacitance.

**UNIT II****9 Hours****PROGRAMMABLE ASICs, PROGRAMMABLE ASIC LOGIC CELLS AND PROGRAMMABLE ASIC I/O CELLS**

Anti-fuse - static RAM - EPROM and EEPROM technology - Actel ACT - Xilinx LCA - Altera FLEX - Altera MAX DC & AC inputs and outputs - Clock & Power inputs.

**UNIT III****9 Hours****PROGRAMMABLE ASIC ARCHITECTURE**

Architecture and configuration of Spartan and Virtex FPGAs - Micro-Blaze based embedded systems - Signal probing techniques.

**UNIT IV****9 Hours****LOGIC SYNTHESIS, PLACEMENT AND ROUTING**

Logic synthesis - ASIC floor planning- placement and routing - power and clocking strategies.

**UNIT V**

**9 Hours**

**HIGH PERFORMANCE ALGORITHMS FOR ASICs/ SOCS. SOC CASE STUDIES**

DAA and computation of FFT and DCT. High performance filters using delta-sigma modulators. Case Studies: Digital camera, SDRAM.

**Total: 45 Hours**

**Reference(s)**

1. M.J.S.Smith, "Application - Specific Integrated Circuits", Pearson,2003
2. Mohammed Ismail and Terri Fiez, "Analog VLSI Signal and Information Processing ", McGraw Hill, 1994.
3. Douglas J. Smith, HDL Chip Design, Madison, AL, USA: Doone Publications, 1996.
4. Jose E. France, YannisTsivlidis, "Design of Analog - Digital VLSI Circuits for Telecommunication and Signal Processing", Prentice Hall, 1994.
5. Roger Woods, John McAllister, Dr. Ying Yi, Gaye Lightbod, "FPGA-based Implementation of Signal Processing Systems", Wiley, 2008
6. Steve Kilts, "Advanced FPGA Design", Wiley Inter-Science



**21EC016 LOW POWER VLSI DESIGN****3 0 0 3****Course Objectives**

- ✓ Identify sources of power in an IC.
- ✓ Identify the power reduction techniques based on technology independent and technology dependent.
- ✓ Power dissipation mechanism in various MOS logic style.
- ✓ Identify suitable techniques to reduce the power dissipation.
- ✓ Design memory circuits with low power dissipation.

**Course Outcomes (COs)**

1. Analyze different sources of power dissipation in VLSI circuits
2. Apply the different techniques involved in low power adders and multipliers
3. Analyze leakage power reduction mechanism at device level and circuit level
4. Analyze the techniques involved in low power SRAM
5. Apply advanced and special techniques for reducing power consumption in memories

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1												2	
2			2	3									1	
3	2				2								1	
4			2	3									1	
5					2								3	

**UNIT I****9 Hours****POWER DISSIPATION IN CMOS**

Basics of power dissipation in CMOS Field Effect Transistors - Hierarchy of limits of power - Sources of power consumption - Static Power Dissipation, Active Power Dissipation - Designing for Low Power, Circuit Techniques for Leakage Power Reduction - Basic principle of low power design.

**UNIT II****9 Hours****POWER OPTIMIZATION**

Logic level power optimization - Circuit level low power design - Standard Adder Cells, CMOS Adders Architectures-BiCMOS adders - Low Voltage Low Power Design Techniques, Current Mode Adder.

**UNIT III****9 Hours****DESIGN OF LOW POWER CMOS CIRCUITS**

Computer arithmetic techniques for low power system - low voltage low power static Random access and dynamic Random access memories - low power clock, inter connect and layout design.

**UNIT IV****9 Hours****POWER ESTIMATION**

Power Estimation techniques - logic power estimation - Simulation power analysis - Probabilistic power analysis.

**UNIT V**

**9 Hours**

**SYNTHESIS AND SOFTWARE DESIGN FOR LOW POWER**

Synthesis for low power - Behavioral level transform - software design for low power.

**Total: 45 Hours**

**Reference(s)**

1. Kaushik Roy and S.C.Prasad, "Low power CMOS VLSI circuit design", Wiley, 2000.
2. Gary Yeap, "Practical low power digital VLSI design", Kluwer, 1998.
3. Kiat-send Yeo, Kaushik Roy "Low-Voltage, Low-power VLSI Subsystem", Tata McGraw-Hill, 2009
4. AbdelatifBelaouar, Mohamed.I.Elmasry, "Low power digital VLSI design", Kluwer, 1995.
5. A.P. Chandrasekaran and R.W.Broadersen, "Low power digital CMOS design", Kluwer,1995.
6. DimitriosSoudris, C.Pignet, Costas Goutis, "Designing CMOS Circuits for Low Power", Kluwer, 2002.

**21EC017 DSP INTEGRATED CIRCUITS****3 0 0 3****Course Objectives**

- ✓ To understand the importance of DSP IC design
- ✓ To analyze the frequency domain behaviour of a given Discrete Time signal using Discrete Fourier Transform
- ✓ To analyse the DSP architectures and implementation methods
- ✓ To develop various arithmetic strategies for the design of digital signal processing systems
- ✓ To design a various digital signal processing elements

**Course Outcomes (COs)**

1. Analyze the DSP IC and CMOS Technologies
2. Analyze the frequency domain behaviour of a given Discrete Time signal using Discrete Fourier Transform
3. Analyze the DSP architectures and its implementation
4. Organize an Arithmetic Architectures required for processing a digital signal
5. Generate an VLSI architecture for the Signal Processing Elements

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2											2	
2	2	2	2										2	
3	2	2	2		2								2	
4	2	2	2		2								2	
5	2	2	2		2								2	

**UNIT I****9 Hours****DSP INTEGRATED CIRCUITS AND VLSI CIRCUIT TECHNOLOGIES**

Standard digital signal processors-Application specific ICs for DSP-DSP systems-DSP system design-Integrated circuit design-MOS transistors-MOS logic

**UNIT II****9 Hours****DSP ARCHITECTURES**

DSP system architectures-Standard DSP architecture-Ideal DSP architectures-Multiprocessors and Multicomputers-Systolic and Wave front arrays

**UNIT III****9 Hours****SYNTHESIS OF DSP ARCHITECTURES**

Shared memory architectures-Mapping of DSP algorithms onto hardware-Shared memory architecture with Bit-serial PEs

**UNIT IV**

**9 Hours**

**ARITHMETIC ELEMENTS**

Conventional number system-Redundant Number system-Residue Number System-Bit-parallel and Bit-Serial arithmetic-Minimum Number of Basic Operations-Bit Serial Squarers-Serial/Serial Multipliers-Digit Serial Arithmetic.

**UNIT V**

**9 Hours**

**SIGNAL PROCESSING ELEMENTS**

CORDIC Algorithm-Distributed Arithmetic-Basic shift accumulator-Reducing the memory size-Complex multipliers-Improved shift-accumulator-FFT Processor-DCT Processor

**Total: 45 Hours**

**Reference(s)**

1. Lars Wanhammer, DSP Integrated Circuits, Academic press, New York 1999.
2. Oppenheim A.V. Schafer, R.W., and Buck, J.R. Discrete-time Signal Processing, Pearson education, 2000
3. Emmanuel C. Ifeachor, Barrie W. Jervis, Digital signal processing-A Practical Approach, Second edition, Pearson education, Asia 2001
4. Keshab K. Parhi, VLSI digital Signal Processing Systems design and Implementation, John Wiley & Sons, 1999
5. John G. Proakis and Dimitris K. Manolakis, Digital Signal Processing, 4th edition, Pearson Education India, 2001

**21EC018 VLSI VERIFICATION****3 0 0 3****Course Objectives**

- ✓ To model the digital logic using Verilog HDL
- ✓ To understand object-oriented programming concepts
- ✓ To understand the System Verilog verification environment

**Course Outcomes (COs)**

1. Design digital logic using advanced Verilog HDL
2. Carry-out object-oriented programming concepts for verification environment
3. Implement the different system Verilog constraints and arrays
4. Construct the system Verilog verification environment
5. Analyze the different coverage types

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2										2	
2	2	2	2										2	
3	2	2	2	2									2	
4	2	2	2	2									2	
5	2	2	2	2									2	

**UNIT I****9 Hours****BASICS OF SYSTEM VERILOG**

Importance of System Verilog(SV), Difference between Verilog and SV, SV Data types: 2 State Data types (bit, byte, int, long\_int, short\_int), 4 State Data types (integer, real, realtime, logic, reg), User defined data types (Struct, enum, string, typedef)

**UNIT II****9 Hours****OBJECT ORIENTED PROGRAMMING AND METHODS**

OOPs, Encapsulation, Polymorphism, Inheritance, Built-in Methods: Randomization, Pre & Post Randomize, Object Creation (new), User-Defined Methods: print method, copy methods (copy by handle, Shallow copy, Deep Copy)

**UNIT III****9 Hours****SV CONSTRAINTS AND ARRAYS**

Simple Constraints, Weighted Distributed Constraint, Implication Operator Based Constraint, Variable Order Based Constraint, Static Array and Dynamic Arrays (Dynamic, Associative, and Queue Array)

**UNIT IV****9 Hours****INTER PROCESS COMMUNICATION (IPC), INTERFACE AND COVERAGE**

IPC, Semaphore, Mailbox, Events, Interface, Virtual Interface, Modport, Clocking Block, Coverage, Functional Coverage, Code Coverage, Cross Coverage, Coverage option

**UNIT V**

**9 Hours**

**SV VERIFICATION ENVIRONMENT**

SV Verification Blocks , Generator Block: Bus Functional Model (BFM) Block, Interface Block, Monitor Block, Assertion Block, Environment Block, Program Block

**Total: 45 Hours**

**Reference(s)**

1. S.Palnitkar, Verilog HDL: A Guide to Digital Design and Synthesis, Prentice Hall, 2nd edition, 2003
2. Chris Spear and Greg Tumbush, SystemVerilog for Verification, Third Edition, Springer US, 2012
3. Stuart Sutherland , Simon Davidmann , Peter Flake , SystemVerilog for Design, Second Edition, Springer New York, NY, 2006
4. <https://verificationguide.com/systemverilog/systemverilog,tutorial/>
5. <https://www.chipverify.com/systemverilog/systemverilog,tutorial/>

**21EC019 ADVANCED DIGITAL SIGNAL  
PROCESSING**

**3 0 0 3**

**Course Objectives**

- ✓ To Learn fundamental concepts on Random variables and random process.
- ✓ To Analyze the concepts of multi rate signal processing and multi rate filters.
- ✓ To Design the optimum and adaptive filters for signal processing applications.

**Course Outcomes (COs)**

1. Apply the concept of random variables and random process in Discrete Time Signals
2. Apply the Multirate signal processing concepts in design of filter banks, subband coding
3. Analyze the design of LMS adaptive filters and its performance for non-stationary signals
4. Analyze the design of RLS adaptive filter and its variants.
5. Attribute the concept of wiener filter in prediction and noise cancellation applications and analyze its performance.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	2										3	3
2	2	3	2		2								2	2
3	2	3	2		2								2	2
4	2	2	2		2								2	2
5	2	1		3									2	2

**UNIT I**

**9 Hours**

**DISCRETE TIME RANDOM PROCESS**

Random variables- Ensemble Averages-Jointed distributed random variables- Independent, uncorrelated and orthogonal random Variables-Gaussian random variables- Random processes

**UNIT II**

**9 Hours**

**MULTIRATE SIGNAL PROCESSING**

Introduction, decimation by a factor "D", Interpolation by a factor "I", sampling rate conversion by a factor "I/D", Implementation of sampling rate conversion, Multistage implementation of sampling rate conversion.

**UNIT III**

**9 Hours**

**FIR ADAPTIVE FILTERS**

The steepest Descent Adaptive Filter, The LMS Algorithm- Convergence of the LMS algorithm, Normalized LMS algorithm, LMS based adaptive filters, Gradient Adaptive Lattice filter

**UNIT IV**

**9 Hours**

**ADAPTIVE RECURSIVE FILTERS**

Adaptive Recursive filters, Recursive Least square algorithm, Exponentially Weighted RLS, Sliding window RLS, Lattice recursive least squares filter (LRLS)

**UNIT V**

**9 Hours**

**WIENER FILTERS**

The FIR Wiener Filter, -Linear Prediction, Noise cancellation, Lattice representation for the FIR wiener filter. The IIR wiener filter- Non-causal IIR wiener filter, The causal IIR wiener filter

**Total: 45 Hours**

**Reference(s)**

1. Ramrez, David, Ignacio Santamaría, and Louis Scharf. Coherence: In Signal Processing and Machine Learning. Springer Nature, 2023.
2. H.MonsonHayes,Statistical Digital Signal Processing and Modeling, John Wiley and Sons, Inc., 2008.
3. G. John Proakis and G.Dimitris Manolakis,Digital Signal Processing,Pearson Education,2006.
4. P.P.Vaidyanathan,Multirate Systems and Filter Banks,Pearson Education,2008.
5. N.J.Filege,Multirate Digital Signal Processing,John Wiley and Sons, 2000.
6. G.JohnProakis,Algorithms for Statistical Signal Processing, Pearson Education, 2002.



**21EC020 SPEECH SIGNAL PROCESSING****3 0 0 3****Course Objectives**

- ✓ To study the basics of speech signal, speech production mechanisms
- ✓ To explore time domain and frequency domain analysis of speech signal
- ✓ To focus on the applications of speech signal processing

**Course Outcomes (COs)**

1. Understand the fundamentals and mechanism of speech signals
2. Apply time domain methods to extract the speech parameters
3. Apply and analyze frequency domain methods of speech processing
4. Apply and analyze the concepts of linear predictive analysis for speech processing
5. Attribute the concepts of speech processing for various signal processing models

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	2										2	2
2	2	3	2		2								2	2
3	2	3	2		2								2	2
4	2	2	2		2								2	2
5	2	1		3									2	2

**UNIT I****9 Hours****MECHANICS OF SPEECH**

Speech production mechanism- Nature of Speech signal - Representation of Speech signals - Classification of Speech sounds - Phonetic and Phonemic alphabets - Articulatory features - Auditory perception

**UNIT II****9 Hours****TIME DOMAIN METHODS FOR SPEECH PROCESSING**

Time domain parameters of Speech signal - Methods for extracting the parameters Energy- Average Magnitude - Zero crossing Rate - Silence Discrimination using ZCR and energy

**UNIT III****9 Hours****FREQUENCY DOMAIN METHOD FOR SPEECH PROCESSING**

Short Time Fourier analysis - Filter bank analysis - Formant extraction - Pitch Extraction - Analysis by Synthesis- Phase vocoder - Channel vocoder -Formant and Pitch Estimation Speech enhancement

**UNIT IV****9 Hours****LINEAR PREDICTIVE ANALYSIS OF SPEECH**

Formulation of Linear Prediction problem in Time Domain -Basic Principle - Auto correlation method - Covariance method - Solution of LPC equations - Durbin's Recursive algorithm - Case study on analyzing customers' buying behavior in retail industries

**UNIT V**

**9 Hours**

**APPLICATION OF SPEECH SIGNAL PROCESSING**

Algorithms: Spectral Estimation, dynamic time warping - Hidden Markov model - Pitch Detection - Feature analysis for recognition- Automatic Speech Recognition - Feature Extraction for ASR - Multi-language text-to-speech conversion

**Total: 45 Hours**

**Reference(s)**

1. Nilanjan Dey, Intelligent Speech Signal Processing, Elsevier Books Inc, 2019
2. Ben Gold and Nelson Morgan, Speech and Audio Signal Processing, John Wiley and Sons Inc., 2004
3. Quatieri, Discrete-time Speech Signal Processing, Prentice Hall, 2001
4. L.R.Rabiner and R.W. Schaffer., Digital Processing of Speech signals, Prentice Hall, 1978
5. I.H. Witten, Principles of Computer Speech, Academic Press, 1982

**21EC021 DIGITAL IMAGE PROCESSING****3 0 0 3****Course Objectives**

- ✓ To study the digital image processing fundamentals.
- ✓ To understand the working of mathematical transforms applied on digital images.
- ✓ To acquire the basic knowledge in filters, image enhancement, image restoration and compression techniques.

**Course Outcomes (COs)**

1. Understand the fundamentals of digital images and application of mathematical transforms on images.
2. Apply different methodologies for smoothening and sharpening of images in spatial and frequency domain.
3. Implement the segmentation techniques for the detection of edges, lines, and thresholding techniques.
4. Analyze the methods for image restoration and reconstruction using different filtering and projections.
5. Analyze different lossy and lossless coding techniques for image compression.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2										2	2
2	2	2	2		2								2	2
3	2	2	2		2								2	2
4	2	2	2		2								2	2
5	2	2		2									2	2

**UNIT I****9 Hours****DIGITAL IMAGE FUNDAMENTALS**

Fundamentals of digital image processing, Elements of visual perception, Image sampling and quantization, Basic Relationships between pixels. Image Transforms: Discrete Fourier transform, Cosine, Hadamard, Haar, Walsh and Slant transform

**UNIT II****9 Hours****IMAGE ANALYSIS**

Spatial domain: Histogram processing, Equalization, Basics of spatial filtering, Smoothing spatial filters, Sharpening spatial filters, Frequency Domain: Image smoothing and sharpening using frequency domain filters.

**UNIT III****9 Hours****IMAGE SEGMENTATION**

Edge detection: Point, line and edge detection- Detection of isolated points, Line detection, Edge models, Edge linking and boundary detection. Thresholding, Region splitting and Region Merging.

**UNIT IV**

**9 Hours**

**IMAGE RESTORATION AND RECONSTRUCTION**

Image Restoration: Image degradation/ restoration model, Noise models, Restoration-Spatial Filtering, Inverse filtering, Wiener Filtering, Geometric Mean Filter, Image reconstruction from projections.

**UNIT V**

**9 Hours**

**IMAGE COMPRESSION**

Basic compression methods-Huffman coding, Golomb coding, Arithmetic coding, LZW coding, Run-length coding, Block transform coding, Wavelet coding.

**Total: 45 Hours**

**Reference(s)**

1. Rafael C Gonzalez, Richard E Woods, Digital Image Processing, 4th Edition, Pearson Education 2018.
2. Digital Image Processing, S. Jayaraman, S. Esakkirajan, T. Veerakumar, McGraw Hill Education, 2009. Pvt Ltd, NewDelhi.
3. S Sridhar, Digital Image Processing, 2nd ed., Oxford University Press, 2016.
4. Tinku Acharya and Ajoy K. Ray-Image Processing Principles and Applications, A John Wiley & Sons, Mc., Publication 2005.
5. Ardeshir Goshtasby, 2D and 3D Image registration for Medical, Remote Sensing and Industrial Applications, John Wiley and Sons, 2005.

## 21EC022 MULTIMEDIA COMPRESSION TECHNIQUES

**3 0 0 3**

### Course Objectives

- ✓ To Understand the special features and representations of different data types.
- ✓ To Analyze different compression techniques for text data and audio signals
- ✓ To Analyze various compression techniques for image and video signals

### Course Outcomes (COs)

1. Apply the fundamental concepts of multimedia and compression techniques.
2. Implement different lossy and lossless coding techniques for text compression.
3. Analyze the various lossy and lossless coding techniques for audio compression.
4. Apply and analyze the compression techniques for images.
5. Analyze different video compression standards and techniques.

### Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2										2	2
2	2	2	2		2								2	2
3	2	2	2		2								2	2
4	2	2	2		2								2	2
5	2	2		2									2	2

### UNIT I

**9 Hours**

#### INTRODUCTION

Special features of Multimedia - Graphics and Image Data Representations - Fundamental Concepts in Text, Images, Graphics, Video and Digital Audio - Storage requirements for multimedia applications - Need for Compression - Lossy & Lossless compression techniques

### UNIT II

**9 Hours**

#### TEXT COMPRESSION

Compression techniques - Huffman coding - Adaptive Huffman Coding - Arithmetic coding - Shannon-Fano coding - Dictionary techniques - LZ77, LZ78, LZW family algorithms.

### UNIT III

**9 Hours**

#### AUDIO COMPRESSION

Audio compression techniques-MU-Law and A-Law companding - Frequency domain and filtering - Basic sub-band coding -DPC M-ADPCM-DM-LPC-CELP -Application to speech coding - G.722 - Application to audio coding - MPEG audio

### UNIT IV

**9 Hours**

#### IMAGE COMPRESSION

MMR coding - Transform Coding - JPEG Standard - Sub-band coding algorithms - Design of Filter banks- Wavelet based compression - Implementation using filters - EZW, SPIHT coders - JPEG 2000 standards- Run length coding.

**UNIT V**

**9 Hours**

**VIDEO COMPRESSION**

Video compression techniques and standards - MPEG Video Coding I: MPEG-1 and 2 - MPEG Video Coding II - MPEG - 4 and 7 - Motion estimation and compensation techniques - H.261 Standard

**Total: 45 Hours**

**Reference(s)**

1. David Salomon, Data Compression, The Complete Reference, Springer Verlag, 2006
2. Colt McAnlis, Understanding Compression, O'Reilly Media, Inc, 2016
3. Khalid Sayood, Introduction to Data Compression, Morgan Kaufman Harcourt India, 2007.
4. Yun Q. Shi and Huifang Sun, Image and Video Compression for Multimedia Engineering. Fundamentals, Algorithms & Standards, CRC press, 2003.
5. Peter Symes, Digital Video Compression, McGraw Hill Publication, 2004.
6. Mark S. Drew and Ze-Nian Li, Fundamentals of Multimedia, PHI, 2003.

**21EC023 COMPUTER VISION****3 0 0 3****Course Objectives**

- ✓ To Learn the image fundamentals and mathematical transforms necessary for image processing
- ✓ To Understand the image enhancement and restoration methods
- ✓ To Study the concepts of optics and lens systems

**Course Outcomes (COs)**

1. Apply the various image enhancement and segmentation methods
2. Carry-out the different morphological operations and shape representations in digital images
3. Differentiate of different techniques in object recognition systems
4. Analyze the different camera systems for 3D vision tasks
5. Analyze the various motion methods in processing of machine vision images

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	2										2	2
2	2	3	2		2								2	2
3	2	3	2		2								2	2
4	2	2	2		2								2	2
5	2	1		3									2	2

**UNIT I****9 Hours****IMAGE SEGMENTATION**

Thresholding - Edge based segmentation - Region based segmentation - Matching - Evaluation issues in segmentation - Mean Shift segmentation - Active contour models - snakes - Geometric deformable models - level sets and geodesic active contours - Fuzzy Connectivity

**UNIT II****9 Hours****MORPHOLOGY AND SHAPE REPRESENTATION**

Basic morphological concepts - Four morphological principles - Binary dilation and erosion-Gray scale dilation and erosion -Skeletons and object marking - Granulometry - Morphological segmentation and watersheds. Region identification

**UNIT III****9 Hours****OBJECT RECOGNITION**

Knowledge representation - Statistical pattern recognition - Neural nets - Syntactic pattern recognition - Recognition as graph matching - Optimization techniques in recognition - Fuzzy systems - Boosting in pattern recognition

**UNIT IV****9 Hours****3D VISION**

3D vision tasks - Basics of projective geometry - A single perspective camera-Scene reconstruction from multiple views -Two cameras, stereopsis - Three cameras and trifocal tensor- 3D information from radiometric measurements

**UNIT V**

**9 Hours**

**MOTION ANALYSIS**

Differential motion analysis methods - Optical flow - Analysis based on correspondence of interest points - Detection of specific motion patterns - Video tracking - Motion models to aid tracking

**Total: 45 Hours**

**Reference(s)**

1. Ramesh Jain, Rangachar Kasturi and Brian G. Schunck, Machine Vision, McGraw Hill International Edition, 2012
2. Sonka, Hlavac, Boyle, Image Processing, Analysis and Machine Vision, CENGAGE Learning, 4th Edition, 2015
3. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, Pearson India, 3rd Edition, 2013
4. W.K. Pratt, Digital Image Processing, John Wiley and Sons, 2001



**21EC024 WAVELET TRANSFORMS AND APPLICATIONS****3 0 0 3****Course Objectives**

- To understand the basic concept of wavelet transforms.
- To apply the wavelet transforms in the dynamic system models and classifiers.
- To apply wavelet signal processing techniques in domains of signal and image processing techniques.

**Course Outcomes (COs)**

1. Apply the fundamentals of continuous and discrete wavelet transforms.
2. Implement the orthonormal basis and filter banks of wavelet transform.
3. Apply and analyze biorthogonal wavelet bases and 2D wavelet packets.
4. Apply and analyze wavelet transform in signal and image models.
5. Outline the recent advancements of wavelet transform in signal and image processing applications.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	2										3	3
2	2	3	2		2								2	2
3	2	3	2		2								2	2
4	2	2	2		2								2	2
5	2	1		3									2	2

**UNIT I****9 Hours****CONTINUOUS AND DISCRETE WAVELET TRANSFORM**

Concepts of continuous time wavelet transform, CWT as a correlation, Constant Q factor filtering-interpretation, time frequency resolution, CWT as a operator, inverse CWT, Discrete wavelet transform

**UNIT II****9 Hours****ORTHONORMAL WAVELETS AND FILTER BANKS**

Definition of MRA, Construction of a general orthonormal MRA, Wavelet basis for MRA, Digital filtering, Examples of orthonormal basis, generating wavelets, Interpreting orthonormal MRA for discrete, time signals

**UNIT III****9 Hours****ALTERNATIVE WAVELET TRANSFORMS**

Biorthogonal wavelet bases, Filtering relations for orthogonal filters, examples of biorthogonal scaling functions and wavelets, 2D Wavelets, non separable multidimensional wavelets, Wavelet packets, transform coding

**UNIT IV**

**9 Hours**

**APPLICATION OF WAVELET TRANSFORMS**

Wavelet denoising, speckle removing, Edge detection and object isolation, image fusion, Object detection by wavelet transforms of projections, communication applications, scaling functions as signaling pulses

**UNIT V**

**9 Hours**

**ADVANCED TOPICS**

Parsevals identity for CWT, wavelet inner product as a projection operations, CWT with an orthonormal basis for generating wavelet, ATrous algorithm, regularity, convergence, Daubechies construction of orthonormal scaling functions, band limited biorthogonal decomposition.

**Total: 45 Hours**

**Reference(s)**

1. Lokenath Debnath, Firdous Ahmad Shah, Wavelet Transforms and Their Applications, Birkhauser Boston Inc, 2014
2. Mallat., Wavelet Tour of Signal Processing, Academic Press, 2008.
3. Raghuveer. M. Rao and Ajit. S. Bopardikar, Wavelet transforms Introduction to theory and Applications, Addison Wesley education Asia 2000.
4. C.Sidney burrus, Ramesh A. Gopinath, and Haitao Guo, Introduction to wavelets and wavelet transforms A Primer, PH International Editions, 1998.
5. G, .Strang and T.Nguyen, Wavelets and Filter Banks, Wellesley Cambridge Press, 1996

**21EC025 UNDERWATER ACOUSTIC COMMUNICATIONS**

**3 0 0 3**

**Course Objectives**

- ✓ Learn the characteristics of Underwater Acoustic environment.
- ✓ To be able to analyze and design the performance of underwater acoustic systems
- ✓ Detection of active signal, estimation of time of arrival and signal magnitude to assess geometric properties of underwater channel and to assess emission level and target strength.
- ✓ Design the Optimization techniques in Echo cancellation, Beam forming and Noise reduction methods.
- ✓ Understand the concepts of acoustic signal models.

**Course Outcomes (COs)**

1. Identify the characteristics of underwater acoustic channel environment.
2. Understand the principles and characteristics of SONAR systems.
3. Analyze and develop acoustic an echo cancellation algorithm and beamforming techniques.
4. Analyze the challenges in noise reduction in underwater environment.
5. Analyze the acoustic MIMO system design for underwater scenario.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2	2									2	
2	2	3	2		2								2	
3	2	3	1		1								2	
4	2	2	2		1								2	
5	2	1		3	1								2	

**UNIT I**

**7 Hours**

**FUNDAMENTAL OF UNDERWATER ACOUSTICS**

Speed of sound in seawater - Transmission Loss - Refraction - Deep sound channel and Reliable acoustic path - Surface Interference - Active and Passive UWSN - Noise and Bandwidth Considerations.

**UNIT II**

**11 Hours**

**SONAR SYSTEMS**

SONAR equations: Active and Passive, Underwater sound systems: Generic Active SONAR systems and Generic Passive SONAR systems, SONAR Transducers, Receivers, Receiving arrays and sonobuoys - Signal processing functions.

**UNIT III**

**10 Hours**

**ECHO CANCELLATION AND BEAM FORMING TECHNIQUES**

Acoustic echo cancellation (AEC) - Adaptive Beam Forming - Joint Acoustic echo cancellation and Adaptive Beamforming - Optimization Techniques: LCLSE, GSC, GSAEC, and RGSC Methods.

**UNIT IV**

**10 Hours**

**NOISE REDUCTION**

Weiner Filter and spectral subtraction - Optimum Filter design in the digital domain - Wiener filter in the frequency domain - Wiener filter realizations - Spectral subtraction: Principles and realizations.

**UNIT V**

**7 Hours**

**ACOUSTIC MIMO SYSTEMS**

Acoustic environment distraction - Signal Models: SISO, SIMO, MISO, and MIMO - Characteristics: Reverberation Time - Channel Invertibility and Minimum phase filter - Multichannel diversity and Common Zero problem - Sparse Impulse response.

**Total: 45 Hours**

**Reference(s)**

1. Stergiopoulos, Stergios- Advanced signal processing handbook\_theory and implementation for radar, sonar, and medical imaging real time systems-CR (2017).
2. David Havelock, Sonoko Kuwano, Michael Vorlander-Handbook of Signal Processing in Acoustics (2 vol set) - Springer (2009).
3. Jens Blauert, Ning Xiang-Acoustic MIMO Signal Processing-Springer (2006).
4. E. Hansler, G. Schmidt -Topics in Acoustic Echo and Noise Control-Springer (2006)
5. Hanzo L., Somerville F.S., Woodard J.-Acoustic Signal Processing for Telecommunication, (2002).
6. L.Kinsler, et al., Fundamentals of Acoustics, Wiley Publications, (2000) - Fourth edition.

**21EC026 SATELLITE COMMUNICATION****3 0 0 3****Course Objectives**

- ✓ To know the basics of satellite communication
- ✓ To understand the concepts of orbital mechanics, multiple access techniques and space links
- ✓ To gain knowledge on spacecraft subsystems, earth stations and satellite platform applications

**Course Outcomes (COs)**

1. Apply Orbital effects in Communication System and analyze performance of Attitude control
2. Understand the various subsystems of spacecraft
3. Design and analyze the characteristics of satellite links
4. Analyze various multiple access techniques in a satellite network
5. Compare different types of satellite services in broadcasting multimedia applications

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3		1									2	2
2	2	3	2										2	2
3		2	3										2	2
4		2		3									2	2
5			2			1	2						2	2

**UNIT I****9 Hours****ORBITAL MECHANICS**

Kepler's laws of motion, Orbits, Orbit Equations, Orbit Description, Locating the Satellite in the Orbit and with Respect to Earth, Orbital Elements-Look Angle Determination and Visibility - Orbital Perturbations, Orbit Determination, Launch Vehicles, Spectrum allocations for satellite systems.

**UNIT II****9 Hours****SPACECRAFT SUB SYSTEMS AND EARTH STATION**

Spacecraft Subsystems, Altitude and Orbit Control, Telemetry and Tracking, Power Systems, Communication Subsystems - Transponders, Antennas, Amplifier, Amplifier Noise Temperature, Equipment Reliability.

**UNIT III****9 Hours****SPACE LINKS**

Satellite Link Design - Satellite uplink and down link power Budget, Basic Transmission Theory, System Noise Temp, G/T Ratio, Noise Figure, Interference between satellite circuits, Energy Dispersal, propagation characteristics of fixed and mobile satellite links.

**UNIT IV****9 Hours****MULTIPLE ACCESS TECHNIQUES AND NETWORK ASPECTS**

Multiple access (MA). Classical MA techniques: FDMA, TDMA, CDMA, DAMA. Mobile satellite network design, ATM via satellite. TCP/IP via satellite - Call control, handover and call set up procedures. Hybrid satellite-terrestrial networks.

**UNIT V**

**9 Hours**

**SERVICES AND APPLICATIONS**

INTELSAT series, INSAT, VSAT, Remote Sensing - Mobile satellite service: GSM, GPS, INMARSAT, LEO, MEO, Navigation System, Direct to Home service (DTH), Digital Audio Broadcast (DAB), Special services-E-mail, Video conferencing and Internet connectivity.

**Total: 45 Hours**

**Reference(s)**

1. Dennis Roddy, Satellite Communications, Fourth Edition, Mc Graw Hill International Editions, 2006.
2. Bruce R.Elbert, The Satellite Communication Applications Hand Book, Artech House Boston, Second Edition, 2004.
3. Wilbur L.Pritchard, Hendri G.Suyderhood, Robert A.Nelson, Satellite Communication Systems Engineering, Second Edition, Prentice Hall, New Jersey, 1993.
4. Louis J. Ippolito, Jr., Satellite Communications Systems Engineering - Atmospheric Effects, Satellite Link Design and System Performance, First edition, John Wiley & Sons Ltd., 2008.
5. Tri T.Ha, Digital satellite communication, 2nd Edition, McGraw Hill, New York, 1990
6. Peter Teunissen, Springer Handbook of Global Navigation Satellite Systems, Springer Handbooks, ISBN: 9783030731724, July 25th, 2021.

## 21EC027 OPTICAL COMMUNICATION AND NETWORKS

**3 0 0 3**

### Course Objectives

- Awareness on phenomena involved light propagation through various fiber configurations and the issues like attenuation mechanisms (losses) and signal degradation (dispersion effects)
- Characteristics of different components like transmitters, receivers, coupler etc., and their suitability to different types of optical communication links.
- Determination of choice of components for deployment of a given optical link based on link power (losses) & rise time (dispersive) budget and managing the optical network.

### Course Outcomes (COs)

1. Implement the behavior of different optical medium (fibers) and performance of signal Propagation.
2. Demonstrate the issues in propagation of optical signals resulting from signal degradation mechanism of optical fiber media.
3. Analyze the performance of optical sources, detectors and the concept for choice of light sources, detectors for the given optical link
4. Attribute the working of optical components in the design of optical networks. optical links.
5. Analyse the power loss and signal dispersive nature of optical media and apply the result to identify appropriate transmitter, receiver, on line.

### Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	2	1		1							2	
2	3	3	3	3			1						1	
3	3	2	3	2		1							2	
4	3	2	3	2		1							2	
5	3	3	3	3	1								1	

### UNIT I

**9 Hours**

#### INTRODUCTION TO OPTICAL FIBERS

Evolution of fiber optic system- Element of an Optical Fiber Transmission link- Ray Optics-Optical Fiber Modes and Configurations. Mode theory of Circular Waveguides- Overview of Modes-Key Modal concepts- Linearly Polarized Modes Single-Mode Fibers

### UNIT II

**9 Hours**

#### SIGNAL DEGRADATION OPTICAL FIBERS

Attenuation, Absorption losses, scattering losses, Bending Losses, Core and Cladding losses, Signal Distortion in Optical Waveguides-Information Capacity determination. Group Delay-Material Dispersion, Waveguide Dispersion, Polarization Mode dispersion, Intermodal dispersion, Mode Coupling

### UNIT III

**9 Hours**

#### FIBER OPTICAL SOURCES AND DETECTORS

Direct and indirect Band gap materials -LED- lasers Diodes - Quantum efficiency-PIN and APD diodes- Photo detector noises, SNR, Detector Response time, Comparison of Photo detectors.

**UNIT IV**

**9 Hours**

**OPTICAL NETWORK COMPONENTS**

Couplers, Isolators, Switches, Wavelength Converters, Circulators, Filters, Multiplexers, WDM, Optical Amplifiers-EDFA - Basic on concepts of SONET/SDH Network

**UNIT V**

**9 Hours**

**SYSTEM DESIGN AND MANAGEMENT**

Point to Point links System considerations, Power budget, time budget- bandwidth budget calculations, Noise Effects on System Performance- OTDR -Attenuation and dispersion, Field Measurements. Network Management- Performance and fault management, Configuration Management.

**Total: 45 Hours**

**Reference(s)**

1. Optical Fiber Communication by Gerd Keiser, Springer Nature Singapore, March 2021
2. Optical Networks: A Practical Perspective by Rajiv Ramaswami and Kumar Sivarajan Morgan Kaufmann, 2010.
3. Optical Communication, Principles and Practice by J.Senior Prentice Hall of India, Third edition published 2009.
4. Optical Communication-Components and Systems by J.H. Franz, V.K. Jain, Narosa Publishing House, 2000.
5. Optical Network Design and Implementation by Vivek Alwayn, Pearson Education, 2006.
6. Optical Networks: Architecture and Survivability by Hussein T. Mouftab and Pin-Han Ho, Springer US, 2003



**21EC028 MIMO COMMUNICATION****3 0 0 3****Course Objectives**

- ✓ To learn the concepts of MIMO channel propagation and MIMO channel model.
- ✓ To understand spatial diversity and MIMO channel capacity performance in wireless communication.
- ✓ To provide the fundamental knowledge on Space-Time Codes and MIMO detection techniques.

**Course Outcomes (COs)**

1. Understand the various channel models and its power allocation in MIMO Systems.
2. Apply the mathematics concepts and Calculate the capacity of deterministic, random MIMO and fading channel Models
3. Analyze the implication of spatial diversity method and calculate the diversity order and channel variability.
4. Analyze the concept of different space time coding techniques like STBCs, STTCs and Space time turbo codes
5. Analyze the various algorithms used to detect the received signal in MIMO systems like Maximum likelihood, MMSE, ZFE

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2			1								2	
2	2	2	1		2	1							2	
3	2	2	1		3								2	
4	2	2	2		3								2	
5	2	2	2		3								2	

**UNIT I****9 Hours****INTRODUCTION TO MIMO CHANNEL MODELS**

Diversity-multiplexing trade-off, transmit diversity schemes, advantages and applications of MIMO systems, Fading Channel Models: Uncorrelated - fully correlated - separately correlated - keyhole MIMO fading models, parallel decomposition of MIMO channel, Power allocation in MIMO: Uniform - adaptive - near optimal power allocation

**UNIT II****9 Hours****MIMO CHANNEL CAPACITY**

Capacity for deterministic MIMO Channels: SISO, SIMO, MISO, MIMO, Capacity of random MIMO channels: SISO, SIMO, MISO, MIMO (Unity Channel Matrix, Identity Channel Matrix), Capacity of independent identically distributed channels, Capacity of separately correlated Rayleigh fading MIMO channels, Capacity of keyhole Rayleigh fading MIMO channel

**UNIT III****9 Hours****SPATIAL DIVERSITY**

Diversity gain, receive antenna diversity, transmit antenna diversity, Diversity order and channel variability, Diversity performance in extended channels, combined space and path diversity, Indirect transmit diversity, Diversity of a space, time, frequency selective fading channel.

**UNIT IV**

**9 Hours**

**SPACE-TIME CODES**

Advantages, code design criteria, Alamouti space time codes, SER analysis of Alamouti space-time code over fading channels, Space time block codes, Space time trellis codes, Performance analysis of Space, time codes over separately correlated MIMO channel, Space-time turbo codes, BLAST Architectures: VBLAST , HBLAST ,SCBLAST , DBLAST

**UNIT V**

**9 Hours**

**MIMO DETECTION TECHNIQUES**

Maximum Likelihood, Zero Forcing, Minimum Mean Square Error, Zero Forcing Equalization with Successive Interference Cancellation, Minimum Mean Square Error Successive Interference Cancellation, Lattice Reduction based detection

**Total: 45 Hours**

**Reference(s)**

1. Tolga M. Duman and Ali Ghrayeb, Coding for MIMO Communication Systems, John Wiley & Sons Ltd., 2007
2. Ezio Biglieri, Robert Calderbank and Anthony Constantinides. MIMO Wireless Communications Cambridge University Press, 2007
3. R. S. Kshetrimayum, Fundamentals of MIMO Wireless Communications, Cambridge University Press, 2017.
4. B. Kumbhani and R. S. Kshetrimayum, MIMO Wireless Communications over Generalized Fading Channels, CRC Press, 2017
5. T. L. Marzetta, E. G. Larsson, H. Yang and H. Q. Ngo, Fundamentals of Massive MIMO, Cambridge University Press, 2016.

**21EC029 SIGNAL PROCESSING FOR mmWAVE  
COMMUNICATION**

**3 0 0 3**

**Course Objectives**

- To impart the knowledge and encompasses the complete mmWave communication from the signal processing point of view.
- To give an in-depth knowledge about the mmWave channel models.
- To analyze the MIMO-OFDM in mmWave channel models.
- To design and analyze the beamforming technology of the mmWave models.

**Course Outcomes (COs)**

1. Analyze the ray tracing channel models in narrowband and wideband aspects.
2. Analyze the various time varying channel model
3. Analyze the mmWave channel model using Transmitter and receiver side multiple antennas
4. Design and analysis of various beamforming techniques in mmWave channel model.
5. Analyze the Precoder, Phase Shifter, Equalizer for better optimization of design parameters.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	2										2	
2	2	3	2		2								2	
3	2	3	2		2								2	
4	2	3	2		2								2	
5	2	1		3									2	

**UNIT I**

**9 Hours**

**AN INTRODUCTION TO WIRELESS CHANNELS**

Wireless Channel - A ray tracing model - Fundamentals and General Channel Model - RMS Delay, and Doppler effect of the channels, Understanding of various channel-related parameter statistics - Narrowband and broadband aspect.

**UNIT II**

**9 Hours**

**TIME VARYING CHANNEL MODEL**

Time-varying model - Doppler impact of coherence Bandwidth - AR, ARMA and MA process - Doppler with AR process - Coherence Time and parameters

**UNIT III**

**9 Hours**

**MMWAVE CHANNEL MODEL**

Basics of ISI channel - Channel estimation and Equalizer -Precoder and MIMO channel - mmWave Spectrum - 3D Concepts: AOA - AOD - mmWave Channel Model: mmWave channel model with Rx Beamforming - Channel Model: Tx with multiple antennas.

**UNIT IV**

**9 Hours**

**BEAMFORMING TECHNIQUES**

Single antenna Beamforming - Different geometry of antenna from an electrical point of view - Basics of Beamforming pattern - SISO Beamforming - Concept of antenna many fold vector, beam parameters, efficiency of beams pattern.

**UNIT V**

**9 Hours**

**HYBRID BEAMFORMING TECHNIQUES**

Hybrid Beamforming of mmWave MIMO systems: Precoder, Phase Shifter, Equalizer, Optimization of design parameters, MIMO-OFDM, parameter estimation using LMMSE - mmWave system impairments.

**Total: 45 Hours**

**Reference(s)**

1. Kao-Cheng Huang, Zhaocheng Wang, Millimeter Wave Communication Systems, 1st edition, Wiley-IEEE Press, 2011
2. David Tse, Pramod Viswanath, Fundamentals of wireless communication, Cambridge University Press, 2003.

**21EC030 MACHINE LEARNING FOR WIRELESS COMMUNICATIONS****3 0 0 3****Course Objectives**

- To understand the principles of machine learning and apply the fundamental principles for regression and classification.
- To apply the mathematical principles of probability, linear algebra and optimisation
- To apply machine learning principles in the design of some physical layer techniques in wireless communications

**Course Outcomes (COs)**

1. Apply the principles of machine learning and apply the fundamental principles for regression and classification.
2. Apply the linear Modeling approach for estimation of the signal.
3. Apply the Bayesian Approach to Machine Learning for channel estimation.
4. Apply the machine learning concept for clustering and classification.
5. Attribute different Machine learning algorithms for wireless applications.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	2										1	
2	2	3	2		2								1	
3	2	3	2		2								1	
4	2	2	2		2								1	
5	2	1		3									1	

**UNIT I****9 Hours****FUNDAMENTALS OF MACHINE LEARNING**

Quick overview of Supervised, Unsupervised and Reinforcement Learning- Supervised Learning- Classification, Neural networks and Deep Learning, Unsupervised Learning-Clustering, Autoencoders, Reinforcement Learning-Markov Decision Processes, Q-Learning o Multi-armed Bandits

**UNIT II****9 Hours****LINEAR MODELING**

A Least Squares Approach, Linear modelling, Generalization and over fitting, Regularized least squares A Maximum Likelihood Approach, Errors as noise, Maximum likelihood, Bias-variance trade-off, Effect of noise on parameter estimates.

**UNIT III****9 Hours****BAYESIAN APPROACH**

Exact posterior, Marginal likelihood, Hyperparameters, Bayesian Inference- Non-conjugate models, Point estimate, MAP solution, Laplace approximation

**UNIT IV****9 Hours****CLUSTERING AND CLASSIFICATION**

Classification: Probabilistic classifiers, Bayes classifier, logistic regression, Non Probabilistic classifiers, K-nearest neighbors, Discriminative and generative classifiers

Clustering: General Problem, K-means clustering, Gaussian mixture models (GMM), EM algorithm, MAP estimates, Bayesian mixture models.

**UNIT V**

**9 Hours**

**APPLICATION IN WIRELESS**

Physical layer communications, Use of autoencoders, Modulation, Channel coding, Modulation / Signal classification, Localization, Spectrum Sensing, Adaptive modulation and coding (AMC): classical AMC, using support vector machines, using k-nearest neighbors, using k-means, using reinforcement learning.

**Total: 45 Hours**

**Reference(s)**

1. M. Bishop Pattern Recognition And Machine Learning, Christopher ,Springer 2009.
2. P Murphy, MIT Machine Learning A Probabilistic Perspective, Kevin Press 2012
3. Machine Learning and Wireless Communications, Yonina C. Eldar, Princeton University, New Jersey, Cambridge University Press, June 2022.

**21EC031 MICROWAVE CIRCUITS AND SYSTEMS****3 0 0 3****Course Objectives**

- ✓ To describe the basic principles and advanced applications of Microwave Engineering.
- ✓ To introduce the concept of transmission lines and waveguides.
- ✓ To illustrate the concepts of microwave network analysis and impedance matching.
- ✓ To learn about various types of resonators.
- ✓ To learn about Microwave Filters.
- ✓ To describe the procedures to design different amplifiers, oscillators and mixers.

**Course Outcomes (COs)**

1. Apply the concept and derive different characteristics of various transmission lines waveguides
2. Analyze various parameters of microwave networks.
3. Analyze and design microwave filters and resonators
4. Analyze the concept of amplifier stability, gain and noise figure
5. Analyze EMI /EMC for all microwave small signal and power amplifiers

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
1	2	2	2										2	2
2	2	2	2		2								2	2
3	2	2	2		2								2	2
4	2	2	2		2								2	2
5	2	2		2									2	2

**UNIT I****9 Hours****RF AND MICROWAVE PASSIVE COMPONENTS**

Resistor Inductor and Capacitor at High Frequency Directional couplers Two hole directional couplers Isolator Circulator S Matrix for microwave components

**UNIT II****11 Hours****MICROWAVE NETWORK ANALYSIS AND TUNING**

Impedance and admittance matrices, scattering matrices, ABCD matrix, Signal flow graphs, discontinuities and modal analysis, Series and parallel resonance circuits, transmission line resonators rectangular waveguide cavity resonator, circular waveguide cavity resonator, dielectric resonator.

**UNIT III****9 Hours****MICROWAVE FILTERS**

Periodic structures, filter design by: Image parameter method, insertion loss method, filter transformation, filter implementation, LPF, coupled line filters, filters using coupled resonators

**UNIT IV****9 Hours****MICROWAVE AMPLIFIER, OSCILLATOR AND MIXER DESIGN**

Two port power gains, single stage transistor amplifier design, broadband transistor amplifier design, power amplifier, RF oscillators Microwave Oscillator, oscillator phase noise, frequency multipliers, and mixers.

**UNIT V**

**7 Hours**

**MODERN TRENDS IN MICROWAVES ENGINEERING**

Effect of Microwaves on human body. Medical and Civil applications of microwaves. Electromagnetic interference Electromagnetic Compatibility (EMI EMC).

**Total: 45 Hours**

**Reference(s)**

1. R.E.Collin, Foundations of Microwave Engineering, Wiley, 2nd edition 2007.
2. Ramo, Whinnery and Van Duzer, Fields and Waves in Communication Electronics, 3rd Edition, Wiley, 2007.
3. David. M Pozar, Microwave and RF System Design, Wiley 2001.
4. Wayne Tomasi, Advanced Microwave Communication Systems, PHI, 2nd Edition, 2002



**21EC032 MICROWAVE INTEGRATED CIRCUITS****3 0 0 3****Course Objectives**

- ✓ To acquire an insight view and knowledge to design different types of resonators, filters and advanced microwave structures.
- ✓ To gain proficiency regarding microwave integrated circuit concepts and relation between different parameters.
- ✓ To analyse and design microwave integrated circuit design using lumped elements and transmission lines.

**Course Outcomes (COs)**

1. Apply the concept of production methods, substrates, packaging and components in Monolithic MIC technology.
2. Analyze and design the different types of microwave integrated circuits by using transmission lines and lumped elements.
3. Analyze different types of resonators and filters to select frequencies in microwave communication circuit.
4. Analyze the various measurement techniques involved in Microwave Integrated Circuits.
5. Analyze the design and development of advanced microwave structures to enable the current MIC technologies in near future.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	2										2	
2	1	2	3										2	
3		2	3										2	
4	1	2		2										1
5		1	3		2								2	

**UNIT I****9 Hours****MONOLITHIC MIC TECHNOLOGY**

Introduction to microwave communication and EM spectrum Characteristics of Microwave and Millimeter waves MMIC technology, Applications, Substrates, Production Methods, Packaging, and Electrical Connections, Components for Integrated Microwave Circuits.

**UNIT II****9 Hours****TRANSMISSION LINES AND LUMPED ELEMENTS**

Characteristics of Planar Transmission lines Strip line, Microstrip, Suspended and Inverted Microstrip Lines, Coupled Lines and its Discontinuities Lumped elements: Design of Lumped elements, Inductors, Capacitors, and Resistors.

**UNIT III****9 Hours****FILTERS AND RESONATORS**

Introduction Resonator parameters Planar Microstrip resonant structures Dielectric resonator. Filter Synthesis: Low pass filter, Special response filter, Filter transformations, Impedance and Admittance Inverters Filter Modelling: Narrowband approximation, Filter Realizations Dielectric Resonant filters Practical considerations.

**UNIT IV**

**9 Hours**

**MICROWAVE IC DESIGN AND MEASUREMENT TECHNIQUES**

Microwave Integrated Circuits MIC Materials Hybrid versus Monolithic MICs Multichip Module Technology Fabrication Techniques, Miniaturization techniques, Introduction to SOC, SOP, Test fixture measurements, probe station measurements.

**UNIT V**

**9 Hours**

**ADVANCED MICROWAVE STRUCTURES**

Defect Ground Structure Introduction, Base structure, Circuit topologies, Characteristics, Modelling of DGS and Application of DGS Substrate Integrated Waveguides: Introduction Geometry Operation principle Analysis Techniques of SIW Design Considerations.

**Total: 45 Hours**

**Reference(s)**

1. David M. Pozar, Microwave Engineering, John Wiley & Sons, 1998.
2. David M. Pozar, Microwave & RF Design of Wireless Systems, John Wiley & Sons, 1998.
3. Ulrich L. Rohde, Matthias Rudolph RF/Microwave Circuit Design for Wireless Applications Wiley (2012).
4. InderBahl, Prakash Bhartia Microwave Solid State Circuit Design-Wiley Interscience(2003).
5. Ramesh Garg, InderBahl, Maurizio Bozzi Microstrip Lines and Slotlines, Third Edition Artech House (2013).
6. Hoffman R.K, Handbook of Microwave Integrated Circuit, Artech House (1987).

**21EC033 RF SYSTEM DESIGN****3 0 0 3****Course Objectives**

- ✓ To identify the and realize the different specification parameters of a wireless system.
- ✓ To analyze the characteristics of noise and distortion in wireless RF systems.
- ✓ To design RF systems using behavior models of the subsystems present in the receiver chains.

**Course Outcomes (COs)**

1. Analyze the characteristics of noise and distortion in the microwave systems due to temperature, mismatched terminations and inter-modulations.
2. Design and implement the Filters using image impedance, insertion loss and prototype techniques.
3. Analyze the performance of amplifier circuits in the receivers in different configuration modes.
4. Design the different mixer circuits using Schottky barrier diode, FETs and analyze its characteristics.
5. Analyze the devices for switches, oscillator circuits, frequency synthesizers and evaluate its performance at the receiver end.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	2										1	
2	2	3	2		2								1	
3	2	3	2		2								1	
4	2	2	2		2								1	
5	2	1		3									1	

**UNIT I****9 Hours****NOISE AND DISTORTION IN RF SYSTEMS**

Noise temperature and noise figure, noise figure of a lossy transmission line; Noise figure of cascade systems; Noise figure of passive networks, mismatched transmission lines and Wilkinson power dividers; Dynamic range and inter-modulation distortion.

**UNIT II****9 Hours****RF FILTER DESIGN**

RF filter design-constant K prototype filter design-derived prototype filter design. Insertion loss method- Maximally flat low pass prototype, Equal ripple low pass prototype, Filter transformation and filter implementation.

**UNIT III****9 Hours****RF AMPLIFIER DESIGN**

Circuit models for FETs and BJTs; Amplifier design using S-parameters: Design for maximum gain, maximum stable gain, design for specified gain, low-noise amplifier design, design of class-A power amplifiers.

**UNIT IV**

**9 Hours**

**MIXERS**

Mixer characteristics: Image frequency, conversion loss, noise figure; Diode mixers: Small-signal characteristics of diode, single-ended mixer, large-signal model, switching model; FET Mixers: Single-ended mixer, other FET mixers; Balanced mixers; Image reject mixers.

**UNIT V**

**9 Hours**

**SWITCHES**

Devices for microwave switches: PIN diode, BJT, FET; Device models; Types of switches; Switch configurations; Basic theory of switches; Multi-port, broad-band and isolation switches.

**Total: 45 Hours**

**Reference(s)**

1. Pozar, D.M. Microwave and RF Design of Wireless Systems, John Wiley & Sons.
2. Gonzalez, G., Microwave Transistor Amplifiers: Analysis and Design, 2nd Ed., Prentice-Hall. 1997.
3. Bahl, I. and Bhartia, P., Microwave Solid State Circuit Design, 2nd Ed., John Wiley & Sons. 2003.
4. Chang, K., Bahl, I. and Nair, V., RF and Microwave Circuit and Component Design for Wireless Systems, Wiley Interscience. 2002.
5. Rohde, U.L. and Newkirk, D.P., RF/Microwave Circuit Design for Wireless Applications, John Wiley & Sons. 2000.
6. Larson, L.E., RF and Microwave Circuit Design for Wireless Applications, Artech House. 1996.

**21EC034 ELECTROMAGNETIC INTERFERENCE  
AND COMPATIBILITY**

**3 0 0 3**

**Course Objectives**

- To apply, identify and understand the basic sources of EMI & EMC.
- To formulate and analyze different EMI measurements.
- To understand the concepts of EMI control mechanisms which meets the specific needs with appropriate techniques.
- To select, apply and differentiate appropriate standards for EMI/EMC
- To design, analyze and understand the process of creating EMC PCBs

**Course Outcomes (COs)**

1. Understand the effects of EMI-EMC and their sources of origination
2. Design and implement the EMI rejection filters for a particular application.
3. Apply EMI control mechanisms for specific needs with appropriate techniques
4. Compare and discuss about different standards for EMI/EMC.
5. Design and analyze the process of creating EMC PCBs

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	2										1	2
2	1	2	2										2	1
3		2	2	1									2	1
4		2	1	2									2	2
5		2	1	1	2								2	1

**UNIT I**

**9 Hours**

**EMI ENVIRONMENT**

Concepts of EMI and EMC and definitions Sources of EMI Celestial Electromagnetic noise Lightning discharge-Electrostatic Discharge Electromagnetic Pulse Electromagnetic emissions Noise from relays and Switches Nonlinearities in Circuits.

**UNIT II**

**9 Hours**

**EMI COUPLING PRINCIPLES**

Capacitive coupling Inductive coupling Common impedance ground coupling- Ground loop coupling Transients in power supply lines Radiation coupling, Conduction coupling Common mode and Differential mode interferences Conducted EM noise on power supply lines.

**UNIT III**

**9 Hours**

**EMI MEASUREMENTS**

Open area test site measurements Measurement precautions Open -area test site Anechoic Chamber TEM Reverberating TEM GTEM cell Comparisons

**UNIT IV**

**9 Hours**

**EMI CONTROL TECHNIQUES**

EMC Technology Grounding-Shielding Electrical Bonding Power line filter CM filter DM filter EMI suppression Cables EMC Connectors Isolation transformer.

**UNIT V**

**9 Hours**

**EMI / EMC STANDARDS**

Introduction Standards for EMI/EMC MIL STD 461/462-IEEE/ANSI standard CISPR/IEC standard FCC regulations British standards VDE standards Euro norms Performance standards Comparisons.

**Total: 45 Hours**

**Reference(s)**

1. V.P.Kodali, Engineering EMC Principles, Measurements and Technologies, IEEE Press, 2 nd edition 2011.
2. C.R.Paul, Introduction to Electromagnetic Compatibility, John Wiley and Sons, Inc, 2 nd edition 2010.
3. Henry W.Ott, Electromagnetic Compatibility Engineering, John Wiley and Sons, New York, 2009.
4. Clayton R. Paul, Introduction to Electromagnetic Compatibility, 2nd Edition, wiley publishers, 2006.

## 21EC035 ANTENNA TECHNOLOGIES FOR WIRELESS APPLICATIONS

**3 0 0 3**

### Course Objectives

- ✓ To understand the fundamental knowledge on evolution of wireless communications
- ✓ To analyze the performance of the antenna for nearfield and indoor Applications
- ✓ To design the antenna for cellular applications

### Course Outcomes (COs)

1. Understand the requirements of an antenna under various environments for wireless applications
2. Analyze the radiation pattern of RFID Tag antennas for near field applications
3. Design the antennas for typical applications including RFID, Zigbee, cellular, wearable devices and UWB communication
4. Design and analysis of antennas for cellular applications
5. Analyze the challenges associated with the deployment and implementation of 5G networks

### Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	3		3								1	
2	2	2	3		2								2	
3	1	3	2		2								2	
4	2	2	2		2			2					1	
5	1	2		3				2					2	

### UNIT I

**9 Hours**

#### INTRODUCTION TO WIRELESS SYSTEMS AND STANDARDS

Wireless systems and standards -Applications, Air interface - Near field, Indoor, Outdoor, Requirements of antennas for above applications, Base station (BS) and User equipment (UE) antennas

### UNIT II

**9 Hours**

#### NEAR FIELD APPLICATIONS

Reader antennas- Specifications- gain, bandwidth and polarization, pillar antennas and design. RFID Tag Antennas: Tag architecture- Tag, clip type, Types of Tag, Radio Link, Parameters, Effect of Environment on RFID Tag Antennas. Design of reader and tag antennas.

### UNIT III

**9 Hours**

#### ANTENNAS FOR INDOOR APPLICATIONS

Zigbee and WLAN: air interface, frequency, Bandwidth and data rate requirement. Specification & topologies, Antennas for Zigbee/WLAN Access points- whip antennas, diversity. Antennas for user equipment- design challenges- gain, efficiency, SAR and size constraints.

**UNIT IV**

**9 Hours**

**CELLULAR ANTENNAS**

Cellular applications, Performance Requirements, Mode of operation, Base station antenna-specifications and challenges, topologies, Electrically Small Antennas, Topologies- Patch arrays, Beam tilting, null fill.

**UNIT V**

**9 Hours**

**ANTENNAS FOR NEXT GENERATION WIRELESS APPLICATIONS**

4G & 5G communication, challenges, form factor and broadband performance, Conformal, wearable antennas for body area network and UWB antennas.

**Total: 45 Hours**

**Reference(s)**

1. Zhi Ning Chen, Antennas for Portable devices Wiley Publishers, 2007
2. R. Waterhouse Printed antennas for wireless communications John Wiley Publishers
3. Peter S. Hall, Yang Hao Antennas and propagation for body-centric wireless communications
4. J.C. Liberti, JR and Theodore Rappaport, Smart Antennas for Wireless communication, Prentice Hall of India, 1999.
5. Grishkumar and K.P. Ray, Broadband microstrip antennas Artech House, 2003
6. John D. Kraus, Ronald J. Marhefka Antennas for all Applications Fourth Edition, Tata McGraw-Hill, 2006.



**21EC036 SMART ANTENNAS****3 0 0 3****Course Objectives**

- ✓ To Understand the fundamental knowledge on smart antenna systems and its configuration
- ✓ To estimate the Direction of arrival and using appropriate techniques.
- ✓ To simulate and measure the performance of the antenna structures using software tools

**Course Outcomes (COs)**

1. Analyze the architecture of smart antenna systems and its configuration to meet the requirements of real time applications
2. Apply the adaptive antenna systems and digital radio receiver techniques for smart antennas.
3. Analyze and evaluate the range and capacity of wireless systems equipped with smart antennas
4. Analyze the direction of arrival of the signal from the smart antenna array using appropriate methodologies
5. Design the smart antennas using simulation tools and to evaluate its performance with vector network analyzer

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	3										2	
2	2	1	2		2								1	
3	1	2	3		2								2	
4	2	1	2		2								3	
5	1	3		2				2					3	

**UNIT I****9 Hours****SMART ANTENNAS**

Spatial Processing for Wireless Systems, Key Benefits of Smart Antennas, smart antenna configuration, SDMA, architecture of smart antenna systems.

**UNIT II****9 Hours****SMART ANTENNA SYSTEMS**

The Vector Channel Impulse Response and the Spatial Signature, Spatial Processing Receivers, Fixed Beam forming Networks, Switched Beam Systems, Adaptive Antenna Systems, Digital Radio Receiver Techniques and Software Radios for Smart Antennas

**UNIT III****9 Hours****MULTI-USER SPATIAL PROCESSING TECHNIQUES**

Multi user spatial Processing, Dynamic resectoring- Range and capacity extension Range and Capacity analysis using smart antennas. Spatio temporal channel models. Spatial Channel Measurements, Application of Spatial Channel Models, Environment and signal parameters.

**UNIT IV**

**9 Hours**

**DOA ESTIMATION**

DOA estimation, conventional and subspace methods. ML estimation techniques. Estimation of the number of sources using Eigen decomposition. DOA Estimation under Coherent Signal Conditions, The Integrated Approach to DOA Estimation, Direction finding and true ranging PL systems.

**UNIT V**

**9 Hours**

**ANTENNA MEASUREMENT**

Introduction to Simulation tools for smart antenna design- ADS, HFSS. Introduction to Vector Network Analyzer, Antenna test range Design.

**Total: 45 Hours**

**Reference(s)**

1. T.S. Rappaport and J.C. Liberti, Smart Antennas for Wireless Communications, Prentice Hall, 2007.
2. Tapan K Sarkar , Smart Antennas ,IEEE Press, John Wiley & Sons Publications,2004.
3. L.C.Godara, Applications of antenna arrays to mobile communications, Part I: Performance improvement, feasibility, and system considerations, Proc. IEEE, vol. 85, no.7, pp.1031-1060, 2003.

**21EC037 SOFT COMPUTING****3 0 0 3****Course Objectives**

- ✓ To understand Fuzzy logic and Neural Network concepts
- ✓ To acquire the basic knowledge of Genetic algorithms
- ✓ To equip the students with the latest application of soft computing

**Course Outcomes (COs)**

1. Analyze the various types of Classical sets, Fuzzy sets with its properties
2. Analyze the basics of artificial neural networks
3. Understand the key concepts of Neuro Fuzzy systems
4. Analyze the various operations involved in the genetic algorithms
5. Analyze the concepts of soft computing for various Applications

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	2											2
2	1	2	3											2
3	2	3	2											2
4	3	3	2											3
5	2	3	2						2	2	1	2		2

**UNIT I****9 Hours****FUZZY SYSTEMS**

Fuzzy Sets, operations on Fuzzy Sets, Fuzzy Relations, Membership Functions: Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making.

**UNIT II****9 Hours****NEURAL NETWORKS**

Basic concepts-knowledge based processing-single layer perceptron-multilayer perceptron-supervised band unsupervised learning-feed forward and back propagation and counter propagation networks-kohens self organizing networks.

**UNIT III****9 Hours****NEURO-FUZZY MODELING**

Adaptive neuro fuzzy inference systems-classification and regression trees- data clustering-rule base structure identification.

**UNIT IV****9 Hours****GENETIC ALGORITHMS**

Basic Concepts-Working Principles -Encoding- Fitness Function - Reproduction - Inheritance Operators - CrossOver -Inversion and Deletion -Mutation Operator -Bit-wise Operators-Convergence of Genetic Algorithms.

**UNIT V**

**9 Hours**

**APPLICATIONS OF SOFT COMPUTING**

Fuzzy techniques for inverted pendulum case-SIRM fuzzy systems-MCDM for weather forecasting and financial marketing-Neural networks for pattern recognition-TS problems-Routers. GA application to metabolic modelling.

**Total: 45 Hours**

**Reference(s)**

1. Samarjeet Borah, Ranjit Panigrahi, Applied Soft computing: Techniques and Applications, 2022.
2. Timothy J. Ross, McGraw Hill Inc, Fuzzy Logic with Engineering Applications, 2000.
3. Madan M Gupta, Naresh K Sinha, Soft Computing and Intelligent Systems: Theory and Applications, Academic Press, 1999.
4. Rajasekaran, G A Vijayalakshmi Pai, Neural Networks, Fuzzy Logic and Genetic Algorithms Synthesis and Applications, Prentice Hall India, 2003.
5. S N Sivanandam, S Sumathi, S N Deepa, 5. Neural Networks using MATLAB, Tata McGraw Hill, 2005.
6. David E Goldberg, Genetic Algorithms in Search, Optimization, and Machine Learning, Pearson Education, 1996.

**21EC038 OPTIMIZATION TECHNIQUES****3 0 0 3****Course Objectives**

- ✓ To familiarize with the basic concepts and models of the operations research.
- ✓ To use transportation and assignment model techniques for effective decisions making.
- ✓ To optimization that are tailored to large-scale statistics and machine learning problems.

**Course Outcomes (COs)**

1. Understand the basics of convex optimization in linear programming
2. Apply the suitable method to predict the optimum solution for nonconvex problems.
3. Analyze the modern optimization techniques in Genetic Algorithm.
4. Analyze the methodology to reduce optimization problems using fuzzy logic and genetic algorithms.
5. Analyze the various optimization techniques involved in PSO.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	2	3										2
2	1	2	3	2										1
3	1	2	2	3										2
4	2	1	2	2										1
5	2	1	1	2										2

**UNIT I****9 Hours****BASICS OF CONVEX OPTIMIZATION**

Convex sets, convexity-preserving operations, examples of convex programs (linear programming (LP), second-order cone programming (SOCP), semidefinite programming (SDP)), convex relaxation, KKT conditions, duality

**UNIT II****9 Hours****STOCHASTIC AND NONCONVEX OPTIMIZATION**

Dual averaging, Polyak Juditsky averaging, stochastic variance reduced gradient (SVRG), Langevin dynamics, escaping saddle points, landscape of nonconvex problems, deep learning .

**UNIT III****9 Hours****MODERN OPTIMIZATION IN GA**

Genetic algorithm : Introduction , biological background , traditional optimization and search techniques , Genetic basic concepts , operators ,Encoding scheme , Fitness evaluation , crossover , mutation , genetic programming , multilevel optimization , real life problem , advances in GA .

**UNIT IV****9 Hours****GENETIC PROGRAMMING**

Principles of genetic programming, terminal sets, functional sets, differences between GA & GP, Random population generation. Fuzzy Systems: Fuzzy set Theory, Optimization of Fuzzy systems .

**UNIT V**

**9 Hours**

**PARTICLE SWARM OPTIMIZATION**

Swarm Intelligence Swarm intelligence, Particle Swarm Optimization (PSO) Algorithm- Formulations, Pseudo-code, parameters, premature convergence, topology, biases, Real valued and binary PSO, Ant colony optimization (ACO)- Formulations, Pseudo-code. Applications of PSO and ACO.

**Total: 45 Hours**

**Reference(s)**

1. Stephen Boyd, Convex Optimization, Lieven Vandenberghe book.
2. Introductory Lectures on Convex Optimization, Nesterov old book.
3. Kalyanmoy Deb, Optimization for Engineering Design, PHI Publishers
4. D. E. Goldberg, Addison, Genetic algorithms in Search, Optimization, and Machine learning, Wesley Publishers.

**21EC039 MACHINE LEARNING TECHNIQUES****3 0 0 3****Course Objectives**

- ✓ To apply Machine learning concepts for real-time problems.
- ✓ To implement machine learning techniques and computing environments that are suitable for the applications under consideration.
- ✓ To apply scaling up machine learning techniques and associated computing techniques and technologies.

**Course Outcomes (COs)**

1. Understand the basics concepts of machine learning.
2. Implement probabilistic discriminative and generative algorithms for regression and classification problems and analyze the results.
3. Design an unsupervised algorithm to predict the continuous and categorical data and analyze the results.
4. Implement machine learning algorithms and solve real-world problems.
5. Analyze machine learning models for regression and classification problems.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1											1	
2	2	2	1										2	
3	2	3	3	2									2	
4	2	1	2	2									2	
5	1	2	2	3	2							2	3	

**UNIT I****7 Hours****INTRODUCTION**

Introduction-Definitions, types of learning, designing learning systems, issues in machine learning, - hypothesis space and inductive bias, evaluation, cross-validation.

**UNIT II****10 Hours****SUPERVISED LEARNING**

Regression-Linear and multilinear regression, polynomial, decision trees, random forest, support vector machine(svm). Classification- k-nearest neighbour algorithm, Classification and Regression Tree, logistic regression, SVM

**UNIT III****10 Hours****UNSUPERVISED LEARNING**

Clustering- k-means clustering and dimensionality reduction-singular value decomposition, principal component analysis, Categorical-Association analysis, Apriori, Frequent pattern growth, Hidden Markov model.

**UNIT IV**

**9 Hours**

**NEURAL NETWORKS**

Biological Motivation- McCulloch Pitts Neuron, Thresholding Logic, Perceptron, Perceptron Learning Algorithm, Multilayer Perceptron-Back propagation algorithm, Sigmoid Neurons, neural network representation, Gradient Descent, bagging and boosting.

**UNIT V**

**9 Hours**

**APPLICATION**

Machine Learning Frameworks- Scikit Learn, Tensor flow, Azure, Theano. Applications-Boston house price prediction, Face recognition, Iris Classification.

**Total: 45 Hours**

**Reference(s)**

1. John Paul Mueller, Luca Massaron, Machine Learning For Dummies, second edition, Wiley, 2021
2. Stuart Jonathan Russell, Peter Norvig, John Canny, Artificial Intelligence A Modern Approach, Prentice Hall, Fourth edition, 2020
3. Ameet V Joshi, Machine Learning and Artificial Intelligence, Springer Publications, 2020
4. T.M. Mitchell, Machine Learning, McGraw-Hill 2017
5. Stephen Marsland, Machine Learning An Algorithmic Perspective, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014



## 21EC040 PYTHON PROGRAMMING FOR AI AND ML

**3 0 0 3**

### Course Objectives

- ✓ To understand the basics of algorithmic problem-solving.
- ✓ To learn to solve problems using Python conditionals and loops.
- ✓ To define Python functions and use function calls to solve problems.
- ✓ To use Python data structures - lists, tuples, and dictionaries to represent complex data.
- ✓ To utilize the Python libraries for interpreting data and visualization of data.

### Course Outcomes (COs)

1. Use an algorithmic solution to design a simple computational problem.
2. Develop and execute simple Python programs.
3. Execute simple Python programs using conditional and loop statements.
4. Analyze compound data using Python lists, tuples, dictionaries etc.
5. Use the Python Libraries to interpret and explore data.

### Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	2		2									2
2	1	2	3	2	3									1
3	2	1	2	3	2									2
4	2	1	2	3	3									2
5	1	1	2	3	2									2

### UNIT I

**9 Hours**

#### COMPUTATIONAL THINKING AND PROBLEM SOLVING

Fundamentals of Computing - Identification of Computational Problems - 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 (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

### UNIT II

**9 Hours**

#### DATA TYPES, EXPRESSIONS, STATEMENTS

Python interpreter and interactive mode, debugging; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

### UNIT III

**9 Hours**

#### CONTROL FLOW, FUNCTIONS, STRINGS

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string

slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

#### **UNIT IV**

**9 Hours**

##### **LISTS, TUPLES, DICTIONARIES**

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as a return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: simple sorting, histogram, Students marks statement, Retail bill preparation.

#### **UNIT V**

**9 Hours**

##### **PYTHON LIBRARIES AND DATA VISUALIZATION**

Basics of Numpy arrays -aggregations -computations on arrays -comparisons, masks, boolean logic - fancy indexing - structured arrays - Data manipulation with Pandas - data indexing and selection - operating on data - missing data - Hierarchical indexing - combining datasets - aggregation and grouping - pivot tables-Importing Matplotlib - Line plots - Scatter plots - visualizing errors - density and contour plots - Histograms - legends - colors - subplots - Visualization with Seaborn.

**Total: 45 Hours**

#### **Reference(s)**

1. Python for Programmers, by Paul Deitel and Harvey Deitel Pearson Education, 1st Edition, 2021
2. Computational Thinking: A Primer for Programmers and Data Scientists by G Venkatesh and Madhavan Mukund, 1st Edition, Notion Press, 2021
3. Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data by John V Guttag, Third Edition, MIT Press, 2021
4. Computational Thinking: A Beginner's Guide to Problem Solving and Programming, by Karl Beecher, 1st Edition, BCS Learning & Development Limited, 2017.
5. Think Python: How to Think like a Computer Scientist by Allen B. Downey, 2nd Edition, O Reilly Publishers, 2016.

**21EC041 DEEP LEARNING TECHNIQUES****3 0 0 3****Course Objectives**

- ✓ To understand the operations of Deep Learning Neural Networks
- ✓ To apply the Deep Learning concepts to the real world applications
- ✓ To analyze the performance of deep learning architectures for real time applications

**Course Outcomes (COs)**

1. Understand the mathematical background and significance of Machine Learning Principles.
2. Apply the mathematical background and significance of Artificial Neural Networks in Deep Learning.
3. Apply deep learning concepts in the text and image processing.
4. Implement deep generative models for real time applications.
5. Analyze the recent developments and real world examples of Deep Learning architectures.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	2		3									1
2	2	1	3	2	2									2
3	2	1	2	3	2									2
4	2	1	2	2	3									1
5	2	2	2	1	3									2

**UNIT I****7 Hours****INTRODUCTION TO MACHINE LEARNING**

Overview of machine learning, linear classifiers, loss functions, Stochastic gradient descent, back-propagation

**UNIT II****9 Hours****INTRODUCTION TO DEEP NEURAL NETWORKS**

Activation functions, initialization, regularization, batch normalization, model selection, CNN architectures, pooling, visualization

**UNIT III****11 Hours****DEEP NEURAL NETWORK FOR TEXT AND IMAGE PROCESSING**

Transposed convolution, object detection, semantic segmentation, Recurrent neural networks (RNN), long-short term memory (LSTM), language models, machine translation, image captioning, video processing, visual question answering

**UNIT IV****11 Hours****DEEP GENERATIVE MODELS**

Auto-encoders, variational auto-encoders, generative adversarial networks, autoregressive models, generative image models, unsupervised and self-supervised representation learning

**UNIT V**

**7 Hours**

**DEEP REINFORCEMENT LEARNING**

Policy gradient methods, Q-Learning, Real World Applications of Deep Learning Techniques

**Total: 45 Hours**

**Reference(s)**

1. Magnus Ekman, Addison-Wesley, Learning Deep Learning, 2021
2. I. Goodfellow, Y. Bengio, A. Courville, Deep Learning, , MIT Press, 2016
3. K. P. Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
4. C. M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006

**21EC042 NATURAL LANGUAGE PROCESSING****3 0 0 3****Course Objectives**

- To understand the theory and methodology of natural language understanding and generation.
- To analyze topics include stemming, lemmatization, parts of speech tagging, parsing, and machine translation.
- To design employing specialized libraries, students develop applications for topic modelling, sentiment analysis, and text summarization.

**Course Outcomes (COs)**

1. Analyze Extract information from text automatically using concepts and methods from natural language processing (NLP) including stemming, n-grams, POS tagging, and parsing.
2. Analyze the syntax, semantics, and pragmatics of a statement written in a natural language.
3. Develop a conversational agent that uses natural language understanding and generation.
4. Apply machine learning algorithms to natural language processing.
5. Develop scripts and applications in Python to carry out natural language processing using libraries such as NLTK, Gensim, and spaCY.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	2										2	
2	2	1	2	2									1	
3	2	3	2	3	3							2	2	
4	1	2	2	3	3							2	2	
5	2	1	2	1	3							2	2	

**UNIT I****9 Hours****INTRODUCTION TO NLP PHASES AND PYTHON**

Introduction, Natural Language Processing, History, Advantages and Disadvantages of NLP, Components and Applications of NLP, Difference between NLP and Computer Language, NLTK- Natural language Toolkit, Python3, and Jupyter Notebook, Introduction to HPC High Performance Computing,

**UNIT II****9 Hours****NLP IN ARTIFICIAL INTELLIGENCE**

To build an NLP Pipeline, Phases of NLP, Lexical Analysis, Syntactic Analysis, Semantic Analysis, Discourse Integration, Pragmatic Analysis, Textual Sources, and formatting, Web Scraping, Building the Corpus, Tokenization the corpus, N-Grams, Stemming and Lemmatization, Synsets and Hypernyms.

**UNIT III****9 Hours****NLP APIS AND LIBRARIES**

IBM Watson API, Chatbot API, Speech to text API, Sentiment Analysis API, Translation API, Text Analysis API, Cloud NLP API, Google Cloud Natural API, Scikit Learn, NLTK Natural Language toolkit, Pattern, Text blob, Quepy, SpaCY, Gensim.

**UNIT IV**

**9 Hours**

**NLP IN MACHINE LEARNING**

Machine Learning for Natural Language Processing, Supervised Machine Learning for Natural Language Processing and Text Analytics, Unsupervised Machine Learning for Natural Language Processing and Text Analytics, ML vs NLP and Using Machine Learning on Natural Language Sentences, Hybrid Machine Learning Systems for NLP.

**UNIT V**

**9 Hours**

**NLP IN DEEP LEARNING**

Dependency Parsing, Neural Machine Translation and attention, Neural Networks, RNNs and Language models, Transformers and Pretaining, Using PyTorch from scratch, Word vectors.

**Total: 45 Hours**

**Reference(s)**

1. Natural Language Processing: A Machine Learning Perspective by Yue Zhang, Zhiyang Teng, 2021.
2. Natural Language Processing Succinctly by Joseph D Booth, 2018.
3. Deep Learning for NLP and Speech Recognition by Uday Kamath, John Liu, James Whitaker, First Edition, 2019.
4. Natural Language Processing with Python by Steven Bird, Ewan Klein, Edward Loper, , 2009.
5. Neural Network Methods for Natural Language Processing by Yoav Goldberg, 2017.
6. Speech and Language Processing by Daniel Jurafsky and James Martin, 2014.

**21EC043 MEDICAL ELECTRONICS AND INSTRUMENTATION****3 0 0 3****Course Objectives**

- To study the generation of bio-potentials, its representation recording
- To understand electrical and non-electrical parameter measurements
- To study the various diagnostic and therapeutic equipment

**Course Outcomes (COs)**

1. Understand the concepts of Electro-Physiology and Bio-Potential Recording.
2. Analyze Bio medical and non-electrical parameter measurements.
3. Analyze the concepts of Assist Devices and Bio-Telemetry
4. Analyze the various operations involved in Radiological Equipment.
5. Analyze recent trends in Medical Instrumentation

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	1	1									2	
2	2	3	2	2									1	
3	1	2	2	3									2	
4	2	2	1	2									2	
5	2	1	2	3									2	

**UNIT I****9 Hours****ELECTRO-PHYSIOLOGY AND BIO-POTENTIAL RECORDING**

The Origin of Bio-potentials; bio potential electrodes, biological amplifiers, ECG, EEG, EMG, PCG, EOG, lead systems and recording methods-typical waveform and signal characteristics.

**UNIT II****9 Hours****BIO- CHEMICAL AND NON ELECTRICAL PARAMETER MEASUREMENT**

PH, PO<sub>2</sub>, PCO<sub>2</sub>, PHCO<sub>3</sub>, Electrophoresis, colorimeter, photometer, Autoanalyzer, Blood flow meter, cardiac output, respiratory measurement, Blood pressure, temperature, pulse, Blood cell counters

**UNIT III****9 Hours****ASSIST DEVICES AND BIO-TELEMETRY**

Cardiac pacemakers, DC Defibrillator, Telemetry principles, frequency selection, Bio-telemetry, radio-pill and tele-stimulation, Signal sources for Analog I/O, Digital I/O waveform generation for testing and calibration

**UNIT IV****9 Hours****RADIOLOGICAL EQUIPMENTS**

Ionizing radiation, Diagnostic x-ray equipment, use of Radio Isotope in diagnosis, Multi section Radiography, plane of movement-Radiation Therapy

**UNIT V**

**9 Hours**

**RECENT TRENDS IN MEDICAL INSTRUMENTATION**

Thermograph, endoscopy unit, Lasers in medicine, Diathermy units, Electrical safety in medical equipment Patient monitoring system.

**Total: 45 Hours**

**Reference(s)**

1. Leslie Cromwell, Bio medical Instrumentation and Measurement, PHI, 2007
2. David Prutchi and Michael Norris, Design and Development of Medical Electronic Instrumentation: A Practical perspective of the design construction and test of Medical Device, 2004.
3. RS Khandpur, Hand book of Bio Medical Instrumentation, Tata McGraw-Hill, 2005.
4. Joseph J. Carr and John M. Brown, Introduction to Bio medical equipment Technology, John Wiley, 2004.
5. David Prutchi and Michael Norris, Design and Development of Medical Electronic Instrumentation: A Practical perspective of the design construction and test of Medical Device, 2004.



**21EC044 CONSUMER ELECTRONICS****3 0 0 3****Course Objectives**

- ✓ Understand the basics of audio and video technology.
- ✓ Understand the electronic gadgets and telecommunication systems.
- ✓ Explain the working concepts of consumer appliances.

**Course Outcomes (COs)**

1. Understand the various Microphones and Loudspeakers used in real time applications.
2. Analyse different techniques involved in audio processing.
3. Analyse the various video standards and systems.
4. Analyze the various technologies involved in communication and consumer gadgets
5. Analyze the evolution and development of Modern Consumer applications.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	2	3									3	2
2	3	3	2	2									2	3
3	3	3	2	2									3	3
4	2	2	3	3									3	2
5	2	3	3	2									3	3

**UNIT I****9 Hours****AUDIO SYSTEM COMPONENTS**

Introduction to wave motion -Interference and superposition of waves- Beats, Resonance, Echos- characteristics of microphones- types of microphone- wireless microphones-types of headphones- Types of loudspeakers- Multispeaker systems-Acoustic Insulation and acoustic design. Stereo systems and multiway systems

**UNIT II****9 Hours****AUDIO PROCESSING**

Audio Filters, Types of AGC -Loudspeaker Impedance matching- Pre-emphasis and De-emphasis noise reduction- Optical recording and reproduction- stereophony, Quadraphony-Stereo controls- Active tone control, filtering, bass and treble control-Integrated Stereo amplifier- Equalizers- Codecs -LPC, Sub-band Coding, CELP. MPEG-1, MPEG-2, MPEG-4 and Dolby Digital.

**UNIT III****9 Hours****VIDEO STANDARDS AND SYSTEMS**

Elements of a TV system, scanning process- resolution, interlacing, composite signal- Types of TV camera-compatibility between monochrome and colour TV - TV standards- NTSC, PAL, SECAM, CCIR-B.

**UNIT IV****9 Hours****COMMUNICATION AND CONSUMER GADGETS**

Radio system- VHF and UHF- Types of mobile phones-Facsimile machine- electronic calculators-digital clocks- Automobile computers- Antilocking Breaking Systems, Electronically Controlled Suspension, Safety Belt System, Navigation System- Microwave Ovens. Dish washers and TV Remote.

**UNIT V**

**9 Hours**

**CONSUMER APPLICATIONS**

Washing Machines- electronic controller, fuzzy logic, Hardware and Software development- Air Conditioners- Components, Remote Controls, Bar Coders- Bar codes, scanner and decoder- Set Top Box- Types, firmware development, Interactive program guides. Video on demand.

**Total: 45 Hours**

**Reference(s)**

1. S.P.Bali, Consumer Electronics, Pearson Education, 2005. Department of ECE, Bannari Amman Inst. of Tech. | Regulation 2011|Revision 2013 Approved in 9th Academic Council Meeting 183.
2. C.A. Schuler and W.L. Mc Namee, Modern Industrial Electronics, McGraw Hill, 2002.
3. D.J. Shanefield, Industrial Electronics for Engineers, Chemists and Technicians, Jaico Publishing House, 2007.

**21EC045 NANO ELECTRONICS****3 0 0 3****Course Objectives**

- ✓ To study the channel and gate effect of MOS system
- ✓ To understand nanotube FETs and MOSFETs
- ✓ To study the recent trends of nano devices in the industry

**Course Outcomes (COs)**

1. Understand the basic concepts of nanotechnology
2. Analyze the concepts of nanoelectronics
3. Demonstrate the concept of Silicon MOSFET and quantum transport devices
4. Analyse the process involved in carbon nanotubes
5. Analyze the concept of molecular electronics

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	3	2			2						2	2
2	2	2	1	2									2	1
3	2	2	1	3			2						1	2
4	2	1	3	2									2	1
5	2		2				1					1	2	1

**UNIT I****9 Hours****INTRODUCTION TO NANOTECHNOLOGY**

Background to nanotechnology: Types of nanotechnology and nano machines; Molecular Nanotechnology: Electron microscope-scanning electron microscope-atomic force microscope-scanning tunnelling microscope-nano manipulator-nano tweezers-atom manipulation-nanodots; Top down and bottom up approaches: self assembly-dip pen nano lithography. Nanomaterials: preparation-plasma arcing-chemical vapor deposition-sol-gels-electrodeposition ballmilling

**UNIT II****9 Hours****FUNDAMENTALS OF NANOELECTRONICS**

Fundamentals of logic devices:-Requirements-dynamic properties-threshold gates; physical limits to computations; concepts of logic devices:-classifications-two terminal devices-field effect devices-coulomb blockade devices-spintronics-quantum dot cellular automata-quantum computing-DNA computer, Ultimate computation:-power dissipation limit-dissipation in reversible computation.

**UNIT III****9 Hours****SILICON MOSFETS**

Silicon MOSFETS-Novel materials and alternate concepts:-fundamentals of MOSFET Devices-scaling rules-silicon-dioxide based gate dielectrics-metal gates-junctions & contacts-advanced MOSFET concepts. Quantum transport devices based on resonant tunnelling :-Electron tunnelling -resonant tunneling diodes resonant tunneling devices; Single electron devices for logic applications:-Single electron devices

**UNIT IV**

**9 Hours**

**CARBON NANOTUBES**

Carbon Nanotube: Fullerenes-types of nanotubes-formation of nanotubes-assemblies-purification of carbonnanotubes-electronic properties-synthesis of carbon nanotubes-carbonnanotube interconnects carbonnanotube FETs-Nanotube for memory applications.

**UNIT V**

**9 Hours**

**MOLECULAR ELECTRONICS**

Electrodes & contacts-functions-molecular electronic devices-first test systems-simulation and circuit design-fabrication; Future applications.

**Total: 45 Hours**

**Reference(s)**

1. Michael Wilson, Kamali Kannangara, Geoff Smith, Michelle Simmons and BurkhardRaguse, Nanotechnology: Basic Science and Emerging Technologies, Chapman & Hall /CRC, 2002
2. T. Pradeep, NANO: The Essentials-Understanding Nanoscience and Nanotechnology, TMH, 2007
3. Rainer Waser (Ed.), Nanoelectronics and Information Technology: Advanced ElectronicMaterials andNovel Devices, Wiley-VCH, 2012
4. Saito, S., Carbon Nanotubes for Next-Generation Electronics Device, Science 278(5335): 77-78. doi:10.1126/science.278.5335.77
5. George W. Hanson, Fundamentals of nano electronics, Prentice Hall, 2008

## 21EC046 AUTOMOTIVE ELECTRONICS AND NETWORKING

**3 0 0 3**

### Course Objectives

- ✓ To gain the basic knowledge about automotive systems.
- ✓ To study the characteristics of automotive sensors and actuators.
- ✓ To understand the fundamentals of automotive networking in new generation vehicles.

### Course Outcomes (COs)

1. Apply the fundamentals and concept of electronics in automotive industry.
2. Analyze the functionalities of automotive sensors.
3. Analyze the concepts of automotive actuators in modern vehicles.
4. Apply the basic knowledge of electronics in vehicular architecture.
5. Asses the most suitable networking topologies for a new generation automotive system.

### Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	2	1									2	
2	2	1	2	2									1	2
3	2	3	3										2	
4	1	2	3										2	2
5	2	2	1										2	

### UNIT I

**8 Hours**

#### FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS

Automobile systems: Engine and its control - Ignition systems - Steering systems - Control systems: proportion controller, Proportional Integral controller and Proportional Integral differential controller.

### UNIT II

**10 Hours**

#### AUTOMOTIVE SENSORS

Sensor basics & its Functions - Air mass flow sensor- Crankshaft angular position sensor - Throttle valve sensor – Eddy current sensors -Hall sensors -Exhaust gas oxygen sensors- Ultrasound sensor - GPS and distance travelled measurement.

### UNIT III

**9 Hours**

#### AUTOMOTIVE ACTUATORS

Fuel Injectors - Exhaust gas recirculation Actuator - Electronic Ignition sub-systems - Digital Engine control systems: Speed density method - Idle speed control method- EGR control - Distributor-less Ignition control.

### UNIT IV

**9 Hours**

#### VEHICULAR ELECTRONICS ARCHITECTURE

Intelligent Power distribution module - Supplemental restraint systems - Body control module - Engine control modules- Automatic drive positioned control unit - Driver seat control module - Front air control unit and transmission control unit.

**UNIT V**

**9 Hours**

**AUTOMOTIVE NETWORKING**

Networking basics topologies - Addressing - Control mechanisms: Event control & Timer control - Network topologies for new generation vehicles - Bus systems: CAN Bus, High speed CAN, LIN bus, MOST bus, Bluetooth: Piconet and scatternet.

**Total: 45 Hours**

**Reference(s)**

1. Konrad Reif -Automotive Mechatronics\_ Automotive Networking, Driving Stability Systems, Electronics-Vieweg-Teubner Verlag (2015).
2. Najamuz Zaman (auth.)-Automotive Electronics Design Fundamentals-Springer International Publishing (2015).
3. Robert Bosch GmbH, Bosch Automotive Electrics and Automotive Electronics\_ Systems and Components, Networking and Hybrid Drive-Springer Vieweg (2014).
4. William Ribbens-Understanding Automotive Electronics, Fifth Edition-Newnes (1998).
5. W.H.Crouse ,Automobile Electrical Equipment, McGraw-Hill, 1996.
6. P.L.Kholi, Automotive Electrical Equipment, Tata McGraw-Hill, 1995.

**21EC047 PCB DESIGN AND FABRICATION****3 0 0 3****Course Objectives**

- ✓ Understand the basic concepts involved in PCB design
- ✓ Design a circuit schematic and PCB layout
- ✓ Prototype the PCB and analyze the manufacturing and assembly techniques

**Course Outcomes (COs)**

1. Analyze the basic concepts involved in the PCB design
2. Design a circuit schematic using electronic components
3. Design a PCB layout and realize the manufacturing data
4. Design a PCB for High Speed Circuits
5. Develop a prototype model and understand the PCB manufacturing process and PCB assembly process

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	3										2	2
2	2	1	2	2	2								2	1
3	2	1	2	2	2								1	2
4			2	3	2								2	2
5	1	2	2	3	2								2	2

**UNIT I****9 Hours****BASICS OF PCB**

PCB - Overview, History, Challenges, Market - Classification of PCB - Classes of PCB Design - PCB Laminates - Terminologies in PCB - VIAS - PCB Design Process CAD /CAM Operation - Industry Standard PCB Design Tools

**UNIT II****9 Hours****SCHEMATIC DESIGN AND FOOTPRINT CREATION**

Reading Drawings and Diagrams - Schematic symbols for common electronic components - Symbol Properties - Reference Designators - BoM - ERC - Symbol Creation - Mounting Technologies - Through Hole and SMD - Component Library Creation - PTH Components Footprint Designing - SMD Components Footprint Designing as per IPC 7351 Standards

**UNIT III****9 Hours****LAYOUT PLANNING AND DESIGN**

General PCB Consideration - Mechanical and Electrical Design Consideration - PCB Stack up - Component Placement Rules - Conductor Orientation, Routing and spacing - Current and Impedance Calculation - Holes and Solder PAD - Automatic routers for PCB design - Layout Verification - DRC, Net, LVS - Layout Design Check list - DRC - Gerber File - PCB Design Check List

**UNIT IV**

**9 Hours**

**HIGH SPEED PCB DESIGN**

High-Speed Design Considerations - Signal Integrity - Need for Signal Integrity - Causes of Signal Integrity Issues in a PCB - Electromagnetic Compatibility (EMC) - EMI - Sources of EMI - Best PCB Design Practices for EMC - Power Integrity - Component Placement Considerations in High-Speed PCBs - Separating Analog and Digital Circuits - Component Orientation - High-Speed Routing Strategy - Differential Pair Signals - Length Matching - High-Speed PCB Design Checklist

**UNIT V**

**9 Hours**

**PCB FABRICATION**

PCB Safety Guidelines - CAM Editing - Single Layer, Double Layer and Multilayer PCB Board Manufacturing Process - PCB Defects - PCB Assembly Process - Through Hole and SMD - Quality Assurance - Acceptance Criteria

**Total: 45 Hours**

**Reference(s)**

1. R.S. Khadhapur, Printed Circuit Boards: Design, Fabrication and Assembly, McGraw Hill Companies, Electronic Engineering, 2006.
2. Earl Gates, Introduction to Basic Electricity and Electronics Technology, Delmar Cengage Learning, 2013.
3. Kraig Mitzner, Complete PCB Design using OrCAD Capture and Layout, Newnes, 2007.
4. Clyde F. Coombs, Printed Circuits Handbook, McGraw Hill, Sixth Edition, 2008.
5. Sd. Mehta, Electronic Product Design Vol. 1 Basics of PCB Design, S Chand & Company Pvt. Ltd, 2011.
6. Bosshart Walter C, Printed Circuit Boards, Tata McGraw Hill Publishing Company Limited, 1984.



## 21EC048 CRYPTOGRAPHY AND NETWORK SECURITY

**3 0 0 3**

### Course Objectives

- ✓ Understand the basic concept of Cryptography and Network Security, their mathematical models.
- ✓ To understand the necessity of network security, threats/vulnerabilities to networks and counter measures.
- ✓ To understand Authentication functions with Message Authentication Codes and Hash Functions.
- ✓ To provide familiarity in Intrusion detection and Firewall Design Principles.

### Course Outcomes (COs)

1. Understand the network security fundamental concepts and principles.
2. Apply various models for Encrypt and decrypt messages using block ciphers and network security technology and Protocols.
3. Analyze key agreement algorithms to identify their weaknesses.
4. Analyze the different types of Message Authentication and Hash functions.
5. Identify and Assess different types of threats, malware, spyware, viruses, vulnerabilities.

### Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1		2	3									2	
2	2	1		3									2	
3	1		2	2									2	
4	1	2		2									2	
5	1	3		2									2	

### UNIT I

**9 Hours**

#### INTRODUCTION TO CONVENTIONAL ENCRYPTION MODELS

Security Services, Mechanisms, and Attacks, A Model for Internetwork security, Classical Techniques: Conventional Encryption model, Steganography, Classical Encryption Techniques. Modern Techniques: Simplified DES, Block Cipher Principles, Data Encryption standard, Strength of DES, Block Cipher Design Principles.

### UNIT II

**9 Hours**

#### ENCRYPTION TECHNIQUES

Triple DES, International Data Encryption algorithm, Blowfish, RC5, Characteristics of Advanced Symmetric Block Ciphers. Placement of Encryption function, Traffic confidentiality, Keydistribution, Random Number Generation.

### UNIT III

**9 Hours**

#### PUBLIC KEY CRYPTOGRAPHY

Principles, RSA Algorithm, Key Management, Diffie Hellman Key exchange, Elliptic Curve Cryptography. Number Theory: Prime and Relatively prime numbers, Modular

arithmetic, Fermat and Euler's theorems, Testing for primality, Euclid Algorithm, the Chinese remainder theorem, Discrete logarithms.

**UNIT IV**

**9 Hours**

**MESSAGE AUTHENTICATION AND HASH FUNCTIONS**

Authentication requirements and functions, Message Authentication, Hash functions, Security of Hash functions, and MACs. Hash and Mac Algorithms: MD-5, Message Digest Algorithm, Secure Hash Algorithm. Digital signatures and Authentication protocols: Digital signatures, Authentication Protocols, Digital signature standards. Authentication Applications: Kerberos, Electronic Mail Security: Pretty Good Privacy, SIME/MIME.

**UNIT V**

**9 Hours**

**IP AND WEB SECURITY**

IP security: Overview, Architecture, Authentication, Encapsulating Security Payload, Key Management. Web Security: Web Security requirements, Secure sockets layer and Transport layer security, Secure Electronic Transaction. Intruders, Viruses, and Worms: Intruders, Viruses and Related threats. Fire Walls: Fire wall Design Principles, Trusted systems.

**Total: 45 Hours**

**Reference(s)**

1. Atul Kahate, Cryptography and Network Security, Mc Graw Hill, 4th Edition, 2017.
2. William Stallings, Cryptography and Network Security - Principles and Practice, Pearson Education, 6th Edition, 2013.
3. Behrouz A. Forouzan, Cryptography and Network Security, Tata McGraw Hill 2007.

## 21OCE01 ENERGY CONSERVATION AND MANAGEMENT

**3 0 0 3**

### Course Objectives

- ✓ To develop an understanding and analyze the energy data of industries
- ✓ To carryout energy accounting and balancing
- ✓ To conduct energy audit and suggest methodologies for energy savings and
- ✓ To utilize the available resources in optimal ways

### Course Outcomes (COs)

1. Classify and characterize the various energy utilization techniques.
2. Identify suitable technique to provide an energy efficient system.
3. Identify the need for thermal systems with latest technologies.
4. Choose suitable techniques doe conserving energy with respect to emerging trends.
5. Assess the impact economics on the conservation of energy.

### Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	1										1	3
2	1	3									1	3
3	1	3									2	3
4	1	3	2								3	3
5	1	2	2								1	3

### UNIT I

**9 Hours**

#### INTRODUCTION

Energy - Power – Past & Present scenario of World; National Energy consumption Data – Environmental aspects associated with energy utilization – Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers. Instruments for energy auditing.

### UNIT II

**9 Hours**

#### ELECTRICAL SYSTEMS

Components of EB billing – HT and LT supply, Transformers, Cable Sizing, Concept of Capacitors, Power Factor Improvement, Harmonics, Electric Motors - Motor Efficiency Computation, Energy Efficient Motors, Illumination – Lux, Lumens, Types of lighting, Efficacy, LED Lighting and scope of Encon in Illumination.

### UNIT III

**9 Hours**

#### THERMAL SYSTEMS

Stoichiometry, Boilers, Furnaces and Thermic Fluid Heaters – Efficiency computation and Encon measures. Steam: Distribution &U sage: Steam Traps, Condensate Recovery, Flash Steam Utilization, Insulators & Refractories

### UNIT IV

**9 Hours**

#### ENERGY CONSERVATION IN MAJOR UTILITIES

Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems – Cooling Towers – D.G. sets

**UNIT V**

**9 Hours**

**ECONIMICS**

Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing –ESCO concept.

**Total: 45 Hours**

**Reference(s)**

1. Energy Manager Training Manual (4 Volumes) available at [www.energymanagertraining.com](http://www.energymanagertraining.com), a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India, 2004.
2. Witte. L.C., P.S. Schmidt, D.R. Brown, “Industrial Energy Management and Utilisation” Hemisphere Publ, Washington, 1988.
3. Callaghn, P.W. “Design and Management for Energy Conservation”, Pergamon Press, Oxford, 1981.
4. Dryden. I.G.C., “The Efficient Use of Energy” Butterworths, London, 1982
5. Turner. W.C., “Energy Management Hand book”, Wiley, New York, 1982.
6. Murphy. W.R. and G. Mc KAY, “Energy Management”, Butterworths, London 1987.

**21OCS01 OBJECT ORIENTED PROGRAMMING****3 0 0 3****Course Objectives**

- ✓ Understand the concepts of Object Oriented Programming
- ✓ Study the concepts of objects and classes.
- ✓ Familiarize in the types of constructors.

**Course Outcomes (COs)**

1. Identify the characteristics and data types of C++ language.
2. Develop programs using objects and classes for real world applications
3. Construct programs to implement operator overloading and inheritance techniques
4. Apply Polymorphism and File streams concepts to develop C++ program
5. Design applications using templates and apply exception handling mechanisms

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2			3									
2	1	2	3		3									
3	1	2	2		3									
4	1	2	3		3									
5	1	2	3		3									

**UNIT I****8 Hours****INTRODUCTION**

Need for object oriented programming - Procedural Languages vs. Object oriented approach - Characteristics Object oriented programming - C++ Programming Basics: Basic Program Construction - Output Using cout - Input with cin - Data types- Variables and Constants - Operators - Control Statements-Manipulators - Type conversion. Function Prototyping- call by reference, return by reference- Inline function- Default arguments - Function overloading.(sona)

**UNIT II****8 Hours****OBJECTS AND CLASSES**

Objects and Classes Simple Class - C++ Objects as Physical Objects - C++ Object as Data types-CONSTRUCTORS: Parameterized Constructors - Multiple Constructors in a Class - Constructors with Default Arguments - Dynamic Initialization of Objects - Copy and Dynamic Constructors - Destructors(PSG) - Structures and Classes - Arrays and Strings

**UNIT III****9 Hours****OPERATOR OVERLOADING AND INHERITANCE**

Operator Overloading and Inheritance Need of operator overloading- Overloading Unary Operators-Overloading binary Operators - Overloading Special Operators - Data Conversion Inheritance: Derived Class and Base Class - Derived Class Constructors-Overriding Member Functions-Class Hierarchies- Public and Private Inheritance-Levels of Inheritance-Multiple Inheritance.

**UNIT IV**

**10 Hours**

**POLYMORPHISM AND FILE STREAMS**

Polymorphism and File Streams Virtual Function - Friend Function - Static Function-Assignment and Copy Initialization- Memory Management: new and delete Pointers to Objects, this Pointer-Streams - String I/O - Character I/O - Object I/O - I/O with Multiple Objects - File Pointers - Disk I/O with Member Functions- Error Handling in File I/O.

**UNIT V**

**10 Hours**

**TEMPLATES AND EXCEPTION HANDLING**

Templates: Introduction - Function Templates - Overloading Function Templates-, user defined template arguments(sona) - Class Templates - Exception Handling - Syntax, multiple exceptions, exceptions with arguments.

**Total: 45 Hours**

**Reference(s)**

1. Deitel & Deitel, C++ How to program, Prentice Hall,2005
2. Robert Lafore, Object Oriented Programming in-C++, Galgotia Publication.
3. D.S.Malik, C++ Programming, Thomson, 2007.
4. K.R. Venugopal, Rajkumar and T.Ravishankar, Mastering C++, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2006.
5. E.Balagurusamy, Object Oriented Programming with C++, Tata McGraw Hill Publishing.

**21OCS02 JAVA FUNDAMENTALS****3 0 0 3****Course Objectives**

- ✓ Implement applications based on core Java Concepts with examples
- ✓ Construct application using inheritance, packages and exception handling for real time problems.
- ✓ Integrate the Java I/O concepts to handle input and output operations.
- ✓ Develop programs to perform string manipulation in java.
- ✓ Design GUI with Java for event handling and database applications.

**Course Outcomes (COs)**

1. Demonstrate applications based on core Java Concepts with examples
2. Construct application using inheritance, packages and exception handling for real time problem
3. Explain the Java I/O concepts to handle input and output operations.
4. Develop programs to perform string manipulation in Java.
5. Design GUI with Java for event handling and database applications.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	2		2									
2	2	3	2		2									
3	3	3	3		3									
4	2	2	2		2									
5	2	2	2		2									

**UNIT I****9 Hours****BASICS OF JAVA**

The Genesis of Java - Overview of Java - Data Types, Variables, and Arrays - Operators – Control Statements - Introducing Classes - Methods and Classes.

**UNIT II****9 Hours****INHERITANCE, PACKAGES AND EXCEPTIONS**

Inheritance: Basics - Using Super - Creating a Multilevel Hierarchy - Method overriding - Using Abstract Classes - Packages and Interfaces: Packages - Access Protection - Importing Packages- Interfaces Definitions and Implementations - Exception Handling: Types - Try and Catch - Throw.

**UNIT III****9 Hours****EXPLORING JAVA I/O**

I/O Basics - Reading Console Input -Writing Console output - Native Methods - I/ O Classes and Interfaces - File - The Byte Streams - The Character Streams - Using Stream I/ O - Serialization.

**UNIT IV****9 Hours****JAVA STRINGS**

String Handling: Special String operations and Methods - String Buffer - Exploring java.lang: Simple type Wrappers - System - Math - Collections Framework: Collections Interfaces and Classes – Utility Classes: String Tokenizer - Date and Time.

**UNIT V**

**9 Hours**

**GUI WITH JAVA**

Applet Basics - Applet Architecture - Applet Display Methods - Parameter Passing - Event Handling Mechanisms - Event Classes - Event Listener - Working with Windows, Graphics, Colors and Fonts - AWT Controls - Layout Managers and Menus – JDBC

**Total: 45 Hours**

**Reference(s)**

1. Herbert Schildt, Java 2-Complete Reference, Tata Mc Graw Hill, 2015.
2. Deitel & Deitel, Java How to Program, Prentice Hall of India, 2010.
3. Gary Cornell and Cay S.Horstmann, Core Java Vol.1 and Vol.2, Sun Microsystems Press, 2008.



## 21OCS03 KNOWLEDGE DISCOVERY IN DATABASES

**3 0 0 3**

### Course Objectives

- Introduce the basic concepts of data warehousing.
- Impart knowledge about the data mining functionalities.
- Assess the strengths and weaknesses of association mining and cluster analysis.

### Course Outcomes (COs)

1. Explain the concepts of Data Warehousing architecture and business analysis process.
2. Illustrate the process of Data Mining and preprocessing techniques for data cleansing.
3. Apply the association rules for mining the various kinds of data
4. Analyze Classification and Clustering algorithms for various problems with high dimensional data.
5. Illustrate the various data mining techniques on complex data objects

### Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2													
2	2	3	2											
3	2	2	2											
4	3	2	2	2										
5	2	2	2	2										

### UNIT I

**9 Hours**

#### DATA WAREHOUSING AND BUSINESS ANALYSIS

Data warehousing Components -Building a Data warehouse -Data Warehouse and DBMS-Metadata-Multidimensional data model - Data Extraction, Cleanup and Transformation Tools - Reporting, Query tools and Applications - OLAP vs OLTP - OLAP operations - Data Warehouse Schemas: Stars, Snowflakes and Fact constellations.

### UNIT II

**8 Hours**

#### INTRODUCTION TO DATA MINING

Introduction - Steps in knowledge discovery from databases process - Architecture of a Typical Data Mining Systems - Data Mining Functionalities - Classification of Data Mining Systems - Data mining on different kinds of data - Different kinds of pattern - Task Primitives - Integration of a Data Mining System with a Data Warehouse - Major issues in Data mining.

### UNIT III

**9 Hours**

#### ASSOCIATION RULE MINING

Market Basket Analysis- Frequent Item Set Mining methods: Apriori algorithm - Generating Association Rules - A Pattern Growth Approach- Pattern mining in multilevel and multidimensional space - Mining Various Kinds Of Association Rules - Association Analysis to Correlation Analysis - Constraint Based Association Mining.

**UNIT IV**

**9 Hours**

**CLASSIFICATION AND CLUSTERING**

Decision Tree Induction - Bayesian Classification - Rule Based Classification - Classification by Back propagation - Support Vector Machines - Clustering: Types of data - Partitioning methods: k-means, k-medoid - Hierarchical Methods: distance based agglomerative and divisible clustering, BIRCH – Density Based Method: DBSCAN - Grid Based Method: STING.

**UNIT V**

**10 Hours**

**DATA MINING APPLICATIONS**

Mining complex data objects - Text Mining - Graph mining - Web mining - Spatial Data mining - Application and trends in data mining - Social impacts of Data mining.

**Total: 45 Hours**

**Reference(s)**

- 1 Jiawei Han, Micheline Kamber and Jian Pei, Data Mining: Concepts and Techniques, Morgan Kaufman, 3rd Edition, 2013.
- 2 Alex Berson and Stephen J Smith, Data Warehousing, Data Mining, and OLAP, Tata Mcgraw-Hill, 1997.
- 3 David Hand, Heikki Mannila, Padhraic Smyth, Principles of Data Mining, MIT Press, 2001.
- 4 Margaret H. Dunham, Data Mining: Introductory and Advanced Topics, Pearson Education 2003.

**21OCS04 E-LEARNING TECHNIQUES****3 0 0 3****Course Objectives**

- ✓ Understand the technologies involved in e-learning.
- ✓ Gain the fundamentals of e-learning techniques
- ✓ Determine the characteristics of Teaching-Learning Process

**Course Outcomes (COs)**

1. Acquire knowledge about the basic concepts of e-learning.
2. Explain the technology mediated communication in e-learning
3. Exemplify of e-learning and content the process management.
4. Analyze the teaching and learning processes in e-learning environment.
5. Assess the various applications of e-learning.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2												
2	2	2	3											
3	3	3	3											
4	2	2	2											
5	2	2	2											

**UNIT I****9 Hours****INTRODUCTION**

Evolution of Education - Generations of Distance Educational Technology - Role of E-Learning - Components of e-learning: CBT, WBT, Virtual Classroom - Barriers to e-Learning Roles and Responsibilities: Subject Matter Expert - Instructional Designer - Graphic Designer - Multimedia Author - Programmer - System Administrator - Web Master

**UNIT II****9 Hours****TECHNOLOGIES**

Satellite Broadcasting - Interactive Television - Call Centers - Whiteboard Environment - Teleconferencing: Audio Conferencing - Video Conferencing -Computer Conferencing. Internet: E-mail, Instant Messaging, Chat, Discussion Forums, Bulletin Boards, Voice Mail, File Sharing, Streaming Audio and Video.

**UNIT III****9 Hours****MANAGEMENT**

Content: E-Content, Dynamic Content, Trends - Technology: Authoring, Delivery, Collaboration - Services: Expert Service, Information Search Service, Knowledge Creation Service - Learning Objects and E-Learning Standards. Process of E-Learning: Knowledge acquisition and creation, Sharing of knowledge, Utilization of knowledge - Knowledge Management in E-Learning.

**UNIT IV****9 Hours****TEACHING-LEARNING PROCESS**

Interactions: Teacher-Student - Student-Student - Student-Content - Teacher- Content - Teacher-Teacher - Content-Content Role of Teachers in E-Learning - Blended Learning -Cooperative Learning

Collaborative Learning - Multi Channel learning -Virtual University - Virtual Library.

**UNIT V**

**9 Hours**

**APPLICATIONS**

Customer service training - Sales training - Customer training - Safety training - IT training – Product training - Healthcare training.

**Total: 45 Hours**

**Reference(s)**

1. E-Learning: An Expression of the Knowledge Economy, Gaurav Chadha, S.M. Nafay Kumail, Tata McGraw-Hill Publication, 2002.
2. E-Learning: New Trends and Innovations, P.P. Singh, Sandhir Sharma, Deep & Deep Publications, 2005.
3. E-Learning: Concepts, Trends and Applications, Epignosis LLC, LLC publications, 2014.
4. Michael Allen's Guide to E-Learning, Michael W. Allen, Michael Allen, Wiley Publication, 2002.

**21OCS05 SOCIAL TEXT AND MEDIA ANALYTICS****3 0 0 3****Course Objectives**

- ✓ Understand the basic ideas of Text mining.
- ✓ Analyze the methods and approaches used in analytics.
- ✓ Gain knowledge on various types of analytics like web, social network, and social media

**Course Outcomes (COs)**

1. Demonstrate the concepts and applications of text mining
2. Explain Content analysis and Sentiment analysis
3. Illustrate web analytics with a suitable model
4. Illustrate social network analytics with suitable example.
5. Illustrate social media analytics with suitable example.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3		2	3									
2	2	3		2	2									
3	2	3		3	3									
4	2	2	2	3	2									
5	2	3		2	3									

**UNIT I****7 Hours****TEXT MINING**

Introduction, Core text mining operations, Preprocessing techniques, Categorization, Clustering, Information extraction, Probabilistic models for information extraction, Text mining applications.

**UNIT II****9 Hours****METHODS**

Content Analysis-Natural Language Processing-Clustering & Topic Detection-Simple Predictive Modeling-Sentiment Analysis; Sentiment Prediction.

**UNIT III****9 Hours****WEB ANALYTICS**

Web analytics tools-Clickstream analysis-A/B testing, online surveys-Web search and retrieval-Search engine optimization-Web crawling and Indexing-Ranking algorithms-Web traffic models.

**UNIT IV****10 Hours****SOCIAL NETWORK ANALYTICS**

Social contexts: Affiliation and identity - Social network analysis - Social network and web data and methods. Graphs and Matrices - Basic measures for individuals and networks

**UNIT V**

**10 Hours**

**SOCIAL MEDIA ANALYTICS**

Information visualization - Making connections: Link analysis - Random graphs and network evolution.

**Total: 45 Hours**

**Reference(s)**

1. Ronen Feldman and James Sanger, The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data, Cambridge University Press, 2006.
2. Hansen, Derek, Ben Shneiderman, Marc Smith. Analyzing Social Media Networks with NodeXL: Insights from a Connected World, Morgan Kaufmann, 2011.
3. Avinash Kaushik. Web Analytics 2.0: The Art of Online Accountability, 2009.
4. Hanneman, Robert and Mark Riddle. Introduction to Social Network Method, 2005.
5. Wasserman, S. & Faust, K. Social network analysis: Methods and applications. New York: Cambridge University Press, 1994.
6. Monge, P. R. & Contractor, N. S. Theories of communication networks. New York: Oxford University, 2003

**21OEI01 PROGRAMMABLE LOGIC CONTROLLERS****3 0 0 3****Course Objectives**

- ✓ To impart knowledge about automation and architecture of PLC
- ✓ To understand the PLC programming using timers, counters and advanced PLC functions
- ✓ To familiarize the student with PLC based applications

**Course Outcomes (COs)**

1. Outline the fundamental Concepts of Automation
2. Conclude the architecture, interfacing and communication techniques of PLC
3. Execute the suitable PLC Programming languages
4. Attribute the various functions and instruction sets of PLC
5. Generate a suitable logical programming for given applications

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1		2	2		3							
2	2	1		2	2		3							
3	2	1		2	2		3							
4	2	1		2	2		3							
5	2	1		2	2		3							

**UNIT I****10 Hours****INTRODUCTION TO AUTOMATION**

Evolution of automation -Types of automation - Fixed, flexible and programmable automation - Batch process and continuous process - open loop system and closed loop system - Function of sensors - Proximity sensors: Capacitive and Inductive - Infrared and Laser Push-buttons and toggle switches - Actuators: Solenoid valve - servo motor - electromagnetic relays.

**UNIT II****9 Hours****ARCHITECTURE OF PLC**

Components of PLC - sink and source I/O cards - Processor - Memory: Types of memory, Input and Output modules: Discrete, Analog -Scan time of PLC -Interfacing computer and PLC: RS232, RS485, Ethernet - Selection criteria for PLC.

**UNIT III****8 Hours****PLC PROGRAMMING**

Programming languages - Ladder logic components: User and bit Instructions, branch instructions, internal relay instruction Boolean logic using ladder logic programming, Latching -Timers: On Delay timer, OFF Delay timer and Retentive timer - Counters: Up Counter and Down Counter.

**UNIT IV****10 Hours****ADVANCED PLC FUNCTIONS**

Instructions in PLC: Program Control Instructions, Math Instructions, Data Manipulation Instructions: Data compare operations, Data transfer operations - Sequencer and Shift register instructions- Analog Instructions: PID Controller - Scaling Instructions.

**UNIT V**

**8 Hours**

**APPLICATIONS OF PLC**

Case Studies: Bottle filling system - Pick and place robot - Car Parking - Traffic light control (4 ways with pedestrian signal) -Elevators - Pneumatic stamping system - alarm annunciator system.

**Total: 45 Hours**

**Reference(s)**

1. F.D. Petruzella, Programmable Logic Controllers, Tata Mc-Graw Hill, Third edition, 2015.
2. Benjamin C Kuo, Automatic Control Systems, Prentice Hall of India, New Delhi, 2014.
3. John Park, Steve Mackay, Edwin Wright, Practical data communications for instrumentation and control, Newnes, Elsevier, 2015.
4. K. L.S. Sharma, Overview of Industrial Process Automation, Elsevier, 2014.
5. John W Webb and Ronald A Resis, Programmable Logic Controller, Prentice Hall of India Pvt. Ltd., New Delhi, 2013.



**21OEI04 OPTOELECTRONICS AND LASER INSTRUMENTATION****3 0 0 3****Course Objectives**

- ✓ To enhance the student knowledge in fiber optics fundamentals and fabrication
- ✓ To be recognized with industrial applications of fibers
- ✓ To understand the fundamental concepts about lasers
- ✓ To identify and describe various fiber optic imaging and optoelectronic sensor applications

**Course Outcomes (COs)**

1. Attribute the properties of optical fibers, their light sources and detectors.
2. Implement the fiber-optic sensor for the measurement of various physical quantities.
3. Conclude the fundamentals of laser, types of laser and its working.
4. Outline the applications of laser for industrial applications.
5. Differentiate the use of laser instruments for various medical applications.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1											
2	3	2	1	2										
3	3	2	1											
4	3	2	2	2										
5	3	2	2	2										

**UNIT I****9 Hours****OPTICAL FIBERS AND THEIR PROPERTIES**

Introduction to optical fibers - Light guidance - Numerical aperture - Dispersion - Different types of fibers and their properties - Light Sources for fiber optics, Photo detectors, source coupling, splicing and connectors.

**UNIT II****9 Hours****INDUSTRIAL APPLICATION OF OPTICAL FIBERS**

Fiber optics instrumentation system - optical fiber sensors, Measurement of pressure, temperature, current, voltage and liquid level - fiber optic communication set up - different types of modulators - detectors.

**UNIT III****9 Hours****LASER FUNDAMENTALS**

Fundamental characteristics of lasers: laser rate equation - three level system - four level system - properties of laser beams - laser modes - resonator configuration - Q- switching and mode locking - cavity dumping - types of lasers: gas lasers, solid state lasers, liquid lasers and semiconductor lasers.

**UNIT IV****9 Hours****INDUSTRIAL APPLICATION OF LASERS**

Lasers for measurement of distance and length, velocity, acceleration, atmospheric effects, sonic boom, pollutants - material processing: laser heating, melting, welding and trimming of materials - removal and vaporization - calculation of power requirements of laser for material processing.

**UNIT V**

**9 Hours**

**HOLOGRAM AND MEDICAL APPLICATIONS**

Holography: basic principle, methods - holographic interferometry and application, holography for non-destructive - medical applications of lasers, laser and tissue interactive - laser instruments for surgery, removal of tumors of vocal cords, brain surgery, plastic surgery, gynaecology and oncology.

**Total: 45 Hours**

**Reference(s)**

1. John M. Senior, Optical Fiber Communications - Principles and Practice, Prentice Hall of India, 2010.
2. John F. Ready, Industrial Applications of Lasers, Academic Press, 2012.
3. Gerd Keiser, Optical Fiber Communication, Mc Graw Hill, New York, 2013.
4. S.C. Gupta, Textbook on Fiber Optics Communications and its application, Prentice Hall of India, 2012.
5. John Wilson and J.F.B. Hawkes, Introduction to Opto Electronics, Prentice Hall of India, 2011.
6. R. P. Khare, Fiber Optics and Optoelectronics, Oxford University Press, 2011.

**21OME01 DIGITAL MANUFACTURING****3 0 0 3****Course Objectives**

- ✓ To understand the process of generating 3D Computer Aided Design (CAD) model by different method.
- ✓ To explain the constructional features and develop simple program for CNC lathe and Milling machines.
- ✓ To provide an exhaustive knowledge on various generic process and benefits of Additive Manufacturing.
- ✓ To familiarize about materials and process parameters of liquid and solid based AM techniques.
- ✓ To educate powder based methodology and emerging trends with case studies, applications of AM techniques.

**Course Outcomes (COs)**

1. Design a 3D model from the 2D data.
2. Develop a CNC program for simple components.
3. Generate stl file and manipulate parameters of AM machine
4. Select appropriate liquid or solid materials based AM process to the respective application
5. Select appropriate process to fabricate a functional/prototype for aerospace, automotive, electronics, manufacturing and medical applications.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2		2								1	2
2	2	2	2		2								1	2
3	2	2	2		2								1	2
4	2	2	2		2								1	3
5	2	2	2		2								1	2

**UNIT I****9 Hours****CAD MODELING**

Introduction - Design process - Stages. CAD - Input and Output devices, Modeling methods - Wire frame modelling, Surface modelling, Solid modelling - Constructive Solid Geometry and Boundary Representation Techniques. CAD/CAM data exchange - IGES, STEP. Product Life cycle management (PLM).

**UNIT II****10 Hours****AUTOMATION AND CNC MACHINES**

Introduction to Automation - Definition, types, reasons for automating. CNC Machines - Principles, types, features, advantages, applications. CNC Machine structure - Linear motion bearings, Recirculating ball bearings, drive system, and control system. CNC Lathe and Milling programming - Linear and circular interpolation, threading and drilling programs.

**UNIT III**

**7 Hours**

**ADDITIVE MANUFACTURING**

Introduction - Impact of Additive Manufacturing (AM) and Tooling on Product Development - Distinction between AM and CNC Machining - The Generalized AM Process chain - CAD Model - Input file formats - Generation and Conversion of STL file - File Verification and Repair - Build File Creation - Part Construction - Part Cleaning and finishing - AM Benefits - Classification of AM process

**UNIT IV**

**8 Hours**

**LIQUID AND SOLID MATERIAL BASED SYSTEMS**

Stereo lithography Apparatus (SLA), Digital Light Processing (DLP), Fused Deposition Modelling (FDM) and Laminated Object Manufacturing (LOM) - Working Principle, Construction, Process, Materials and Applications

**UNIT V**

**11 Hours**

**POWDER BASED PROCESSES AND APPLICATIONS OF ADDITIVE MANUFACTURING**

Selective Laser Sintering (SLS), Color Jet Printing (CJP), Electron Beam Melting (EBM) and Laser Engineered Net Shaping (LENS) - Working Principle, Construction, Process Variables, Materials and Applications. Reverse Engineering using 3D scanner. Application of Additive Manufacturing in Medical field, Manufacturing, Automotive industries, Aerospace and Electronics and Retail industries.

**Total: 45 Hours**

**Reference(s)**

1. Ibrahim Zeid, R.Sivasubramania, CAD/CAM Theory and Practice, Tata McGraw Hill, 2010.
2. M. Aditan, B.S. Pabala, CNC Machines, New age International, 2012.
3. C. K. Chua, K. F. Leong and C. S. Lim, Rapid prototyping: Principles and applications, Cambridge University Press, 2010.
4. D. T.Pharm, S. S.Dimov, Rapid manufacturing, Springer-Verlag, London, 2001.
5. I. Gibson, D. W. Rosen, and B. Stucker, Additive Manufacturing Technologies 3D Printing, Rapid Prototyping and Direct Digital Manufacturing, Springer, 2015  
<http://www.springer.com/978-1-4939-2112-6>
6. [www.grabcad.com](http://www.grabcad.com), [www.all3dp.com](http://www.all3dp.com)

**21OME02 INDUSTRIAL PROCESS ENGINEERING****3 0 0 3****Course Objectives**

- ✓ To impart the knowledge on production planning methodologies and layout design
- ✓ To learn about production planning and its control methods
- ✓ To provide the knowledge of work study, process charts and ergonomic condition
- ✓ To impart the knowledge on inventory control and material handling
- ✓ To learn about system analysis and different types of maintenance processes

**Course Outcomes (COs)**

1. Select proper plant layout for the required production system
2. Plan the resources required for the production and to perform the control methods
3. Apply work study method, prepare charts to outline the process and develop ergonomic condition suitable for the processes.
4. Analyze the inventory required based on production needs and material handling
5. Perform system analysis and use different types of maintenance process for smooth operations.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	1		1									2
2	3	3	1		2						2			2
3	1	3	3		2									2
4	2	3	1		2									2
5	2	3	1		2									2

**UNIT I****9 Hours****INDUSTRIAL ENGINEERING AND PRODUCTION SYSTEM**

Industrial engineering - Concept, History and development, Applications, Roles of Industrial engineer- Production management, Industrial engineering versus production management, operations management. Plant layout, Criteria for good layout, Types of layout - Process layout, Product layout, Combination layout and fixed position layout, Flow (material movement) pattern, Workstation Selection and design.

**UNIT II****10 Hours****PROCESS PLANNING AND PRODUCTION CONTROL**

Introduction to Process planning-Definition, Procedure, Process selection, Machine capacity, Process sheet. Process analysis - Group technology, classification and coding system, formation of component family - Production planning, loading, scheduling. Production control -dispatching, routing - Progress control bar, curve, Gantt chart, route and schedule chart.

**UNIT III****8 Hours****WORK STUDY AND ERGONOMICS**

Work study - Definition, Need, Advantages, objectives of method study and work measurement, method study procedure, Process chart - symbols, outline process chart, flow process chart, principles

of motion economy, ergonomics- applications of ergonomic principles in the shop floor- work benches- seating arrangement, Industrial physiology.

**UNIT IV**

**10 Hours**

**INVENTORY MANAGEMENT**

Inventory control, classification, management, objectives, functions. Economic order quantity, Economic batch quantity, inventory models, ABC analysis, Material Requirement Planning (MRPI), Manufacturing Resource Planning (MRPII), Operating cycle, lean manufacturing, Supply chain management - Material handling.

**UNIT V**

**8 Hours**

**SYSTEM ANALYSIS AND MAINTENANCE**

System concept - system analysis, systems engineering, value engineering, value control, types of values. Plant maintenance - objectives, importance. Maintenance engineer - duties, functions and responsibilities. Types - breakdown, scheduled, preventive and predictive - Plant maintenance schedule, Condition monitoring.

**Total: 45 Hours**

**Reference(s)**

1. Khanna O.P., Industrial Engineering and management, Dhanpat Rai Publications., 2010
2. Martand T. Telsang, Industrial Engineering and Production Management, S Chand Publishers, 2006
3. Panneerselvam R., Production and operations management, Heritage Publishers, 2006
4. Ravi Shankar, Industrial Engineering and Management, Golgotia Publications Pvt. Ltd., New Delhi, 2009

**21OME03 MAINTENANCE ENGINEERING****3 0 0 3****Course Objectives**

- ✓ To understand the principles, objectives and importance of maintenance adopted in industry for successful progress.
- ✓ To introduce different maintenance categories, its merits and types of lubrication.
- ✓ To expose the idea of condition monitoring, methods and instruments used for allied measurements.
- ✓ To learn about failure analysis and repair methods for few mechanical elements.
- ✓ To promote computerization in maintenance and inventory management.

**Course Outcomes (COs)**

1. Explain the principles, objectives and importance of maintenance adopted in industry.
2. Select the suitable maintenance category and lubrication type.
3. Apply the appropriate methods and instruments for condition monitoring.
4. Analyze the failures of mechanical systems and select suitable repair methods.
5. Utilize computers in maintenance and inventory management.

**Articulation Matrix**

<b>CO No</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>
1	2	2												2
2	2	2												2
3					2	2	1							2
4	1	2	1		2	2	2							2
5	2	2	2		1	1	1							2

**UNIT I****9 Hours****PRINCIPLES OF MAINTENANCE PLANNING**

Basic principles of maintenance planning - Objectives and principles of planned maintenance activity - Importance and benefits of sound maintenance systems - Maintenance organization - Maintenance economics.

**UNIT II****9 Hours****MAINTENANCE CATEGORIES AND LUBRICATION**

Maintenance categories - Comparative merits of each category - Preventive maintenance, Maintenance schedules, Repair cycle - Total Productive Maintenance - Principles and methods of lubrication.

**UNIT III****9 Hours****CONDITION MONITORING**

Condition based maintenance - Cost comparison with and without Condition Monitoring - Methods and instruments for condition monitoring - Noise, vibration, wear and temperature measurement.

**UNIT IV**

**9 Hours**

**FAILURE ANALYSIS AND REPAIR METHODS**

Failure analysis - Failures and their development - Role of Non Destructive Testing in failure analysis  
- Repair methods for bearings, cylinder block, fuel pump, shaft.

**UNIT V**

**9 Hours**

**COMPUTER AIDED MAINTENANCE MANAGEMENT**

Approach towards Computerization in maintenance - computer-aided maintenance management system (CAMMS) - Advantages of CAMMS - spare parts and inventory centre performance reporting.

**FURTHER READING**

Retrofitting, objectives, classification of retrofitting, cost effectiveness through retrofitting (economical aspects), circumstances leading to retrofitting, features and selection for retrofitting.

**Total: 45 Hours**

**Reference(s)**

1. Srivastava S.K, Maintenance Engineering, S Chand and Company, 2010.
2. Mishra R.C, Pathak K, Maintenance Engineering and Management, Second edition, Prentice Hall India Learning Pvt. Ltd., 2012.
3. Keith Mobley R, Lindley R. Higgins and Darrin J. Wikoff, Maintenance Engineering Handbook, Seventh edition, McGraw-Hill Professional, 2008.
4. Davies A, Handbook of Condition Monitoring: Techniques and Methodology, Springer, 2012.
5. Otegui Jose Luis, Failure Analysis, Fundamentals and Applications in Mechanical Components, Nineteenth edition, Springer, 2014.



**21OME04 SAFETY ENGINEERING****3 0 0 3****Course Objectives**

- ✓ To study the principles of safety management system.
- ✓ To introduce the provisions contained in the industrial laws.
- ✓ To provide knowledge on safety requirements for engineering industry.
- ✓ To learn safety requirement for chemical industry.
- ✓ To study the various safety measures adopted in construction industries.

**Course Outcomes (COs)**

1. Explain safety management system of an industry.
2. Implement the provisions of acts and rules in industries.
3. Implement and review the safety performance followed in various industries
4. Evaluate safety appraisal in chemical industries.
5. Generate safety reports on construction industries.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1					2	1		1						2
2					1			3					2	1
3	2											3	1	
4	2	3							2				2	
5					2					3				3

**UNIT I****8 Hours****SAFETY MANAGEMENT**

Concepts - Evolution, International Labour Organization (ILO), National Safety Council, Techniques - Job Safety Analysis (JSA), Safety survey, Safety inspection, Safety Sampling, Accident Reporting and Investigation - Concept of an accident, Accident causation models, cost of accident, investigation, Safety Performance Monitoring - Safety indices.

**UNIT II****10 Hours****SAFETY AND LAW**

Factory Act 1948-Safety and Health chapters, Tamil Nadu Factories Rules- Safety and Health chapters, Environment and Pollution Laws, Building and other construction works act 1996, Electricity Rules.

**UNIT III****10 Hours****SAFETY IN ENGINEERING INDUSTRIES**

Safety in machine shop,- Principles of machine guarding - Personal protective equipment- Safety in handling industrial gases - Safety in cold forming and hot working of metals- Safety in finishing, inspection and testing, heat treatment, electro plating, leak test, radiography.

**UNIT IV**

**9 Hours**

**SAFETY IN CHEMICAL INDUSTRIES**

Safety in process design, unit operations, pressure vessel, heat exchanger, safety valves -Plant commissioning and inspection, pressure vessel, Plant maintenance and emergency planning, management of maintenance HAZOP study.

**UNIT V**

**8 Hours**

**SAFETY IN CONSTRUCTION INDUSTRY**

Construction regulations, contractual clauses, permit to work, - Education and training-Hazards of construction and prevention- excavation, scaffolding, dismantling, road works, construction of high rise buildings - Working at heights,-Working on fragile roofs, work permit systems-Construction machinery, cranes, chain pulley blocks, earth moving equipment, conveyors- Manual handling, Safety in demolition work, - Safety in confined spaces

**FOR FURTHER READING**

Case Studies- Major accidents at Flixborough, UK, Seveso, Italy, Victoria Dock, India, Bhopal, India.

**Total: 45 Hours**

**Reference(s)**

1. Blake R.B., Industrial Safety, Prentice Hall, Incorporated, New Jersey, 1973.
2. National Safety Council, Accident Prevention Manual for Industrial Operations, Chicago, 1988
3. Subramanian V., The Factories Act, 1948, with Tamil Nadu Factories Rules , 1950, Madras
4. Environmental Pollution Control Act, 1986
5. BOCW Act, 1996, Madras Book agency, Chennai-1
6. Explosive Act, 1884, Eastern Book Company, Lucknow -266 001.

**21OBT01 BIOFUELS****3 0 0 3****Course Objectives**

- To understand and explore the scope of biofuels the most efficient renewable source of energy.
- To develop the expertise in the technology pertaining to their generation and employment in order to surrogate the existing conventional fuels and hence strives towards sustainable development
- To give way to the bolster green technology and incline towards more ecofriendly options.

**Course Outcomes (COs)**

1. Apply the bio resources that can be used for the production of biofuels.
2. Analyze the physical and chemical properties of the biodiesel.
3. Analyze the mechanisms of improvising the quality and performance of engines using biofuels
4. Analyze the bio-fuel conversion technologies and their environmental attributes
5. Evaluate the designing aspects of major unit processes/operations of an integrated bio-refinery

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1		2				3							
2	2						1							
3	1						3							
4	2						3							
5	1						1							

**UNIT I****9 Hours****CLASSIFICATION AND RESOURCES**

Introduction, biofuel as a renewable energy, classification of biofuels - First, second, third and fourth generation biofuels, different plant sources as biofuel feed stocks, Biogases, physical and chemical characteristics of vegetable oils - iodine number, hydroxyl, acid values, rancidity, hydrogenolysis and hydrolysis, Food vs energy.

**UNIT II****9 Hours****BIODIESEL**

Definition, basics and chemistry of biodiesel, vegetable oils in biodiesel production, Trans esterification: Chemical methods, enzymatic methods and types of catalysts, separation and purification, physical properties and characterization of biodiesel - Cloud point, pour point, cold filter plugging point, flash point, viscosity and cetane number.

**UNIT III****9 Hours****QUALITY BIODIESEL AND ENVIRONMENT**

Producing Quality Biodiesel, quality control, test methods, ASTM specifications. Oxidative and thermal stability, estimation of mono, di, triglycerides and free glycerol, engine performance test, blending of ethanol with biodiesel, blending of biodiesel with high speed diesel (HSD) and their combustion properties.

**UNIT IV**

**9 Hours**

**BIOETHANOL AND BIOGASES**

Ethanol as a fuel, microbial and enzymatic production of ethanol from biomass - lignocellulose, sugarcane, sugar beet, corn, wheat starch, purification - wet and dry milling processes, saccharification-chemical and enzymatic. Production of bio methane and bio hydrogen.

**UNIT V**

**9 Hours**

**BIOREFINERIES**

Definition and types of biorefineries, co-products of biorefineries-oil cake and glycerol, purification of glycerol obtained in biodiesel plant; anaerobic and thermal gasification of biomass, economics of biorefineries.

**Total: 45 Hours**

**Reference(s)**

1. Caye Drapcho, John Nghiem and Terry Walker, Biofuels Engineering process technology, McGraw Hill Professional, 2008.
2. Mousdale, Biofuels, CRC Press, 2008
3. Ahindra Nag, Biofuels Refining and Performance, McGraw-Hill Professional, 2007.
4. Lisbeth Olsson, Biofuels (Advances in Biochemical Engineering/ Biotechnology), Springer, 2007

**21OFD01 TRADITIONAL FOODS****3 0 0 3****Course Objectives**

- ✓ Understand the importance of traditional foods and food habits
- ✓ Know the traditional processing of snack, sweet and dairy food products
- ✓ Infer the wide diversity and common features of traditional Indian foods and meal patterns.

**Course Outcomes (COs)**

1. Justify the processing methods of traditional foods in terms of its health benefits
2. Assess the production methods of traditional sweets, snacks and dairy products
3. Differentiate Traditional fermented foods products based on its raw material
4. Implement a large scale production of tradition foods for its increased consumption
5. Compare the health aspects of traditional foods with modern foods

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1													
2		1												
3	2	1	1											
4								2						
5								2						

**UNIT I****9 Hours****TRADITIONAL METHODS OF FOOD PROCESSING**

Introduction - food culture -geographical features and food. Traditional methods of milling grains - rice, wheat and corn - equipment and processes as compared to modern methods. Equipment and processes for edible oil extraction- comparison of traditional and modern methods. Energy costs, efficiency, yield, shelf life and nutrient content comparisons. Traditional methods of food preservation - sun-drying, osmotic drying, brining, pickling and smoking.

**UNIT II****9 Hours****TRADITIONAL SWEETS, SNACKS AND DAIRY PRODUCTS**

Production, formulation, preparation and processing of Indian traditional sweet and snack food products:-Rasgolla, Gulab jamun; formulation and preparation of namkeen, potato chips, banana chips. Acid coagulated and fermented dairy products- paneer, dahi, shrikhand, lassi - processing conditions, defects etc. Fat rich products- Butter, ghee and its processing.

**UNIT III****9 Hours****TRADITIONAL FERMENTED FOOD PRODUCTS**

Idli, Soya sauce, fish pickle, dry fish, meat and vegetable fermented products. Various alcohol based products. Ways to increase nutritional quality of food such as enrichment, fortification, fermentation and mutual supplementation. Best cooking and processing methods to retain nutrients

**UNIT IV**

**10 Hours**

**COMMERCIAL PRODUCTION OF TRADITIONAL FOODS**

Commercial production of traditional breads, snacks, ready-to-eat foods and instant mixes, frozen foods -types marketed, turnover; role of SHGs, SMES industries, national and multinational companies; commercial production and packaging of traditional beverages such as tender coconut water, neera, lassi, buttermilk, dahi. Commercial production of intermediate foods - ginger and garlic pastes, tamarind pastes, masalas (spice mixes), idli and dosa batters

**UNIT V**

**8 Hours**

**HEALTH ASPECTS OF TRADITIONAL FOODS**

Comparison of traditional foods with typical fast foods / junk foods - cost, food safety, nutrient composition, bioactive components; energy and environmental costs of traditional foods; traditional foods used for specific ailments /illnesses.

**Total: 45 Hours**

**Reference(s)**

1. Sen and Colleen Taylor, Food Culture in India, Greenwood Press, 2005.
2. Davidar, Ruth N. "Indian Food Science: A Health and Nutrition Guide to Traditional Recipes:" East West Books, 2001.
3. Steinkrus.K.H. Handbook of Indigenous Fermented Foods, CRC press, 1995.
4. Aneja. R.P, Mathur.BN, R.C. Chandan,and Banerjee.A.K. Technology of Indian Milk Products. Dairy India Year Book, 2009.

**21OFD02 FOOD LAWS AND REGULATIONS****3 0 0 3****Course Objectives**

- ✓ Introduce the concept of food hygiene, importance of safe food and laws governing it
- ✓ Learn common causes of food borne illness - viz. physical, chemical and biological and identification through food analysis
- ✓ Understand food inspection procedures employed in maintaining food quality

**Course Outcomes (COs)**

1. Analyse the food safety strategies and nutritional quality of the food
2. Check the food regulatory mechanism and mandatory laws for food products
3. Determine the national and international regulatory agencies
4. Understand and apply the voluntary regulatory standards
5. Assess the implementation of food safety for a food processing industry

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	1											
2		1				1	2	1						
3		1												
4	1	2												
5	1	2												

**UNIT I****10 Hours****INTRODUCTION**

Introduction, concept of food safety and standards, food safety strategies. Food hazards and contaminations - biological (bacteria, viruses and parasites), chemical (toxic constituents / hazardous materials) pesticides residues / environmental pollution / chemicals) and physical hazards. Preventive food safety systems - monitoring of safety, wholesomeness and nutritional quality of food. Prevention and control of physical, chemical and microbiological hazards. Principles of food safety - Establishment: design and facilities - emergency preparedness - Maintenance cleaning and sanitation - personal hygiene - packaging and labelling - transportation - traceability - recall procedure - visitor policy. Adulteration: Intentional and unintentional - Preservatives - antioxidants, sweeteners, flavours, colours, vitamins, stabilizers - indirect additives - organic residues - inorganic residues and contaminants.

**UNIT II****10 Hours****FOOD LAWS**

Indian and Food Regulatory Regime (Existing and new), PFA Act and Rules, Food Safety and Quality Requirements, Additives, Contaminants and Pesticide Residue. Food Safety and Standards Act, 2006, FSSAI roles and responsibilities, Essential Commodities Act, 1955, Global Scenario, Codex Alimentarius, WHO/FAO Expert Bodies (JECFA/ JEMRA/JMPR) WHO/FAO Expert Bodies (JECFA/ JEMRA/JMPR). Food safety inspection services (FSIS) and their utilization.

### **UNIT III**

**10 Hours**

#### **REGULATIONS**

Introduction to OIE & IPPC, Other International Food Standards (e.g. European Commission, USFDA etc). WTO: Introduction to WTO Agreements: SPS and TBT Agreement, Export & Import Laws and Regulations, Export (Quality Control and Inspection) Act, 1963. Role of Agricultural and Processed Food Products Export Development Authority (APEDA), Customs Act and Import Control Regulations, Other Voluntary and mandatory product specific regulations, Other Voluntary National Food Standards: BIS Other product specific standards; AGMARK. Nutritional Labelling, Health claims.

### **UNIT IV**

**10 Hours**

#### **STANDARDS**

Voluntary Quality Standards and Certification GMP, GHP, HACCP, GAP, Good Animal Husbandry Practices, Good Aquaculture Practices ISO 9000, ISO 22000, ISO 14000, ISO 17025, PAS 22000, FSSC 22000, BRC, BRCIOP, IFS, SQF 1000, SQF 2000. Role of NABL, CFLS.

### **UNIT V**

**5 Hours**

#### **IMPLEMENTATION AND RISK ASSESSMENT**

Implementation of food safety for a desired food processing industry. Risk assessment studies: Risk management, risk characterization and communication.

**Total: 45 Hours**

#### **Reference(s)**

1. Singal RS (1997). Handbook of indices of food quality and authenticity. Woodhead Publ. Cambridge, UK.
2. Shapton DA (1994). Principles and practices of safe processing of foods. Butterworth Publication, London. Winton AL (1999) Techniques of food analysis, Allied Science Publications New Delhi.
3. Pomeranze Y (2004). Food analysis - Theory and Practice CBS Publications, New Delhi.
4. Jacob MB (1999). The chemical analysis of foods and food products. CBS Publ. New Delhi



## 21OFD03 POST HARVEST TECHNOLOGY OF FRUITS AND VEGETABLES

**3 0 0 3**

### Course Objectives

- To understand the importance and different methods of post harvest handling and storage of fruits and vegetables.
- To gain knowledge on different preservation methods of fruits and vegetables
- To familiarize with the value added products from fruits and vegetables

### Course Outcomes (COs)

1. Implement the different post harvest handling practices for the storage of fruits and vegetables
2. Analyze the suitable preservation method (sugar, salt or dehydration) to produce value added products from fruits and vegetables
3. Evaluate the requirement of low temperature and irradiation methods to preserve specific fruits and vegetables
4. Apply the concentration and fermentation methods to preserve fruits and vegetables
5. Implement the canning method to preserve fruits and vegetables

### Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	2	1			1							
2	1	1												
3	1	2												
4	1		1											
5	2	1	1											

### UNIT I

**9 Hours**

#### POST-HARVEST PRACTICES AND PROCESSING

Maturity indices for harvesting; pathological spoilage's during storage, ripening and control measures, Post-harvest handling, sorting & grading, packaging, storage, transportation, Methods of pre-cooling, post-harvest treatments to hasten and delay ripening; Methods of storage at farm level - cold storage, controlled/modified atmosphere storage, Quality management, export requirements, Nutritive value, nutraceutical properties

### UNIT II

**9 Hours**

#### PRESERVATION AND VALUE ADDITION

General principles and methods of fruit and vegetable preservation. Preservation using sugar: Principle and Preparation of jam, jelly, marmalade, squash, RTS, carbonated beverages, crush, nectar, cordial, fruit bar, preserves, candies and carbonated fruit beverages. Processing using salt: Principle - Brining - Preparation of pickles, chutney and sauces, ketchup.

### UNIT III

**9 Hours**

#### PRESERVATION BY LOW TEMPERATURE AND IRRADIATION

Preservation by low temperature: definition, principle, methods - Refrigeration, freezing. Methods of freezing- changes during freezing. Preparation of frozen foods. Minimal Processing of Fruits and

Vegetables - techniques involved - Preservation by irradiation: definition- principle, application, irradiation unit.

**UNIT IV**

**9 Hours**

**PRESERVATION BY DRYING**

Machineries involved in processing of fruits and vegetables products. Drying and dehydration: definition, principle, Types of driers: Solar, cabinet, spray drier, drum drier, fluidized bed drier. Preparation of product for dehydration. Dehydration principles and equipment. Preparation of fruits - powder production. Problems related to storage of dehydrated products.

**UNIT V**

**9 Hours**

**PRESERVATION BY CANNING**

Canning: principles, Types of cans, packing of canned products-preparation of canned products - general considerations in establishing a commercial fruit and vegetable cannery, machineries involved in canning and bottling unit- spoilage of canned foods. Bottling of fruit and vegetable. Precautions in canning operations.

**Total: 45 Hours**

**Reference(s)**

1. S.Ranganna, HandBook of Analysis and Quality Control for Fruit and Vegetable Products, McGraw Hill Education (India) Private Limited, Chennai, 2017
2. N.W. Desrosier, the Technology of Food Preservation, CBS Publisher & Distributions, New Delhi, 1987.
3. R.P. Srivastava and S. Kumar, Fruit and Vegetable Preservation: Principles and Practices, Second Edition, International Book Distribution Co., Lucknow, 1998.
4. G. Lal, G. Siddappa and G.L. Tondon, Preservation of Fruits and Vegetables, Indian Council of Agricultural Research, New Delhi, 1986.
5. Chakraverty, A.S. Mujumdar, G.S.V. Raghavan and H.S. Ramaswamy, Handbook of Post-harvest Technology, Marcel Dekker Press, USA, 2001.
6. D.K. Salunkhe, and S.S. Kadam, Handbook of Fruit Science and Technology: Production, Composition and Processing, Marcel Dekker, New York, 1995.

## 21OFD04 CEREAL, PULSES AND OILSEED TECHNOLOGY

**3 0 0 3**

### Course Objectives

- ✓ Understand the application of scientific principles in the processing technologies specific to the materials
- ✓ Understand the storage methods and handling techniques followed for cereals, pulses and oil seeds
- ✓ Develop the knowledge in the area of Cereals, pulses and oil seed processing and technology

### Course Outcomes (COs)

1. Identify the specific processing technologies employed for cereals
2. Analyse the composition of millets and their nutritional importance
3. Relate the compositional changes and processing methods of pulses and legumes
4. Create the competence in processing of oilseeds technology
5. Relate the storage processing of food grains with quality aspects

### Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2		2		2								
2	1	2		2		1								
3	2	2		1		2								
4	2	3		2		2								2
5	2	2		2		3								

### UNIT I

**9 Hours**

#### CEREALS

Cereal Grains- Basic agricultural aspects, structure and composition; Storage, Insect control; Processing: Wheat- milling, (Atta and maida), quality aspects of flour, wheat proteins and their function, rheology of flour; wheat based baked products - Bread, Biscuit, Cakes, Extruded products, Pizza, Chapatis, malting and malt products; Rice-Milling, Parboiling, Quick cooking rice, Traditional Indian Products- Puffed Rice, flaked rice, Idli/Dosa/vada mixes and other savouries; Corn- Wet and dry milling, Corn Products - Corn flakes, Corn starch, canned corn products, puffed product; Oats-Milling, Oat Products - Steel cut, rolled oats, quick cooking; Traditional and Fermented cereal products.

### UNIT II

**9 Hours**

#### OTHER CEREALS AND MILLETS

Sorghum, Pearl Millet, Finger millet, Foxtail Kodo Millet - Basic agricultural millet, aspects, structure and composition; storage, insect control; processing - pearling, Milling, Malting, Malt based foods, flaked and fermented products; Traditional and Nutritional products based on finger millet.

### UNIT III

**9 Hours**

#### PULSES AND LEGUMES

Basic agricultural aspects, structure, composition, storage, insect control, processing Milling/splitting, dhal milling, products - puffed, flakes, flour, legume-based traditional products, flour based Indian sweets and savouries, soya milk, soy protein Isolate, soya paneer

**UNIT IV**

**9 Hours**

**OIL SEEDS AND NUTS**

Basic agricultural aspects structure, composition, Storage, Insect control; processing: traditional and modern methods of oil extraction, refining, bleaching, deodorizing, hydrogenation; oil blends; applications of different oils and fats in food processing & products.

**UNIT V**

**9 Hours**

**STORAGE AND HANDLING**

Bag Storage - Advantages and Disadvantages, Cover Plinth Storage Structures, CAP storage (Cover and Plinth Storage). Protection against Rodents, Fungi, Pests and Mites. Fumigation Processes for bag storage piles. Bulk Storage in silos and large Bins. Conveyors and Elevators for feeding and discharging.

**Total: 45 Hours**

**Reference(s)**

1. Chakraverty, A.: Post Harvest Technology of Cereals, Pulses and Oilseeds. Oxford and IBH Publishing Co, Calcutta, 1995.
2. Delcour, Jan A. and R. Carl Hoseney., Principles of Cereal Science and Technology, 3rd Edition, American Association of Cereal Chemists, 2010.
3. Karl Kulp, Handbook of Cereal Science and Technology, 2nd Rev. Edition, CRC Press, 2000.
4. N.L.Kent and A.D.Evans, Technology of Cereals (4th Edition) Elsevier Science (Pergaman),Oxford, UK, 1994.
5. Matz, Samuel A., The Chemistry and Technology of Cereals as Food and Feed, 2nd Edition,CBS, 1996.
6. Morris, Peter C. and J.H. Bryce., Cereal Biotechnology, CRC/Wood head publishing, 2004.

**21OFT01 FASHION CRAFTSMANSHIP****3 0 0 3****Course Objectives**

- ✓ To impart theoretical and practical knowledge about various handi-craft techniques
- ✓ To enhance innovative skills on hand crafts.
- ✓ To build confidence on doing handicrafts.

**Course Outcomes (COs)**

1. Outline the classification, techniques and criteria for selecting raw materials for making various handicraft materials and produce textile based handicrafts. Produce various decorative and appealing products
2. Design and construct various wall hangings and fashion accessories.
3. Design and construct toys and accessories
4. Design and construct head accessories, home furnishings and paintings
5. Design and construct various decorative and appealing products for interiors

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1	3				2		2	2		2	2	
2	3	2	3				1		2	3		2	2	
3	3	2	3				2		2	3		2	2	
4	3	2	3				2		2	3		2	2	
5	3	2	3				2		2	3		2	2	

**UNIT I****9 Hours****TECHNIQUES OF HANDICRAFT MATERIALS**

Definition of Handicraft, Classification: Reusable, Non reusable, Raw materials used in various craft materials: printed, embroidered, stitched and handmade, Criteria for selection of raw materials: material types and end uses.

**UNIT II****9 Hours****DECORATIVE AND APPEALING PRODUCTS - INTERIORS**

Designing and Construction procedures for following various decorative and appealing products: Wall hangings - String Art on plywood, Pressed Flower Art frames.

**UNIT III****9 Hours****DECORATIVE AND APPEALING PRODUCTS - ACCESSORIES**

Designing and Construction procedures for following various decorative and appealing products: Handbags, Hats, footwear.

**UNIT IV****9 Hours****DECORATIVE AND APPEALING PRODUCTS - ORNAMENTS**

Designing and Construction procedures for following various decorative and appealing products: Stone necklace using Macrame Technique, Tribal Jewellery using woollen threads, Floral Jewellery using Resin Technique, Fabric Jewellery using Tie and Dye Technique.

**UNIT V**

**9 Hours**

**DECORATIVE AND APPEALING PRODUCTS - FANCY ITEMS**

Designing and Construction procedures for following various decorative and appealing products: Jewellery Box, Utility Holder, Gift items. Lampshade decors from cardboard, Driftwood Frames for pictures and Mirrors.

**Total: 45 Hours**

**Reference(s)**

1. Handmade in India: A Geographic Encyclopaedia of India Handicrafts. Abbeville press; 1 edition (October 20,2009)
2. Encyclopaedia of Card making Techniques (Crafts), Search Press Ltd, illustrated edition, 2007
3. All about Techniques in Illustration, Barron Educational Series, 2001
4. Printing by Hand: A Modern Guide to printing with Handmade stamps, Stencils and Silk Screens, STC Craft/A Melanie Falick Book, 2008
5. Materials & Techniques in the Decorative Arts: An Illustrated Dictionary, University of Chicago Press, 2000
6. <https://www.marthastewart.com/274411/fashion-crafts>

**21OFT02 INTERIOR DESIGN IN FASHION****3 0 0 3****Course Objectives**

- To impart knowledge on interior design.
- To improve the design skills, sustainable with socially-conscious designs

**Course Outcomes (COs)**

1. Interpret the elements of interior design concepts and resolve the personality requirements
2. Develop graphical representations of interior design concepts
3. Resolve the space planning requirements of residential home as per CPWD guidelines
4. Determine the aesthetic requirements of interior design components.
5. Appraise the roles and responsibilities of interior designer.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	3		-	1							2	
2	3	2	3		2	3		2					3	
3	3	3	3		2	2		2					2	
4	3	3	3		2	3		2					2	
5	3	2			2			3					3	

**UNIT I****9 Hours****INTRODUCTION**

Interior designing - definition, importance, requirements and types - Structural design, Decorative Design -Designing interiors, Good taste; Design themes, types and application. Personality of the Home - Art elements - Line: types, characteristics and importance; form: size and shape, characteristics; Colour - sources, qualities, emotional effects, colour wheel and schemes.

**UNIT II****9 Hours****GRAPHICAL PRESENTATIONS**

3D composition; Isometric and Axonometric- Still life- Furniture Sketching- Object Drawing with color rendering - Interior elements, Lighting, plants. Perspective, Axonometric Isometric drawing. Orthographic Projection - Lifts and escalators.

**UNIT III****9 Hours****SPACE PLANNING**

Space planning concepts- interiors, circulation. Definition, application of ergonomic principals in interiors. Residential house space planning case study- CPWD guidelines. Lighting for different locations and activities, measurement, ventilation and indoor air quality, noise control methods.

**UNIT IV****9 Hours****INTERIOR COMPONENTS**

Application of colour in interiors; Texture - types and significance; Pattern: types and effects; Light - importance. Importance of Furniture Design for Interiors- Ancient Age / Middle Age / Contemporary.

Doors, Windows, Staircase designs, False Ceiling, Partitions, Wall Panelling, Comics, Mosaic, Cladding- Flooring and Wall Cladding

**UNIT V**

**9 Hours**

**ROLES AND RESPONSIBILITIES OF INTERIOR DESIGNER**

Role of an Interior Designer- Responsibility towards society and need of an Interior Designer to better the environment- Ethics and Code of Conduct- Responsibility towards client, contractor and supplier, Estimation. Professional Fees- Work of an Interior Designer- Making of portfolio, JD Annual Design Awards.

**Total: 45 Hours**

**Reference(s)**

1. Joanna Gaines, *Homebody: A guide to creating spaces you never want to leave*, Harper design, 2018.
2. Erin gates, *Elements of Style: Designing a Home and a life*, Simon and Schuster, 2014.
3. Simon Dodsworth, *The Fundamentals of Interior Design*, AVA publishing, 2009.
4. V. Mary. Knackstedt, *The Interior Design Business Handbook: A Complete Guide to Profitability*, Wiley, New Jersey; 2006.
5. M. G. Shah, C. M. Kale, and S.Y. Patki, *Building Drawing with an Integrated Approach to Build Environment*, Tata McGraw Hill, 2002.
6. <https://eclectictrends.com>



**21OFT03 SURFACE ORNAMENTATION****3 0 0 3****Course Objectives**

- ✓ To familiarize the students about the various techniques of surface embellishment with relevance to garment embellishments.
- ✓ To aware of various types of embroidery and methods of producing it.
- ✓ To make the students confident about doing surface embellishment work

**Course Outcomes (COs)**

1. Analyze the raw material requirements for surface ornamentation and its application
2. Implement hand embroidery stitches on fabric and show the stitch development procedure in diagrammatic representations
3. Apply the machine and computerized embroidery stitches
4. Analyze the surface embellishment techniques and its application
5. Assess the quality maintenance parameters of all embroidered products and analyze the 6 traditional embroidery techniques

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	2					1						
2	2	3	2						2				2	2
3	2	3	2		3								2	2
4	2	2	2						2				2	2
5	2	2	2						2					2

**UNIT I****9 Hours****INTRODUCTION TO SURFACE ORNAMENTATION**

Introduction, Definition, Need, Types, Raw materials, Importance of surface ornamentation, Selection of needle, thread and fabric for hand embroidery and machine embroidery. various methods of surface embellishment- embroidery and surface ornamentation.

**UNIT II****9 Hours****HAND EMBROIDERY**

General rules for hand embroidery. Types of hand embroidery stitches-Running, Couching, Button hole, Satin, Long & Short, Wheat, Chain, Stem, Herringbone, Cross stitch, Knotted stitches, Fish bone, Fly stitch, Braids, Back, Hem, Seed, Needle weaving, Whip stitches.

**UNIT III****9 Hours****MACHINE EMBROIDERY**

General rules for machine embroidery. Types of frames and methods of transferring the designs. Attachments to sewing machines for embroidery, Types of machine embroidery stitches- Eyelet work, Cut work, patch work, Mirror work, Applique, Shaded embroidery, Shadow work, Bead and Sequins work, Vermicelli, Zigzag, Granite stitch. Computerized embroidery machine- Concept of design and development, software used in embroidery machines, process of designing, method and types of stitch application, punching and digitizing.

**UNIT IV**

**9 Hours**

**EMBELLISHMENT TECHNIQUES**

Materials used and Applications. Types of embellishment techniques- fabric painting-hand, Stencil-dabbing and Spraying. Dyeing and printing-advanced tie and dye techniques, batik and block printing. Trimmings and decorations-Laces, Pompons, Fringes, Tassels, Tucks, Show buttons, Crocheting.

**UNIT V**

**9 Hours**

**TRADITIONAL EMBROIDERIES OF INDIA AND CARE**

Care and maintenance of embroidered articles-care and maintenance methods for embroidered apparel, pressing. Traditional Embroideries of India-Phulkari, Kasuti, Kashmiri embroidery, Kutch work, Chikkankari, Kantha.

**Total: 45 Hours**

**Reference(s)**

1. Ruth Chandler, Modern Hand Stitching-Dozens of stitches with creative free-form variations,2014
2. Sophie Long, Mastering the Art of Embroidery: Traditional Techniques and Contemporary Applications for Hand and Machine Embroidery, Heritage Publishers, London, 2013
3. Christen Brown ,Embroidered & Embellished, C&T Publishing, 2013
4. Sheila Paine, Embroidered Textiles, Thames and Hudson Publisher, UK, 1990.
5. Gail Lawther, Inspirational Ideas for Embroidery on Clothes & Accessories, Search Press Ltd, UK, 1993.
6. <http://www.needlenthread.com/tag/hand-embroidery-stitches>

**21OPH01 NANOMATERIALS SCIENCE****3 0 0 3****Course Objectives**

- ✓ Impart knowledge on Nanoscience
- ✓ Explore different techniques of producing nanomaterials
- ✓ Create expertise on the applications of nanomaterials in various fields

**Course Outcomes (COs)**

1. Summarize the origin and advance of nanomaterials and its classification
2. Compare the different types of methods adopted for synthesizing nanomaterials
3. Analyze the characterization techniques for analyzing nanomaterials
4. Explain the physical properties exhibited by nanomaterials
5. Organize the nanomaterials developed for advanced technological applications

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1												
2	2	2												
3	3	1												
4	1	1												
5	2	3												

**UNIT I****9 Hours****NANO SCALE MATERIALS**

Introduction-Feynman's vision-national nanotechnology initiative (NNI) - past, present, future - classification of nanostructures, nanoscale architecture - effects of the nanometer length scale - changes to the system total energy, and the system structures- effect of nanoscale dimensions on various properties -differences between bulk and nanomaterials and their physical properties.

**UNIT II****9 Hours****NANOMATERIALS SYNTHESIS METHODS**

Top down processes - mechanical milling, nanolithography and types based on radiations - Bottom up process physical method: physical vapour deposition, RF sputtering, CVD- chemical method: colloidal and sol-gel methods - template based growth of nanomaterials - ordering of nanosystems, self-assembly and self-organization.

**UNIT III****9 Hours****CHARACTERIZATION TECHNIQUES**

General classification of characterization methods - analytical and imaging techniques - microscopy techniques - electron microscopy, scanning electron microscopy, transmission electron microscopy,

atomic force microscopy - diffraction techniques - X-ray spectroscopy - thermogravimetric analysis of nanomaterials.

#### **UNIT IV**

**9 Hours**

##### **SEMICONDUCTOR NANOSTRUCTURES**

Quantum confinement in semiconductor nanostructures - quantum wells, quantum wires, quantum dots, super lattices-epitaxial growth of nanostructures-MBE, metal organic VPE, LPE - carbon nano tubes-structure, synthesis and electrical properties -applications- quantum well laser- quantum efficiency of semiconductor nanomaterials

#### **UNIT V**

**9 Hours**

##### **NANOMACHINES AND NANODEVICES**

Microelectromechanical systems (MEMS) and Nanoelectromechanical systems (NEMS)-fabrication, actuators-organic FET- principle, description, requirements, integrated circuits- single electron transistor - - organic photovoltaic cells- spintronics

**Total: 45 Hours**

#### **Reference(s)**

1. Willam A. Goddard, Donald W.Brenner, "Handbook of Nanoscience, Engineering, and Technology", CRC Press, 2012
2. Charles P. Poole Jr and. Frank J. Owens, "Introduction to Nanotechnology", Wiley Interscience, 2007
3. Guozhong Cao, Y. Wang, "Nanostructures and Nanomaterials-Synthesis, Properties & Applications", Imperials College Press, 2011.
4. T. Pradeep, "NANO: The Essentials Understanding Nanoscience and Nanotechnology", McGraw - Hill Education (India) Ltd, 2012
5. Robert W. Kelsall, Ian W. Hamley, Mark Geoghegan, "Nanoscale Science and Technology", John Wiley and Sons Ltd, 2006
6. Viswanathan B, AuliceScibioh M, "Fuel cells: Principles and Applications", University Press, 2009.

**21OPH02 SEMICONDUCTOR PHYSICS AND DEVICES****3 0 0 3****Course Objectives**

- Impart knowledge in physical properties of semiconducting materials
- Analyze the factors affecting the operation of semiconductor devices
- Apply the physics of semiconductors to develop semiconductor devices

**Course Outcomes (COs)**

1. Exemplify the band gap, drift and diffusion current densities due to carrier transport in semiconductors
2. Analyze the energy band diagram in thermal equilibrium and space charge width of PN junction
3. Illustrate the operation of Bipolar Junction transistor at different modes and different configurations
4. Illustrate the operation of metal oxide field effect transistor and their memory devices
5. Represent the working mechanism of opto-electronic devices

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	2	1												
3	2	1												
4	2	1												
5	2	1												

**UNIT I****9 Hours****ENERGY BANDS AND CARRIER TRANSPORT PROPERTIES**

Energy Bands: Formation of energy bands - doping effects - energy levels - electron and hole concept in semiconductor. Carrier transport: Carrier drift-drift current density - conductivity- diffusion current density - total current density

**UNIT II****9 Hours****P-N JUNCTION**

Basic structure and fabrication process of p-n junction - current - voltage characteristics - energy band diagram - equilibrium Fermi levels - depletion region - junction breakdown phenomena - zener - avalanche breakdown.

**UNIT III****9 Hours****BIPOLAR JUNCTION TRANSISTOR**

The basic transistor action - operation in the active mode - current gain - static characteristics - carrier distribution in emitter, base and collector region - modes of operation - current - voltage characteristics of common base and emitter configuration - frequency response and switching of bipolar transistor

#### **UNIT IV**

**9 Hours**

##### **MOSFET**

The ideal MOS diode - basic fundamentals and characteristics - types - CMOS and BiCMOS - CMOS inverter - MOSFET on insulator - thin film transistor (TFT) - silicon on insulators (SOI) devices - MOS Memory structures - DRAM and SRAM

#### **UNIT V**

**9 Hours**

##### **PHOTONIC DEVICES**

Radiative transitions and optical absorption-light emitting diodes-organic LED - infrared LED - semiconductor laser - temperature effect - photo detector - photo diode - silicon and compound semiconductor solar cells - efficiency

**Total: 45 Hours**

##### **Reference(s)**

1. Donald A Neamen, "Semiconductor Physics and Devices", Tata McGraw Hill, 2012
2. S. M. Sze and M. K. Lee, "Semiconductor Devices, Physics and Technology", John-Wiley & Sons, 2015
3. Ben. G. Streetman and S. K. Banerjee , "Solid State Electronic Devices", Pearson Education Ltd, 2015
4. C. Kittel, "Introduction to Solid State Physics", John-Wiley & Sons, 2012
5. J. Millman and C. Halkias, "Electronic Devices and Circuits", Tata McGraw Hill, 2010
6. Hagen Klauk, "Organic Electronics: Materials, Manufacturing and Applications", Wiley-VCH, 2006

**21OPH03 APPLIED LASER SCIENCE****3 0 0 3****Course Objectives**

- Impart knowledge on laser science
- Explore different strategies for producing lasers
- Create expertise on the applications of lasers in various fields

**Course Outcomes (COs)**

1. Illustrate the transition mechanisms and the components of a laser system
2. Compare the different types of lasers based on pumping method, active medium and energy levels
3. Compute the rotation of earth, velocity and distance using lasers and apply the same for day today applications
4. Analyze the role of lasers in surgical and endoscopy applications
5. Apply the laser techniques in industrial applications

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	1	2												
3	2	1												
4	2	1												
5	1	2												

**UNIT I****9 Hours****LASER FUNDAMENTALS**

Introduction - principle - absorption and emission of light - thermal equilibrium - Einstein's prediction - Einstein's relations - A and B coefficients - condition for large stimulated emission - spontaneous and stimulated emission in optical region - light amplification - condition for light amplification - population inversion- Components of lasers - pumping methods - pumping mechanisms - optical resonator

**UNIT II****9 Hours****LASER BEAM CHARACTERISTICS AND TYPES**

Characteristics of laser - Classification of lasers - principle, construction, working, energy level diagram and applications of molecular gas laser (CO<sub>2</sub> laser) - liquid laser (dye laser) - excimer laser - Solid state laser (Nd:YAG laser) - semiconductor laser (homojunction laser).

**UNIT II****9 Hours****LASERS IN SCIENCE**

Introduction - Harmonic generation (SHG) - Stimulated Raman emission - lasers in chemistry - laser in nuclear energy - lasers and gravitational waves - rotation of the earth - measurement of distance - Light detection And Ranging (LIDER) - velocity measurement - holography

#### **UNIT IV**

**9 Hours**

##### **LASERS IN MEDICINE AND SURGERY**

Light induced biological hazards: Eye and skin - Eye laser surgery - photocoagulations - homeostasis - dentistry - laser angioplasty - different laser therapies - advantages & disadvantages - laser endoscopy.

#### **UNIT V**

**9 Hours**

##### **LASERS IN INDUSTRY**

Applications in material processing: laser welding - hole drilling - laser cutting - Lasers in electronics industry: information storage - bar code scanner- Lasers in defence: laser based military weapons - laser walls.

**Total: 45 Hours**

#### **Reference(s)**

1. K. Thiagarajan and A. K. Ghatak, "LASERS: Fundamentals and Applications", Springer, USA, 2015
2. M. N. Avadhanulu, "An Introduction to Lasers Theory and Applications", S. Chand Publisher, 2013
3. W. Koechner, M. Bass, "Solid State Lasers: a graduate text", Springer Verlag, New York, 2006
4. K. P. R. Nair, "Atoms, Molecules and Lasers", Narosa Publishing House, 2009
5. K. R. Nambiar, "Lasers: Principles Types and Applications", New Age International Publications, 2006
6. A. Sennaroglu, "Solid-State Lasers and Applications", CRC Press, 2006



**21OPH04 BIO-PHOTONICS****3 0 0 3****Course Objective:**

- ✓ To understand the light-matter interaction in biological cells or tissues by using the principles of optics and lasers.
- ✓ To apply the properties of biological cells or tissues in biomedical applications by various optical imaging, sensing and activation techniques.
- ✓ To analyze the concepts of Modern optical measurement techniques and devices in early detection of disease and cure them.

**Course Outcomes (COs)**

1. Infer the laws of optics and lasers to interpret the biological cells and tissues.
2. Identify the properties of different optical instruments in biological systems to represent their behavior in structure and design of detection engineering instruments.
3. Use laser tweezers techniques to infer the activities of cells (tissues) and explain the single molecule detection processes in medical diagnosis.
4. Outline the properties of ultra short laser pulses and tissue engineering to rectify the affecting factors in biological cells.
5. Compare the various types of bio-imaging methods to detect the infected cells and molecules in biological science.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2												
2	3	2												
3	3	2							3					
4	3	2							3					
5	3	2												

**UNIT I****9 Hours****INTRODUCTION TO BIOPHOTONICS**

Light as Photon Particles – Coherence of light - lasers – classification of lasers – Mechanisms of Non-linear Optics (NLO) processes associated with Biophotonics - Light scattering mechanisms: Rayleigh scattering, Miescattering, Brillouin Scattering, Raman Scattering -Different light sources – Quantitative description of light: Radiometry

## **UNIT II**

**9 Hours**

### **PHOTOBIOLOGY**

Interaction of light with cells and tissues – Light – Tissue Interaction Variables – Light –Tissue Interaction Theory: Radiative Transport Theory – Photo process in biopolymers – In Vivo Photoexcitation – photo-induced physical, chemical, thermal and mechanical effects in biological systems – Optical biopsy – Single molecule detection

## **UNIT III**

**9 Hours**

### **BIO-NANO-PHOTONICS**

Laser Microtools, Semiconductor quantum dots for bioimaging, Metallic nanoparticles and nanorods for biosensing – Optical biosensors: Fibre-Optic, evanescent wave, surface Plasmon resonance (SPR) based biosensors – biomaterials for photonics – Principle and design of laser tweezers – laser trapping and dissection for biological manipulation.

## **UNIT IV**

**9 Hours**

### **TISSUE ENGINEERING WITH LIGHT**

Basics of tissue optics: Light absorption and scattering in tissues, Wavelength effects and spectra– the therapeutic window, Light penetration in tissues – Absorbing agents in tissues and blood –Skinoptics, response to the UV radiation, Optical parameters of tissues – tissue welding – tissue contouring – tissue regeneration – Femto laser surgery – low level light therapy and photo dynamic therapy

## **UNIT V**

**9 Hours**

### **BIO-IMAGING TECHNIQUES AND ITS APPLICATIONS**

An overview of optical imaging – Fluorescence Microscopy – Scanning Microscopy – In vivo Confocal Microscopy – Multi photon Microscopy – Optical Coherence Tomography (OCT) – Fluorescence Resonance Energy Transfer (FRET) imaging – fluorescence lifetime imaging Microscopy (FLIM) – Nonlinear optical imaging – Coherent Anti-stokes Raman Scattering –Bioimaging Applications.

**Total: 45 Hours**

### **Reference(s)**

1. Introduction to Biophotonics, ParasN.Prasad, WileyInter-science, AJohnWiley & Sons, Inc., Publication (Class notes are developed mainly based on this book.)
2. Introduction to Biomedical Imaging, Andrew G.Webb, 2002, IEEE Press.
3. Biomedical Optics: Principles and Imaging, Lihong.V.Wang, Hsin.-I.Wu, 2007, Wiley Interscience 2007. & "An Introduction to Biomedical Optics", R.Splinterand B.A.Hooper, Taylor & Francis
4. Bioimaging Current Concepts in Light and Electron Microscopy, DouglasE.Chandler & Robert W.Roberson, Jones and Bartlett publishers.
5. Optical Imaging and Microscopy : Techniques and Advanced Systems, Peter Török and Fu-JenKao, 2004, Springer.

**21OPH05 PHYSICS OF SOFT MATTER****3 0 0 3****Course Objectives**

- ✓ To recognize the properties of soft matter and hard matter
- ✓ To understand the fundamental interactions of colloids and gels
- ✓ To explain the structure and phase behavior of liquid crystals and supramolecules
- ✓ To summarize the soft matter properties of structures and components of life

**Course Outcomes (COs)**

1. Identify the salient features of soft matter and hard matter
2. Exemplify the fundamental interactions and stability of colloids and gels
3. Illustrate the structure and properties of liquid crystals
4. Outline the aggregation and phase behavior of surfactants, polymers, copolymers and block copolymers
5. Analyze the soft matter behavior of nucleic acids, proteins, polysaccharides and membranes

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	2	1												
3	2	2												
4	2	2												
5	2	2												

**UNIT I****9 Hours****CONDENSED MATTER**

Intermolecular forces-Condensation and freezing-mechanical response: Hookean solid-Newtonian liquid-viscoelasticity. Glasses: relaxation time-viscosity- glass forming liquids. Soft matter: length scales-fluctuations and Brownian motion

**UNIT II****9 Hours****COLLOIDAL DISPERSIONS & GELS**

Forces between colloidal particles: vander Waals forces-electrostatic double layer forces-steric hindrance-depletion interactions. Stability and phase behaviour: Crystallisation-strong colloids-weak colloids. Physical and chemical gels-classical theory of gelation-elasticity of gels

### **UNIT III**

**9 Hours**

#### **LIQUID CRYSTALS**

Liquid crystal phases-distortions and topological defects-electrical and magnetic properties-polymer liquid crystals-Fredricks transition and liquid crystal displays

### **UNIT IV**

**9 Hours**

#### **SUPRAMOLECULAR SELF ASSEMBLY**

Aggragation and phase separation-types of micelles- bilayers and vesicles. Phase behaviour of concentrated surfactant solutions-phase separation in polymers, copolymers and block copolymers

### **UNIT V**

**9 Hours**

#### **SOFT MATTER IN NATURE**

Components and structures of life-Nucleic acids-proteins-interaction between proteins-polysaccharides-membranes

**Total: 45 Hours**

#### **REFERENCES**

1. Richard A L Jones, Soft Condensd Matter, Oxford University Press, UK, 2002
2. Masao Doi, Soft Matter Physics,Oxford University Press, UK, 2013.
3. Ian W. Hamley, Introduction to Soft Matter, John Wiley & Sons, 2007
4. A. Fernandez-Nieves, A M Puertas, Fluids, Colloids and Soft materials: An Introduction to Soft Matter Physics, John Wiley & Sons, 2016
5. Maurice Kleman, Oleg D. Lavrentovich, Soft Matter Physics: An Introduction, Springer-Verlag, New York, 2003.

**210CH01 CORROSION SCIENCE AND  
ENGINEERING****3 0 0 3****Course Objectives**

- ✓ Analyse the loss incurred due to corrosion in different sectors and terminologies related to corrosion
- ✓ Identify forms and types of corrosion with suitable mechanism
- ✓ Apply various methods of corrosion control, corrosion testing and monitoring

**Course Outcomes (COs)**

1. Explain if corrosion can occur under specific operating conditions in a given equipment or construction and indicate regions of immunity, corrosion and passivity of a metal
2. Compare different corrosion types on metals when exposed to air, water and at high temperatures ( $> 100\text{ }^{\circ}\text{C}$ )
3. Identify the corrosion mechanism on steel, iron, zinc and copper metal surfaces
4. Calculate the rate of corrosion on metals using electrochemical methods of testing
5. Propose the correct materials, design and operation conditions to reduce the likelihood of corrosion in new equipment and constructions

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	2						1							
3	1	3												
4	2	2												
5	3	3					1							

**UNIT I****9 Hours****CORROSION**

Importance of corrosion - spontaneity of corrosion - units of corrosion rate (mdd and mpy) - direct and indirect damage by corrosion - importance of corrosion prevention in industries - Pilling Bedworth ratio and its significance - passivation - area relationship in both active and passive states of metals - Pourbaix diagrams of Mg, Al and Fe and their advantages and disadvantages

**UNIT II****7 Hours****TYPES OF CORROSION**

Eight forms of corrosion: uniform, galvanic, crevice corrosion, pitting, intergranular corrosion, selective leaching, erosion corrosion and stress corrosion-Catastrophic oxidation corrosion

**UNIT III****9 Hours****MECHANISM OF CORROSION**

Hydrogen embrittlement - corrosion fatigue - filiform corrosion - fretting damage and microbes induced corrosion. Corrosion mechanism on steel, iron, zinc and copper metal surfaces

**UNIT IV**

**10 Hours**

**CORROSION RATE AND ITS ESTIMATION**

Rate of corrosion: Factors affecting corrosion. Electrochemical methods of polarization: Tafel extrapolation polarization and linear polarization. Weight loss method - testing for intergranular susceptibility and stress corrosion. Non destructive testing methods: Visual testing - liquid penetrant testing - magnetic particle testing - Ultrasonic monitoring, and eddy current testing

**UNIT V**

**10 Hours**

**CORROSION CONTROL METHODS**

Fundamentals of cathodic protection - types of cathodic protection(sacrificial anodic and impressed current cathodic protection). Stray current corrosion, problems and its prevention. Protective coatings: Metal coatings: Hot dipping (galvanizing, tinning and metal cladding) - natural inhibitors. Selection of suitable design for corrosion control

**Total: 45 Hours**

**Reference(s)**

1. Mouafak A. Zaher, "Introduction to Corrosion Engineering", CreateSpace Independent Publishing Platform, 2016.
2. E.McCafferty, "Introduction to Corrosion Science", Springer; 2010 Edition, January 2010.
3. R. Winstone Revie and Herbert H. Uhlig, "Corrosion and Corrosion Control: An Introduction to Corrosion Science and Engineering", 4th Edition, John Wiley & Science, 2008.
4. Mars G. Fontana, "Corrosion Engineering", Tata McGraw Hill, Singapore, 2008
5. David E.J. Talbot (Author), James D.R. Talbot, "Corrosion Science and Technology", Second Edition (Materials Science & Technology), CRC Press; 2nd Edition, 2007.
6. <http://corrosion-doctors.org/Corrosion-History/Eight.html>

**21OCH02 POLYMER SCIENCE****3 0 0 3****Course Objectives**

- Explain the properties of different polymers with its mechanism
- Select the appropriate polymerization techniques to synthesize the polymers
- Identify suitable polymers for various industrial applications

**Course Outcomes (COs)**

1. Illustrate the types of mechanism of polymerization reactions and analyze the natural and synthetic polymers
2. Identify the suitable polymerization techniques to synthesize the high quality polymers
3. Identify the structure, thermal, and mechanical properties of polymers for different applications
4. Apply the polymer processing methods to design polymer products
5. Analyze the polymers used in electronic and biomedical applications.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	1	2												
3	2	2												
4	1	1	2											
5	1	3	2											

**UNIT I****10 Hours****POLYMERS AND ELASTOMERS**

Classification of polymers - Mechanism: Addition polymerization - free radical, cationic, anionic and co-ordination (Ziegler-Natta) polymerization - copolymerization - condensation polymerization (nylon-6,6) - ring opening polymerization (nylon-6). Elastomers: Natural rubber and synthetic rubber: styrene-butadiene rubber (SBR), butyl, neoprene, thiocol rubbers. High performance polymers: polyethers, polyether ether ketone (PEEK), polysulphones and polyimides

**UNIT II****8 Hours****POLYMERIZATION TECHNIQUES**

Homogeneous and heterogeneous polymerization - bulk polymerization (PMMA, PVC) - solution polymerization - polyacrylic acid, suspension polymerization (ion-exchange resins) - emulsion polymerization (SBR) - advantages and disadvantages of bulk and emulsion polymerization. Melt solution and interfacial poly-condensation

**UNIT III****8 Hours****CHARACTERIZATION AND TESTING**

Characterization of polymers by Infrared Spectroscopy (IR) and Nuclear Magnetic Spectroscopy (NMR) - Thermal properties: TGA and DSC - Testing tensile strength - Izod impact - Compressive strength - Rockwell hardness - Vicot softening point - water absorption

**UNIT IV**

**9 Hours**

**POLYMER PROCESSING**

Moulding: Compression - injection - extrusion and blow mouldings. Film casting - calendering. Thermoforming and vacuum formed polystyrene - foamed polyurethanes. Fibre spinning: melt, dry and wet spinning. Fibre reinforced plastics fabrication: hand-layup - filament winding and pultrusion

**UNIT V**

**10 Hours**

**SPECIALITY POLYMERS**

Preparation and properties of heat resistant and flame retardant polymers. Polymers for electronic applications: liquid crystalline, conducting and photosensitive polymers – E waste management. Polymer for biomedical applications: artificial organs, controlled drug delivery, Scaffolds in tissue Engineering –waste management.

**Total: 45 Hours**

**Reference(s)**

1. V. R. Gowarikar, N. V. Viswanathan and Jayadev Sreedhar, "Polymer Science", New Age International (P) Ltd., New Delhi, 2021
2. Joel R. Fried, "Polymer Science and Technology", Prentice Hall of India (P). Ltd., 2014
3. F. W. Billmeyer, "Text Book of Polymer Science", John Wiley & Sons, New York, 2008
4. Barbara H. Stuart, "Polymer Analysis", John Wiley & Sons, New York, 2008
5. George Odian , "Principles of Polymerization", John Wiley & Sons, New York, 2004
6. R. J. Young and P. A. Lovell, "Introduction to Polymers", CRC Press, New York, 2011
7. Common Biocompatible Polymeric Materials for Tissue Engineering and Regenerative Medicine (2019), Materials Chemistry and Physics <https://doi.org/10.1016/j>.



**210CH03 ENERGY STORING DEVICES****3 0 0 3****Course Objectives**

- Compare the energy density of commercialized primary and secondary batteries.
- Classify the fuel cells and compare their efficiency in different environmental conditions.
- Demonstrate the various energy storage devices and fuel cells.

**Course Outcomes (COs)**

1. Find the parameters required for operation of a cell to evaluate the capacity of energy storage devices.
2. Identify the electrodes, electrolyte and cell reactions of different types of primary, secondary batteries and infer the selection criteria for commercial battery systems with respect to commercial applications.
3. Differentiate fuel cells based on its construction, production of current and applications.
4. Compare different methods of storing hydrogen fuel and its environmental applications.
5. Classify the solar cell based on the materials used in it.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1												
2	2	3					1							
3	3	1												
4	2	2					1							
5	3	3					1							

**UNIT I****6 Hours****BASICS OF CELLS AND BATTERIES**

Components - classification - operation of a cell - theoretical cell voltage - capacity - specific energy - energy density of lithium and lead acid battery - charge efficiency- charge rate - charge retention - closed circuit voltage - open circuit voltage current density - cycle life - discharge rate-over charge-over discharge

**UNIT II****10 Hours****BATTERIES FOR PORTABLE DEVICES AND ELECTRIC VEHICLES**

Primary batteries: zinc-carbon - magnesium, and mercuric oxide - recycling/safe disposal of used cells. Secondary batteries: lead acid - nickel-cadmium - lithium ion batteries - rechargeable zinc alkaline battery. Reserve batteries: Zinc-silver oxide - lithium anode cell - photogalvanic cells. Battery specifications for cars and automobiles. Extraction of metals from battery materials.

**UNIT III****10 Hours****TYPES OF FUEL CELLS**

Importance and classification of fuel cells: Description, working principle, components, applications and environmental aspects of the following types of fuel cells: alkaline fuel cells - phosphoric acid - solid oxide - molten carbonate and direct methanol fuel cells

**UNIT IV**

**10 Hours**

**HYDROGEN AS A FUEL**

Sources and production of hydrogen: Electrolysis and photocatalytic water splitting. Methods of hydrogen storage: High pressurized gas - liquid hydrogen type - metal hydride. Hydrogen as engine fuel - features, application of hydrogen technologies in the future – limitations.

**UNIT V**

**9 Hours**

**ENERGY AND ENVIRONMENT**

Future prospects of renewable energy and efficiency of renewable fuels - economy of hydrogen energy. Solar Cells: First, second, third and fourth generation solar cell - photobiochemical conversion cell.

**Total: 45 Hours**

**Reference(s)**

1. N. Eliaz, E. Gileadi, Physical Electrochemistry, Fundamentals, Techniques and Applications, Wiley, 2019.
2. J. Garche, K. Brandt, Electrochemical Power sources: Fundamentals Systems and Applications, Elsevier, 2018
3. S.P. Jiang, Q. Li, Introduction to Fuel Cells, Springer, 2021.
4. A. Iulianelli, A. Basile, Advances in Hydrogen Production, Storage and Distribution, Elsevier, 2016.
5. M.M. Eboch, The Future of Energy, From Solar Cells to Flying Wind Farms, Capstone, 2020.

## 21OMA01 GRAPH THEORY AND COMBINATORICS

**3 0 0 3**

### Course Objectives

- This course comprehends the graphs as a modeling and analysis tool in computer science & Engineering
- It introduces the structures such as graphs & trees and techniques of counting and combinations, which are needed in number theory based computing and network security studies in Computer Science.

### Course Outcomes (COs)

1. Recognize the basic ideas of Graph and its characteristics.
2. Assess the characteristics of trees and its properties.
3. Predict the coloring of graphs and its applications in the respective areas of engineering.
4. Compute the permutations and combinations in the engineering field.
5. Demonstrate the types of generating functions and their applications in engineering.

### Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2												
2	1	3												
3	2	3												
4	2	3												
5	3	3												

### UNIT I

**9 Hours**

#### INTRODUCTION

Graphs - Introduction - Isomorphism - Sub graphs - Walks, Paths, Circuits - Connectedness - Components - Euler graphs - Hamiltonian paths and circuits - Trees - Properties of trees - Distance and centers in tree - Rooted and binary trees.

### UNIT II

**9 Hours**

#### TREES, CONNECTIVITY

Spanning trees - Fundamental circuits - Spanning trees in a weighted graph - cut sets - Properties of cut set - All cut sets - Fundamental circuits and cut sets - Connectivity and separability - Network flows - 1-Isomorphism - 2-Isomorphism - Combinational and geometric graphs - Planer graphs - Different representation of a planer graph.

### UNIT III

**9 Hours**

#### MATRICES, COLOURING AND DIRECTED GRAPH

Chromatic number - Chromatic partitioning - Chromatic polynomial - Matching - Covering - Four color problem - Directed graphs - Types of directed graphs - Digraphs and binary relations - Directed paths and connectedness - Euler graphs.

**UNIT IV**

**9 Hours**

**PERMUTATIONS**

Fundamental principles of counting - Permutations and combinations - Binomial theorem - combinations with repetition - Combinatorial numbers - Principle of inclusion and exclusion - Derangements - Arrangements with forbidden positions.

**UNIT V**

**9 Hours**

**GENERATING FUNCTIONS**

Generating functions - Partitions of integers - Exponential generating function - Summation operator - Recurrence relations - First order and second order - Non-homogeneous recurrence relations - Method of generating functions.

**Total: 45 Hours**

**Reference(s)**

1. Narsingh Deo, Graph Theory: With Application to Engineering and Computer Science, Prentice Hall of India, 2003
2. Grimaldi R.P., Discrete and Combinatorial Mathematics: An Applied Introduction, Addison Wesley, 1994.
3. Rosen K.H., Discrete Mathematics And Its Applications, McGraw Hil, 2007
4. Clark J. & Holton D.A., A First Look at Graph Theory, Allied Publishers, 1995.
5. Mott J.L., Kandel A. & Baker T.P., Discrete Mathematics for Computer Scientists and Mathematicians, Prentice Hall of India, 1996.
6. Liu C.L., Elements of Discrete Mathematics, McGraw Hill, 1985.

**21OGE01 PRINCIPLES OF MANAGEMENT****3 0 0 3****Course Objectives**

- ✓ To develop cognizance about importance of management principles.
- ✓ Extract the functions and responsibilities of managers.
- ✓ To Study and understand the various HR related activities.
- ✓ Learn the application of the theories in an organization.
- ✓ Analyze the position of self and company goals towards business.

**Course Outcomes (COs)**

1. Students will be able to understand the basic concepts of Management.
2. Have some basic knowledge on planning process and its Tools & Techniques.
3. Ability to understand management concept of organizing and staffing.
4. Ability to understand management concept of directing.
5. Ability to understand management concept of controlling.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									2		3			
2									2		2			
3									2		2			
4									3		2			
5									2		2			

**UNIT I****9 Hours****INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS**

Definition of Management Science or Art Manager Vs Entrepreneur-types of managers - Managerial roles and skills Evolution of Management Scientific, Human Relations, System and Contingency approaches Types of Business organization - Sole proprietorship, partnership, Company - public and private sector enterprises - Organization culture and Environment Current Trends and issues in Management.

**UNIT II****9 Hours****PLANNING**

Nature and purpose of planning - Planning process - Types of planning – Objectives - Setting objectives - Policies - Planning premises - Strategic Management - Planning Tools and Techniques - Decision making steps and process.

**UNIT III****9 Hours****ORGANISING**

Nature and purpose – Formal and informal organization - Organization chart - Organization Structure Types - Line and staff authority - Departmentalization - Delegation of authority - Centralization and decentralization - Job Design - Human Resource - Management - HR Planning, Recruitment, Selection, Training and Development, Performance Management, Career planning and management

**UNIT IV**

**9 Hours**

**DIRECTING**

Foundations of individual and group behaviour - Motivation-Motivation theories - Motivational techniques - Job satisfaction - Job enrichment - Leadership-types and theories of leadership - Communication-Process of communication - Barrier in communication Effective communication-Communication and IT.

**UNIT V**

**9 Hours**

**CONTROLLING**

System and process of controlling - Budgetary and non-Budgetary control techniques - Use of Computers and IT in Management control - Productivity problems and management - Control and Performance-Direct and preventive control - Reporting.

**Total: 45 Hours**

**Reference(s)**

1. Robbins S, Management, (13th ed.), Pearson Education, New Delhi, 2017.
2. Stephen A. Robbins and David A. Decenzo and Mary Coulter, Fundamentals of Management, Pearson Education, 7th Edition, 2011.
3. Robert Kreitner and Mamata Mohapatra, Management, Biztantra, 2008.
4. L. M. Prasad, Principles and Practice of Management. 7th Edition, Sultan Chand & Sons, 2007.
5. P. C. Tripathi and P. N. Reddy, Principles of Management, Fourth Edition, Tata McGraw Hill, 2008.

**21OGE02 ENTREPRENEURSHIP DEVELOPMENT I****3 0 0 3****Course Objectives**

- ✓ Learn the basics and scope of the Entrepreneurship
- ✓ Understand the generation of ideas of the Entrepreneurship
- ✓ Evolve the legal aspects of the business
- ✓ Learn to analyze the various business finance
- ✓ Learn the basics of the Operations Management

**Course Outcomes (COs)**

1. Analyze the role of entrepreneurship in economic development.
2. Explain the types of ideas that to be used for entrepreneurship development.
3. Examine the legal aspects of business and its association.
4. Examine the sources of business and its analysis.
5. Analyse the different modes of operation management.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1						1	2		2					
2						1	2		2					
3						1	2		2					
4						1	2		2					
5						1	2		2					

**UNIT I****9 Hours****BASICS OF ENTREPRENEURSHIP**

Nature, scope and types of Entrepreneurship, Entrepreneur Personality Characteristics, Entrepreneurship process. Role of entrepreneurship in economic development

**UNIT II****9 Hours****GENERATION OF IDEAS**

Creativity and Innovation, Lateral Thinking, Generation of Alternatives, Fractional, Reversal Method, Brain Storming, Analogies

**UNIT III****9 Hours****LEGAL ASPECTS OF BUSINESS**

Contract act-Indian contract act, Essential elements of valid contract, classification of contracts, sale of goods act- Formation of contract of sale, negotiable instruments- promissory note, bills and cheques, partnership, limited liability partnership (LLP), companies act-kinds, formation, memorandum of association, articles of association.

**UNIT IV****9 Hours****BUSINESS FINANCE**

Project evaluation and investment criteria (cases), sources of finance, financial statements, break even analysis, cash flow analysis.

**UNIT V**

**9 Hours**

**OPERATIONS MANAGEMENT**

Importance – functions - deciding on the production system - facility decisions: plant location, plant layout (cases), capacity requirement planning - inventory management (cases) - lean manufacturing, Six sigma.

**Total: 45 Hours**

**Reference(s)**

1. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi: 2005
2. Prasanna Chandra, Projects Planning, Analysis, Selection, Implementation and Reviews, Tata McGraw-Hill Publishing Company Limited, New Delhi: 2000.
3. Akhileshwar Pathak, Legal Aspects of Business, Tata McGraw Hill: 2006



**21OGE03 ENTREPRENEURSHIP DEVELOPMENT II****3 0 0 3****Course Objectives**

- ✓ Evolve the marketing mix for promotion the product / services
- ✓ Handle the human resources and taxation
- ✓ Learn to analyze the taxation
- ✓ Understand the Government industrial policies and supports
- ✓ Preparation of a business plan

**Course Outcomes (COs)**

1. Examine the strategies and plans in marketing management.
2. Analyse the cases involved in human resource management.
3. Classify the direct and indirect taxes in business.
4. Analyze the supports given by government for improving the business.
5. Examine the various steps involved in preparing the business plan.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1						1	2		2					
2						1	2		2					
3						1	2		2					
4						1	2		2					
5						1	2		2					

**UNIT I****9 Hours****MARKETING MANAGEMENT**

Marketing environment, Segmentation, Targeting and positioning, Formulating marketing strategies, Marketing research, marketing plan, marketing mix (cases)

**UNIT II****9 Hours****HUMAN RESOURCE MANAGEMENT**

Human Resource Planning (Cases), Recruitment, Selection, Training and Development, HRIS, Factories Act 1948 (an over view)

**UNIT III****9 Hours****BUSINESS TAXATION**

Direct taxation, Income tax, Corporate tax, MAT, Tax holidays, Wealth tax, Professional tax (Cases). Indirect taxation, Excise duty, Customs, Sales and Service tax, VAT, Octroi, GST (Cases)

**UNIT IV****9 Hours****GOVERNMENT SUPPORT**

Industrial policy of Central and State Government, National Institute - NIESBUD, IIE, EDI. State Level Institutions - TIIC, CED, MSME, Financial Institutions

**UNIT V**

**9 Hours**

**BUSINESS PLAN PREPARATION**

Purpose of writing a business plan, Capital outlay, Technical feasibility, Production plan, HR plan, Market survey and Marketing plan, Financial plan and Viability, Government approvals, SWOT analysis.

**Total: 45 Hours**

**Reference(s)**

1. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi: 2005
2. Philip Kotler., Marketing Management, Prentice Hall of India, New Delhi: 2003
3. Aswathappa K, Human Resource and Personnel Management - Text and Cases, Tata McGraw Hill: 2007.
4. Jain P C., Handbook for New Entrepreneurs, EDIL, Oxford University Press, New Delhi: 2002.
5. Akhileshwar Pathak, Legal Aspects of Business, Tata McGraw Hill: 2006.
6. <http://niesbud.nic.in/agencies.html>

## 21OGE04 NATION BUILDING, LEADERSHIP AND SOCIAL RESPONSIBILITY

**3 0 0 3**

### Course Objectives

- To understand the importance of National Integration, Patriotism and Communal Harmony
- To outline the basic awareness about the significance of soft skills in professional and inter-personal communications and facilitate an all-round development of personality
- To analyze the different types of responsibility role of play for the improvement of society

### Course Outcomes (COs)

1. Understand religio-cultural diversity of the country and its impact on the lives of the people and their beliefs
2. Acquire a sense of responsibility, smartness in appearance and improve self confidence
3. Develop the sense of self-less social service for better social & community life
4. Apply the importance of Physical and Mental health and structure of communication organization and various mode of communication
5. Acquire awareness about the various types of weapon systems in the Armed Forces.

### Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		1				1					3		
2	2		2				2					2		
3	2		1				1					2		
4	2		3				3					3		
5	2		1				1					2		

### UNIT I

**9 Hours**

#### NATIONAL INTEGRATION

Importance & Necessity, Factors Affecting National Integration, Unity in Diversity. Threats to National Security. Water Conservation and Rain Harvesting, Waste Management and Energy Conservation. Leadership Capsule-Traits-Indicators-Motivation-Moral Values-Honor Code-Case Studies: Shivaji, Jhansiki Rani, Case Studies-APJ Abdul kalam, Deepa Malik, Maharana Pratap, N Narayan Murthy Ratan Tata Rabindra Nath Tagore, role of NCC cadets in 1965 war.

### UNIT II

**9 Hours**

#### PERSONALITY DEVELOPMENT AND LEADERSHIP

Intra & Interpersonal skills - Self-Awareness- & Analysis, Empathy, Critical & creative thinking, Decision making and problem solving, Communication skills, Group Discussion – coping with stress and emotions, changing mindset, Public Speaking, Time Management, Social skills, Career counseling, SSB procedure and Interview skills.

### UNIT III

**9 Hours**

#### SOCIAL SERVICE, COMMUNITY DEVELOPMENT AND ENVIRONMENTAL AWARENESS

Basics of social service and its need, Types of social service activities, Objectives of rural development programs and its importance, NGO's and their contribution in social welfare, contribution of youth and NCC in Social welfare. Protection of children & women safety, Road/ Rail Travel Safety, New

initiatives, Cyber and mobile security awareness. Disaster management Capsule-Organization-Types of Disasters-Essential Services-Assistance-Civil Defence Organization

#### **UNIT IV**

**9 Hours**

##### **HEALTH, HYGIENE AND COMMUNICATION**

Sanitation, First Aid in Common Medical Emergencies. Health, Treatment and Care of Wounds. Yoga- Introduction, Definition, Purpose, Benefits. Asanas-Padamsana, Siddhasana, Gyan Mudra, Surya Namaskar, Shavasana, Vajrasana, Dhanurasana, Chakrasana, Sarvaangasana, Halasanaetc. Obstacle Training Contact: Obstacle training - Intro, Safety measures, Benefits, Straight balance, Clear Jump, Gate Vault, ZigZagBalance, High Wall etc. COMMUNICATION: Basic Radio Telephony (RT) Procedure- Introduction, Advantages, Disadvantages, Need for standard- Procedures-Types of Radio Telephony Communication-Radio telephony procedure, Documentation.

#### **UNIT V**

**9 Hours**

##### **ARMED FORCES AND NCC GENERAL**

Introduction to Digital Signal Processors- Basic Classification-Features TMS320C6713 Architecture- Functional Unit-Pipelining- Addressing Modes -Instruction set Simple Assembly Language Program.

**Total: 45 Hours**

#### **Reference(s)**

1. Director General NCC Website: <https://indiancc.nic.in/ncc-general-elective-subject-course-design/>
2. Grooming Tomorrow's Leaders, published by DG, NCC. <https://indiancc.nic.in/>
3. Youth in Action, published by DG, NCC. <https://indiancc.nic.in/>
4. The Cadet, Annual Journal of the NCC. <https://indiancc.nic.in/>
5. Précis Issued by respective Service Headquarters on specialized subject available to PI Staff as reference material. <https://indiancc.nic.in/>