R.M.D. ENGINEERING COLLEGE
RSM Nagar, Kaveraipettai– 601206, Gummidipoondi (T.K), Thiruvallur (D.T), Tamil Nadu
(An Autonomous Institution)
Approved by AICTE, New Delhi/ Affiliated to Anna University, Chennai
All Eligible UG Courses are Accredited by NBA & Institution Accredited by NAAC
An ISO 21001:2018 Certified Institution

Curriculum 2022

Bachelor of Engineering

Electronics & Communication Engineering

R.M.D. ENGINEERING COLLEGE

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REGULATIONS-2022
CHOICE BASED CREDIT SYSTEM

Mapping of Programme Educational Objectives with Department Mission

Mission	PEO1	PEO2	PEO3	PEO4	PEO5
To produce competent engineers to face challenges of the society by providing conducive academic learning environment.	3	2	2	1	2
To facilitate and encourage the students and faculty members to excel in research activities.	2	3	2	2	2
To promote industry institute collaboration and develop the application skills of the students.	1	2	2	1	1
To adopt innovative teaching and learning methodologies that leads to self improvement of students.	2	1	3	3	3
To develop sound technical knowledge, professional ethics, entrepreneurial and leadership skills among students.	2	1	3	3	3

Contribution 1: Reasonable 2: Significant 3: Strong

PROGRAMME EDUCATIONAL OBJECTIVES

PEO1: To enable graduates to pursue research, or have a successful career in academia or industries associated with Electronics and Communication Engineering, or as entrepreneurs

PEO2: To provide students with strong foundational concepts and also advanced techniques and tools in order to enable them to build solutions or systems of varying complexity.

PEO3: To prepare students to critically analyze existing literature in an area of specialization and ethically develop innovative and research oriented methodologies to solve the problems identified.

PROGRAMME OUTCOMES

Engineering Graduates will be able to:

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

b) **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.

c) **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.

d) **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.

e) **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**.**

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

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

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

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

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

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

l) **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

PROGRAM SPECIFIC OBJECTIVES (PSOs)

1. To analyze, design and develop solutions by applying foundational concepts of Electronics and Communication Engineering.
2. To apply design principles and best practices for developing quality products for scientific and business applications.
3. To adapt emerging information and communication technologies (ICT) and innovate ideas and solutions to existing or novel problems

MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES WITH PROGRAMME OUTCOMES

A broad relation between the Programme Educational Objectives and the Programme Outcomes is given in the following table

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES											
	a	b	c	d	e	f	g	h	i	j	k	l
1	3	3	3	3	3	3	2	3	3	3	3	3
2	3	3	3	3	2	2	2	3	3	3	3	3
3	3	3	3	2	2	2	2	3	2	3	2	2

MAPPING OF PROGRAM SPECIFIC OBJECTIVES WITH PROGRAMME OUTCOMES

A broad relation between the Program Specific Objectives and the Programme outcomes is given in the following table

PROGRAM SPECIFIC OBJECTIVES	PROGRAMME OUTCOMES											
	a	b	c	d	e	f	g	h	i	j	k	l
1	3	3	3	3	3	2	2	2	2	2	3	3
2	3	3	3	3	3	1	1	1	2	2	1	2
3	3	3	3	3	1	2	2	1	2	2	2	2

Contribution 1: Reasonable 2: Significant 3: Strong

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING REGULATIONS-2022

CHOICE BASED CREDIT SYSTEM

MAPPING OF COURSE OUTCOMES WITH PROGRAMME OUTCOMES:

A broad relation between the Course Outcomes and Programme Outcomes is given in the table

COURSE COUTCOMES		PROGRAMME OUTCOMES											
Sem	COURSE NAME	a	b	c	d	e	f	g	h	i	j	k	l
I	Matrices and Calculus	✓	✓	✓	✓	✓	✓	✓					✓
	Physics for Electronics Engineering	✓	✓	✓	✓							✓	✓
	Problem Solving using C++	✓	✓	✓					✓	✓	✓		✓
	Software Development Practices	✓	✓	✓		✓	✓		✓	✓	✓		✓
	Digital Principles and System Design	✓	✓	✓					✓	✓	✓		✓
	Professional Communication	✓								✓	✓		✓
	Heritage for Tamils		✓							✓	✓		✓
	Product Development Lab–1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Environmental Sciences and Sustainability (Non Credit)	✓	✓	✓	✓	✓						✓	✓
	Induction Program (Non Credit)							✓	✓	✓	✓	✓	✓
II	Transforms and Numerical Methods	✓	✓	✓	✓	✓	✓						✓
	Electron Devices and Circuit Theory	✓	✓	✓	✓	✓	✓					✓	✓
	Engineering Chemistry	✓	✓				✓	✓					✓
	Data Structures	✓	✓	✓	✓	✓	✓					✓	✓
	Java Programming	✓	✓	✓		✓			✓	✓	✓		✓
	Tamils and Technology		✓							✓	✓		✓
	Computer Aided Engineering Graphics	✓		✓		✓					✓		
	Product Development Lab-2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Yoga for Stress Management							✓	✓	✓	✓	✓	✓
III	Statistics and Linear Algebra	✓	✓	✓	✓					✓	✓		
	Signals and Systems	✓	✓	✓	✓	✓	✓	✓	✓				✓
	Analog Electronics	✓	✓	✓	✓	✓	✓	✓	✓				✓
	Advanced Java Programming	✓	✓	✓		✓			✓	✓	✓		✓
	Electromagnetic Field and Transmission Lines	✓	✓	✓	✓	✓		✓					✓

	Aptitude and Coding Skills I	✓	✓						✓	✓			
	Product Development Lab-3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Value Education (Non Credit)	✓	✓							✓	✓		
	Probability and Random Processes	✓	✓	✓	✓	✓							✓
	Control Engineering	✓	✓	✓	✓	✓	✓		✓		✓		✓
	Linear Integrated Circuits	✓	✓	✓	✓	✓		✓					✓
	Analog and Digital Communication	✓	✓	✓	✓	✓							✓
	Universal Human Values II: Understanding Harmony	✓	✓	✓	✓								✓
	Aptitude and Coding Skills II	✓	✓							✓	✓		
	Product Development Lab-4	✓	✓	✓	✓	✓	✓	✓	✓				✓
	Yoga for Personality Development	✓	✓							✓	✓		
V	Database Management Systems	✓	✓	✓	✓	✓	✓					✓	✓
	Digital VLSI Design	✓	✓	✓	✓	✓	✓					✓	✓
	Microcontroller and Interfacing	✓	✓	✓	✓	✓	✓					✓	✓
	Computer Networks	✓	✓	✓	✓	✓	✓					✓	✓
	Professional Elective I												
	Professional Elective II												
	Advanced Aptitude and Coding Skills I	✓	✓							✓	✓		
	Internship	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Indian Constitution (Non Credit)	✓	✓	✓						✓	✓		
VI	Digital Signal Processing	✓	✓	✓	✓	✓	✓					✓	✓
	Embedded Systems & IoT Design	✓	✓	✓	✓	✓	✓					✓	✓
	Management Elective												
	Professional Elective III												
	Professional Elective IV												
	Open Elective I												
	Advanced Aptitude and Coding Skills II	✓	✓	✓	✓	✓	✓					✓	✓
	Miniproject	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
VII	Antennas and Microwave Engineering	✓	✓	✓	✓	✓	✓						✓
	Wireless Communication	✓	✓	✓	✓	✓				✓	✓	✓	✓
	Professional Ethics in Engineering						✓	✓	✓	✓	✓	✓	✓
	Professional Elective V												
	Open Elective II (MOOC / SWAYAM)												
	Essence of Indian Knowledge Tradition (Non Credit)	✓	✓	✓								✓	✓

	Professional Readiness for Innovation, Employability and Entrepreneurship	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
VIII	Project Work	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING

REGULATIONS–2022

CHOICE BASED CREDIT SYSTEM

SEMESTER–I								
Sl. No.	**Course Code**	**Course Title**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY COURSES WITH LABORATORY COMPONENT								
1	22MA101	Matrices and Calculus	BSC	5	3	0	2	4
2	22PH102	Physics for Electronics Engineering	BSC	5	3	0	2	4
3	22CS101	Problem Solving using C++	ESC	5	3	0	2	4
4	22CS102	Software Development Practices	ESC	5	3	0	2	4
5	22EC101	Digital Principles and System Design	PCC	5	3	0	2	4
6	22HS101	Professional Communication	HSMC	4	2	0	2	3
THEORY COURSE								
7	22GE201	Heritage of Tamils	HSMC	1	1	0	0	1
EMPLOYABILITY ENHANCEMENT COURSES								
8	22GE111	Product Development Lab -1	EEC	2	0	0	2	1
MANDATORY COURSES								
9	22CH104	Environmental Science and Sustainability (Non Credit)	MC	2	2	0	0	0
10		Induction Program (Non Credit)	MC	3Weeks				
TOTAL				**34**	**20**	**0**	**14**	**25**

SEMESTER–II								
Sl. No.	**Course Code**	**Course Title**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY COURSES WITH LABORATORY COMPONENT								
1	22MA201	Transforms and Numerical Methods	BSC	5	3	0	2	4
2	22EC201	Electron Devices and Circuit Theory	PCC	5	3	0	2	4
3	22CH101	Engineering Chemistry	BSC	5	3	0	2	4
4	22CS201	Data Structures	ESC	5	3	0	2	4
5	22CS202	Java Programming	ESC	5	3	0	2	4
THEORY COURSE								
6	22GE302	Tamils and Technology	HSMC	1	1	0	0	1
LABORATORY COURSES WITH THEORY COMPONENT								
7	22GE101	Computer Aided Engineering Graphics	ESC	3	1	0	2	2
EMPLOYABILITY ENHANCEMENT COURSES								
8	22ME211	Product Development Lab -2	EEC	2	0	0	2	1
AUDIT COURSES								
9	22AC201	Yoga for Stress Management	AC	1	1	0	0	0
TOTAL				**32**	**18**	**0**	**14**	**24**

SEMESTER–III								
Sl. No.	**Course Code**	**Course Title**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY COURSES WITH LABORATORY COMPONENT								
1	22MA302	Statistics and Linear Algebra	BSC	5	3	0	2	4
2	22EC301	Signals and Systems	PCC	5	3	0	2	4
3	22EC302	Analog Electronics	PCC	5	3	0	2	4
4	22CS307	Advanced Java Programming	ESC	5	3	0	2	4
THEORY COURSE								
5	22EC303	Electromagnetic fields and Transmission lines	PCC	3	3	0	0	3
EMPLOYABILITY ENHANCEMENT COURSES								
6	22CS311	Aptitude and Coding Skills I	EEC	2	0	0	2	1
7	22EC311	Product Development Lab -3	EEC	2	0	0	2	1
MANDATORY COURSES								
8		Value Education (Non Credit)	MC	1	1	0	0	0
TOTAL				28	16	0	12	21

SEMESTER–IV								
Sl. No.	**Course Code**	**Course Title**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY COURSES WITH LABORATORY COMPONENT								
1	22MA402	Probability and Random Processes	BSC	5	3	0	2	4
2	22EC401	Control Engineering	PCC	5	3	0	2	4
3	22EC402	Linear Integrated Circuits	PCC	5	3	0	2	4
4	22EC403	Analog and Digital Communication	PCC	5	3	0	2	4
THEORY COURSE								
5	22GE301	Universal Human Values II: Understanding	HSMC	3	3	0	0	3
EMPLOYABILITY ENHANCEMENT COURSES								
6	22CS411	Aptitude and Coding Skills II	EEC	2	0	0	2	1
7	22EC411	Product Development Lab -4	EEC	2	0	0	2	1
AUDIT COURSES								
8	22AC401	Yoga for Personality Development	AC	1	1	0	0	0
TOTAL				28	16	0	12	21

SEMESTER–V								
Sl. No.	**Course Code**	**Course Title**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY COURSES WITH LABORATORY COMPONENT								
1	22IT201	Database Management Systems	ESC	5	3	0	2	4
2	22EC501	Digital VLSI Design	PCC	5	3	0	2	4
3	22EC502	Microcontroller and Interfacing	PCC	5	3	0	2	4
THEORY COURSES								
4	22EC503	Computer Networks	PCC	3	3	0	0	3
5		Professional Elective I	PEC	3	3	0	0	3
6		Professional Elective II	PEC	3	3	0	0	3
EMPLOYABILITY E NHANCEMENT COURSES								
7	22CS511	Advanced Aptitude and Coding Skills I	EEC	2	0	0	2	1
8	22EC511	Internship	EEC	2	0	0	2	1
MANDATORY COURSES								
9	22MC501	Indian Constitution (Non Credit)	MC	1	1	0	0	0
TOTAL				29	19	0	10	23

SEMESTER–VI								
Sl. No.	**Course Code**	**Course Title**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY COURSES WITH LABORATORY COMPONENT								
1	22EC601	Digital Signal Processing	PCC	5	3	0	2	4
2	22EC602	Embedded Systems & IoT Design	PCC	5	3	0	2	4
THEORY COURSE								
3		Management Elective	HSMC	3	3	0	0	3
4		Professional Elective III	PEC	3	3	0	0	3
5		Professional Elective IV	PEC	3	3	0	0	3
6		Open Elective I	OEC	3	3	0	0	3
EMPLOYABILITY ENHANCEMENT COURSES								
6	22CS611	Advanced Aptitude and Coding Skills II	EEC	2	0	0	2	1
7	22EC611	Mini project	EEC	2	0	0	2	1
TOTAL				26	18	0	8	22

SEMESTER–VII								
Sl. No.	**Course Co**	**Course Title**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY COURSES WITH LABORATORY COMPONENT								
1	22EC701	Antennas and Microwave Engineering	PCC	5	3	0	2	4
THEORY COURSE								
2	22EC702	Wireless Communication	PCC	3	3	0	0	3
	22EC703	Professional Ethics in Engineering	HSMC	3	3	0	0	3
3		Professional Elective V	PEC	3	3	0	0	3
4		Open Elective II (MOOC / SWAYAM)	OEC	3	3	0	0	3
EMPLOYABILITY ENHANCEMENT COURSES								
5	22EC711	Professional Readiness for Innovation, Employability and Entrepreneurship	EEC	6	0	0	6	3
MANDATORY COURSE								
6	22MC711	Essence of Indian Knowledge Tradition (Non Credit)	MC	1	1	0	0	0
TOTAL				24	16	0	8	19

SEMESTER–VIII								
Sl. No.	**Course Code**	**Course Title**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
EMPLOYABILITY ENHANCEMENT COURSES								
1	22EC811	Project Work	EEC	16	0	0	16	8
TOTAL				16	0	0	16	8

CREDIT DISTRIBUTION

S. No.	Subject Area	CREDITS AS PER SEMESTER								Total Credits	% of Distribution	As per AICTE
		I	II	III	IV	V	VI	VII	VIII			
1	HSMC	4	1	-	3	-	3	3	-	14	8.58	15
2	BSC	8	8	4	4	-	-	-	-	24	14.72	23
3	ESC	8	10	4	-	4	-	-	-	26	15.95	17
4	PCC	4	4	11	12	11	8	7	-	57	34.96	61
5	PEC	-	-	-	-	6	6	3	-	15	9.20	12
6	OEC	-	-	-	-	-	3	3	-	6	3.68	12
7	EEC	1	1	2	2	2	2	3	8	21	12.88	29
8	MC / AC											
TOTAL		25	24	21	21	23	22	19	8	163	100	160

PROFESSIONAL ELECTIVE I
SEMESTER V

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	22EC901	Introduction to Internet of things	PEC	3	3	0	0	3
2	22EC902	FPGA Architecture and Applications	PEC	3	3	0	0	3
3	22EC903	Wireless Sensor Networks	PEC	3	3	0	0	3
4	22EC904	Medical Electronics	PEC	3	3	0	0	3
5	22EC905	Digital Image and Video Processing	PEC	3	3	0	0	3
6	22EC906	Soft Computing	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE II SEMESTER V								
Sl. No.	**Course Code**	**Course Title**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
1	22EC907	Sensors and Actuator Devices	PEC	3	3	0	0	3
2	22EC908	RTL Design with VHDL/Verilog HDL	PEC	3	3	0	0	3
3	22EC909	Optical Communication and Networking	PEC	3	3	0	0	3
4	22EC910	Human Assist Devices	PEC	3	3	0	0	3
5	22EC911	Multimedia Compression and Communication	PEC	3	3	0	0	3
6	22EC912	Quantum Computing	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE III SEMESTER VI								
Sl. No.	**Course Code**	**Course Title**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
1	22EC913	Artificial Intelligence and Machine Learning	PEC	3	3	0	0	3
2	22EC914	Low Power VLSI Design	PEC	3	3	0	0	3
3	22EC915	4G / 5G Communication Networks	PEC	3	3	0	0	3
4	22EC916	Wearable Devices	PEC	3	3	0	0	3
5	22EC917	Speech Processing	PEC	3	3	0	0	3
6	22EC918	Robotics and Applications	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE IV SEMESTER VI								
Sl. No.	**Course Code**	**Course Title**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
1	22EC919	Application of IoT in Robotics	PEC	3	3	0	0	3
2	22EC920	Design Verification and Debugging	PEC	3	3	0	0	3
3	22EC921	Massive MIMO Networks	PEC	3	3	0	0	3
4	22EC922	Body Area Networks	PEC	3	3	0	0	3
5	22EC923	Wireless Networks	PEC	3	3	0	0	3
6	22EC924	Augmented Reality / Virtual Reality	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE V SEMESTER VII								
Sl. No.	**Course Code**	**Course Title**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
1	22EC925	UAV and Drone Technology	PEC	3	3	0	0	3
2	22EC926	Design Optimization and Timing Analysis	PEC	3	3	0	0	3
3	22EC927	Wireless Adhoc Networks	PEC	3	3	0	0	3
4	22EC928	Cyber Security	PEC	3	3	0	0	3
5	22EC929	Data Analytics	PEC	3	3	0	0	3
6	22EC930	Satellite Communication	PEC	3	3	0	0	3

MANAGEMENT ELECTIVES

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	22EC981	Principles of Management	HSMC	3	3	0	0	3
2	22EC982	Total Quality Management	HSMC	3	3	0	0	3
3	22EC983	Introduction to Innovation, IP Management and Entrepreneurship	HSMC	3	3	0	0	3

R2022 (2022-23)
CURRICULUM OF B.E (HONOURS) IN ELECTRONICS AND COMMUNICATION AND ENGINEERING
WITH SPECIALIZATION IN

Internet of Things / VLSI / High Speed Communication / Bio Medical Technology / Signal & Image Processing / Robotics &Automation

INTERNET OF THINGS

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	22EC941	Industrial and Medical IoT	PEC	3	3	0	0	3
2	22EC942	Programming and Web Technologies for IoT	PEC	3	3	0	0	3
3	22EC943	Deep Learning and Its Applications	PEC	3	3	0	0	3
4	22EC944	Design of Smart Cities	PEC	3	3	0	0	3
5	22EC979	Capstone Project	PEC	12	0	0	12	6

VLSI

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	22EC947	Semiconductor Devices and Fabrication Processes	PEC	3	3	0	0	3
2	22EC948	RFIC Design	PEC	3	3	0	0	3
3	22EC949	VLSI Algorithms and Architectures	PEC	3	3	0	0	3
4	22EC952	Reconfigurable Architectures	PEC	3	3	0	0	3
5	22EC979	Capstone Project	PEC	12	0	0	12	6

HIGH SPEED COMMUNICATION

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	22EC953	Advanced Wireless Communication	PEC	3	3	0	0	3
2	22EC954	Advanced Wireless Networks	PEC	3	3	0	0	3
3	22EC955	Software-defined networks	PEC	3	3	0	0	3
4	22EC956	Satellite Communication & Navigation Systems	PEC	3	3	0	0	3
5	22EC979	Capstone Project	PEC	12	0	0	12	6

BIO MEDICAL TECHNOLOGY

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	22EC959	Biometric Systems	PEC	3	3	0	0	3
2	22EC960	Bio-signal Processing	PEC	3	3	0	0	3
3	22EC962	Medical Imaging Techniques	PEC	3	3	0	0	3
4	22EC963	Brain Computer Interface and Applications	PEC	3	3	0	0	3
5	22EC979	Capstone Project	PEC	12	0	0	12	6

SIGNAL & IMAGE PROCESSING

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	22EC965	Computer Vision	PEC	3	3	0	0	3
2	22EC966	Big Data Analytics	PEC	3	3	0	0	3
3	22EC967	Image Processing with Python	PEC	3	3	0	0	3
4	22EC970	Pattern Recognition	PEC	3	3	0	0	3
5	22EC979	Capstone Project	EEC	12	0	0	12	6

ROBOTICS & AUTOMATION

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	22EC971	Concepts in Mobile Robotics	PEC	3	3	0	0	3
2	22EC972	Sensors and Actuators for Robotics	PEC	3	3	0	0	3
3	22EC973	Microcontrollers for Robotics	PEC	3	3	0	0	3
4	22EC974	Process Control Automation	PEC	3	3	0	0	3
5	22EC979	Capstone Project	EEC	12	0	0	12	6

R2022 (2022-23)

B. E. (HONOURS) IN ELECTRONICS AND COMMUNICATION ENGINEERING

Additional 18 credits to be completed from the courses offered in the Professional Elective Verticals.

R2020 (2022-23)

MINOR DEGREE CURRICULUM OFFERED BY DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING (FOR OTHER B.E. / B. TECH PROGRAMMES)

MINOR'S DEGREE IN INTERNET OF THINGS

S.NO	COURSE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	22EC901	Introduction to Internet of Things	PEC	3	3	0	0	3
2	22EC907	Sensors and Actuator Devices	PEC	3	3	0	0	3
3	22EC977	Image and Video Analytics	PEC	3	3	0	0	3
4	22EC978	Robot Operating System	PEC	3	3	0	0	3
5	22EC979	Capstone Project	EEC	12	0	0	12	6

OPEN ELECTIVES (Multidisciplinary)

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	22EC001	PCB Design	OEC	3	3	0	0	3
2	22EC002	Embedded Systems	OEC	3	3	0	0	3
3	22EC003	Principles of Analog and Digital Communication	OEC	3	3	0	0	3
4	22EC004	Sensors and Instrumentation	OEC	3	3	0	0	3
5	22EC005	Automotive Electronics	OEC	3	3	0	0	3
6	22EC006	Robotic Systems	OEC	3	3	0	0	3
7	22EC007	Consumer Electronics	OEC	3	3	0	0	3
8	22EC008	Healthcare Electronics	OEC	3	3	0	0	3
9	22EC009	Semiconductor Physics	OEC	3	3	0	0	3
10	22EC010	Biomedical Instrumentation	OEC	3	3	0	0	3
11	22EC011	MATLAB Programming	OEC	3	3	0	0	3
12	22EC012	Industrial IoT Applications	OEC	3	3	0	0	3

SEMESTER I

COURSE CODE	COURSE TITLE	L	T	P	C
22MA101	**MATRICES & CALCULUS** (Theory course with laboratory component) (Common to all Branches except CSBS)	3	0	2	4

COURSE OBJECTIVES:

The Course will enable learners to:

- Explain the concepts of matrix algebra techniques needed for practical applications.
- Determine the curvature of the curves.
- Illustrate the simple applications of multivariable calculus and vector calculus.
- Elaborate the concept and application of multiple integrals.

UNIT I	MATRICES	15

Eigen values and Eigenvectors of a real matrix – Properties of Eigen values and Eigenvectors – Statement and applications of Cayley-Hamilton Theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms

Experiments using SCILAB:

1. Introduction to SCILAB through matrices and general syntax.
2. Finding the Eigen values and Eigenvectors.

UNIT II	SINGLE VARIABLE CALCULUS	15

Curvature in Cartesian and Polar Co-ordinates – Centre and radius of curvature – Circle of curvature– Evolutes.

Experiments using SCILAB:

1. Evaluating the radius of curvature.
2. Finding the coordinates of the center of curvature.
3. Tracing of Curves.

UNIT III	MULTI VARIABLE CALCULUS	15

Partial derivatives (excluding Euler's theorem) – Total derivative – Differentiation of implicit functions – Jacobian and properties – Taylor's series for functions of two variables – Maxima and minima of functions of two variables.

Experiments using SCILAB:

1. Evaluating the maxima of functions of several variables.
2. Evaluating the minima of functions of several variables.
3. Evaluation of Jacobians

UNIT IV	MULTIPLE INTEGRALS	15

Double integrals – Change of order of integration – Area enclosed by plane curves – Triple integrals – Volume of solids.

Experiments using SCILAB:

1. Evaluating area under a curve.
2. Evaluating area using double integral.
3. Evaluation of volume by integrals.

UNIT V	VECTOR CALCULUS	15

Gradient, divergence and curl (excluding vector identities) – Directional derivative – Irrotational and Solenoidal vector fields – Vector integration – Green's theorem in a plane and Gauss divergence theorem (Statement only) – Simple applications involving cubes and rectangular parallelopipeds.

Experiments using SCILAB:

1. Evaluating gradient.
2. Evaluating directional derivative.
3. Evaluating divergent and curl.

TOTAL: 75 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Use the matrix algebra methods to diagonalize the matrix.

CO2: Determine the evolute of the curve.

CO3: Apply differential calculus ideas on the function of several variables.

CO4: Evaluate the area and volume by applying the concept of multiple integration.

CO5: Utilize the concept of vector calculus in evaluating integrals.

TEXT BOOKS:

1. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley and Sons, 10th Edition, New Delhi, 2016.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, New Delhi, 43rd Edition, 2014.

REFERENCES:

1. M. K. Venkataraman, Engineering Mathematics, Volume I, 4th Edition, The National Publication Company, Chennai, 2003.
2. Sivaramakrishna Dass, C. Vijayakumari, Engineering Mathematics, Pearson Education India, 4th Edition, 2019.
3. H. K. Dass, and Er. Rajnish Verma, Higher Engineering Mathematics, S. Chand Private Limited, 3rd Edition, 2014.

4. B. V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, 6th Edition, New Delhi, 2008.
5. S. S. Sastry, "Engineering Mathematics", Vol. I & II, PHI Learning Private Limited, 4th Edition, New Delhi, 2014.
6. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7th Edition, New Delhi, 2015.

LIST OF EQUIPMENTS:

SCILAB : Open Source

COURSE CODE	COURSE TITLE	L	T	P	C
22PH102	PHYSICS FOR ELECTRONICS ENGINEERING (Theory course with laboratory component)	3	0	2	4

COURSE OBJECTIVES:

The course will enable the learners to:

- Educate the fundamental important concepts in Physics and to apply the knowledge in solving scientific and engineering problems.
- Impart the basic concepts of light propagation in waveguides, conducting materials, semiconducting materials, opto and nano electronic devices and photovoltaic technology.

UNIT I	LASER AND FIBRE OPTICS	15

Population of energy levels – Einstein's A and B coefficients derivation - Resonant cavity - Optical amplification (qualitative) - Semiconductor lasers: homojunction and heterojunction- Engineering applications of lasers in data storage (qualitative). Fibre optics: Principle and propagation of light through optical fibre - V-number - Types of optical fibres (Material, refractive index and mode) - Losses in optical fibre - Fibre optic communication - Fibre optic sensors (pressure and displacement).

1. Determination of divergence of laser beam
2. Determination of acceptance angle and numerical aperture of an optical fibre

UNIT II	ELECTRON THEORIES OF MATERIALS	15

Introduction to Classical, Quantum and Zone theories - Classical free electron theory - Expressions for electrical conductivity and thermal conductivity - Wiedemann - Franz law - Success and failures of CFT- Effect of temperature on Fermi function- Density of energy states and average energy of electron at 0 K - Energy bands in solids.

1. Determination of thermal conductivity of a bad conductor by Lee's disc method.
2. Measurement of the internal resistance using potentiometer.

UNIT III	SEMICONDUCTING MATERIALS	15

Intrinsic Semiconductors – E-K diagram -Direct and indirect band gap semiconductors - Carrier concentration in intrinsic semiconductors- Band gap determination - Extrinsic semiconductors - Carrier concentration in n-type and p-type semiconductors -Electrical conductivity of intrinsic and extrinsic semiconductors -Variation of Fermi level with temperature and impurity concentration - Hall effect and its applications.

1. Bandgap determination of intrinsic semiconductor.
2. Determination of wavelength of semiconductor laser

UNIT IV	OPTO AND NANO ELECTRONIC DEVICES	15

Carrier generation and recombination processes in semiconductors (concepts only) – LED- Organic LED – Photodetectors – Electron density in bulk material (qualitative) -Size dependence of Fermi energy- Band gap of nanomaterial -Quantum confinement -Quantum Structures-Density of states in quantum well, quantum wire and quantum dot structures - Quantum dot lasers.

1. Synthesis of nanoparticles by sol-gel method
2. Determination of particle size using laser source

UNIT V PHOTOVOLTAICS 15

Photovoltaic effect- Solar Cell-Parameters of Solar Cells -Solar Cell Technology - Effect of Conversion Efficiency - Input Light- Solar Cell Area, Angle of Light Falling on Solar Cell-Solar Cell Operating Temperature, photovoltaic thermal collectors, organic solar cells - dye sensitized solar cell.

1. Solar cell characteristics

TOTAL: 75 PERIODS

COURSE OUTCOMES:

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

CO1: Discuss the basic principles of working of laser and their applications in fibre optic communication.

CO2: Summarize the classical and quantum electron theories and energy band structures.

CO3: Describe the conductivity in intrinsic and extrinsic semiconductors and importance of Hall effect measurements.

CO4: Associate the properties of nanoscale materials and their applications in quantum computing.

CO5: Explain the concepts of photovoltaic technology and its applications.

TEXT BOOKS:

1. M.N. Avadhanulu and P.G. Kshirsagar, A text book of Engineering Physics, S. Chand andCompany, New Delhi, 2014.
2. Kasap, S.O. Principles of Electronic Materials and Devices, McGraw-Hill Education, 2007.
3. Wahab, M.A. Solid State Physics: Structure and Properties of Materials‖. Narosa Publishing House,2009.
4. Nelson, J, The physics of Solar Cells, Imperial College Press, 2003.
5. Jui Sheng Hsieh, Solar Energy Engineering, Prentice Hall, 2007

REFERENCES:

1. R.K. Gaur and S.L. Gupta, Engineering Physics, Dhanpat Rai Publications (P) Ltd., Eighth Edition., New Delhi, 2001.
2. Hanson, G.W., Fundamentals of Nanoelectronics, Pearson Education, 2009.
3. R. A. Serway and J.W. Jewett, Physics for Scientists and Engineers, Ninth Edition. Cengage Learning, 2014.
4. Rogers, B., Adams, J. & Pennathur, S. Nanotechnology: Understanding Small Systems‖. CRC Press, 2014.
5. A. Marikani, Materials Science, PHI Learning Private Limited, Eastern Economy Edition, 2017.
6. R. Wolfson, Essential University Physics, Volume 1 and 2 with Mastering Physics, Global Edition, 3rd Edition, Pearson 2017.
7. B.K. Pandey and S. Chaturvedi, Engineering Physics, Cengage Learning India, 2012.
8. J. Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw-Hill Inc., 1995.
9. Garg, H.P., Treatise on Solar Energy, John Wiley & Sons, 2006.

LIST OF EQUIPMENT:

1. Semiconductor Laser
2. Determination of optical fibre parameters
3. Lee's disc apparatus
4. Potentiometer
5. Bandgap determination set up
6. Synthesis of Nanoparticles
7. Bandgap of an LED
8. Solar cell characteristics

COURSE CODE	COURSE TITLE	L	T	P	C
22CS101	PROBLEM SOLVING USING C++ (Theory course with laboratory component)	3	0	2	4

COURSE OBJECTIVES:

The Course will enable learners to:

- To learn problem solving and programming fundamentals.
- To gain knowledge on pointers and functions.
- To apply the principles of object orientated programming.
- To understand operator overloading, inheritance and polymorphism.
- To use the functionalities of I/O operations, files build C++ programs using exceptions.

UNIT I	PROBLEM SOLVING AND PROGRAMMING FUNDAMENTALS	15

General Problem Solving concepts: Algorithm for problem solving with Sequential Logic Structure, Decisions and Loops. Overview of C – Data types – Identifiers – Variables – Storage Class Specifiers – Constants – Operators - Expressions – Statements – Arrays and Strings – Single-Dimensional – Two Dimensional Arrays – Arrays of Strings – Multidimensional Arrays.

List of Exercise/Experiments:

1. Write C/C++ programs for the following:
    a. Find the sum of individual digits of a positive integer.
    b. Compute the GCD of two numbers.
    c. Find the roots of a number (Newton ‘s method)
2. Write C/C++ programs using arrays:
    a. Find the maximum of an array of numbers.
    b. Remove duplicates from an array of numbers.
    c. Print the numbers in an array after removing even numbers.
3. Write C/C++ programs using strings:
    a. Checking for palindrome.
    b. Count the occurrences of each character in a given word.

UNIT II	POINTERS AND FUNCTIONS	15

Pointers -Variables – Operators – Expressions – Pointers and Arrays – Functions - Scope Rules – Function Arguments – return Statement – Recursion – Structures – Unions – Enumerations.

List of Exercise/Experiments:

1. Generate salary slip of employees using structures and pointers. Create a structure Employee with the following members: EID, E name, Designation, DOB, DOJ, Basic pay

    Note that DOB and DOJ should be implemented using structure within structure.

UNIT III	CLASSES AND OBJECTS	15

Concepts of Object Oriented Programming – Benefits of OOP – Simple C++ program - Classes and Objects - Member functions - Nesting of member functions - Private member functions – Memory Allocation for Objects - Static Data Members - Static Member Functions Array of Objects - Objects as function arguments - Returning objects - friend functions – Const Member functions - Constructors – Destructors.

List of Exercise/Experiments:

1. Write a program Illustrating Class Declarations, Definition, and Accessing Class Members.
2. Program to illustrate default constructor, parameterized constructor and copy constructors.

UNIT IV	OPERATOR OVERLOADING, INHERITANCE AND POLYMORPHISM	15

Operator Overloading - Overloading Using Friend functions – Inheritance – Types of inheritance – Virtual Base Class - Abstract Class – Constructors in Derived Classes - member class: nesting of classes. Pointer to objects this pointer- Pointer to derived Class - Virtual functions – Pure Virtual Functions – Polymorphism.

List of Exercise/Experiments:

1. Write a Program to Demonstrate the i) Operator Overloading. ii) Function Overloading.
2. Write a Program to Demonstrate Friend Function and Friend Class.
3. Program to demonstrate inline functions.
4. Program for Overriding of member functions.
5. Write C++ programs that illustrate how the following forms of inheritance are supported: a) Single inheritance b) Multiple inheritance c) Multi level inheritance d) Hierarchical inheritance.

UNIT V	I/O, FILES AND EXCEPTIONS	15

C++ Streams – Unformatted I/O - Formatted Console I/O – Opening and Closing File – File modes – File pointers and their manipulations – Templates – Class Templates – Function Templates - Exception handling.

List of Exercise/Experiments:

1. Program to demonstrate pure virtual function implementation.
2. Count the number of account holders whose balance is less than the minimum balance using sequential access file.
3. Write a Program to Demonstrate the Catching of all Exceptions.
4. Mini project.

TOTAL: 45+30 = 75 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1: Solve problems using basic constructs in C.

CO2: Implement C programs using pointers and functions.

CO3: Apply object-oriented concepts and solve real world problems.

CO4: Develop C++ programs using operator overloading and polymorphism.

CO5: Implement C++ programs using Files and exceptions.

TEXT BOOKS:

1. Herbert Schildt, The Complete Reference C++, 4th Edition, MH, 2015.
2. E Balagurusamy, Object Oriented Programming with C++, 4th Edition, Tata McGraw-Hill Education, 2008.

REFERENCES:

1. Karl Beecher, Computational Thinking: A beginner's guide to problem-solving and programming, BCS Learning & Development Ltd, 2017.
2. Nell Dale, Chip Weems, Programming and Problem Solving with C++, 5th Edition, Jones and Barklett Publishers, 2010.
3. John Hubbard, Schaum's Outline of Programming with C++, MH, 2016.
4. Yashavant P. Kanetkar, Let us C++, BPB Publications, 2020
5. ISRD Group, Introduction to Object-oriented Programming and C++, Tata McGraw-Hill Publishing Company Ltd., 2007.
6. D. S. Malik, C++ Programming: From Problem Analysis to Program Design, 3rd Edition, Thomson Course Technology, 2007.
7. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0129720024067 1948837_shared/overview

LIST OF EQUIPMENT:

1. Standalone desktops with C/C++ compiler (or) Server with C/C++ compiler

COURSE CODE	COURSE TITLE	L	T	P	C
22CS102	**SOFTWARE DEVELOPMENT PRACTICES** (Theory course with laboratory component)	3	0	2	4

COURSE OBJECTIVES:

- To discuss the essence of agile development methods.
- To set up and create a GitHub repository.
- To create interactive websites using HTML
- To design interactive websites using CSS.
- To develop dynamic web page using Java script.

UNIT I	AGILE SOFTWARE DEVELOPMENT AND Git and GitHub	15

Software Engineering Practices – Waterfall Model - Agility – Agile Process – Extreme Programming - Agile Process Models – Adaptive Software Development – Scrum – Dynamic Systems Development Method – Crystal – Feature Driven Development – Lean Software Development – Agile Modeling – Agile Unified Process – Tool set for Agile Process.

Introduction to Git –Setting up a Git Repository - Recording Changes to the Repository - Viewing the Commit History - Undoing Things - Working with Remotes -Tagging - Git Aliases - Git Branching - Branches in a Nutshell Basic Branching and Merging - Branch Management - Branching Workflows – Remote Branches - Rebasing.

Introduction to GitHub – Set up and Configuration - Contribution to Projects, Maintaining a Project – Scripting GitHub.

List of Exercise/Experiments:

1. Form a Team, Decide on a project:
    a) Create a repository in GitHub for the team.
    b) Choose and follow a Git workflow
        - Each team member can create a StudentName.txt file with contents about themselves and the team project
        - Each team member can create a branch, commit the file with a proper commit message and push the branch to remote GitHub repository.

- Team members can now create a Pull request to merge the branch to master branch or
  main development branch.
- The Pull request can have two reviewers, one peer team member and one faculty.
  Reviewers can give at least one comment for Pull Request updating.
- Once pull request is reviewed and merged, the master or main development branch will have files created by all team members.

2. Create a web page with at least three links to different web pages. Each of the web pages is to be designed by a team member. Follow Git workflow, pull request and peer reviews.
3. Form a Team, Decide on a project:
   c) Create a repository in GitHub for the team.
   d) Choose and follow a Git workflow
      - Each team member can create a StudentName.txt file with contents about themselves and the team project
      - Each team member can create a branch, commit the file with a proper commit message and push the branch to remote GitHub repository.
      - Team members can now create a Pull request to merge the branch to master branch or main development branch.
      - The Pull request can have two reviewers, one peer team member and one faculty.
        Reviewers can give at least one comment for Pull Request updation.

UNIT II	**HTML**	**15**

Introduction – Web Basics – Multitier Application Architecture – Cline-Side Scripting versus Server-side Scripting – HTML5 – Headings – Linking – Images – Special Characters and Horizontal Rules Lists – Tables – Forms – Internal Linking – meta Elements – Form input Types – input and data list Elements Page-Structure Elements.

List of Exercise/Experiments:

1. Create web pages using the following:
   a) Tables and Lists
   b) Image map
   c) Forms and Form elements
   d) Frames

UNIT III	CSS	15

Inline Styles – Embedded Style Sheets – Conflicting Styles – Linking External Style Sheets – Positioning Elements – Backgrounds – Element Dimensions – Box Model and Text Flow – Media Types and Media Queries Drop-Down Menus – Text Shadows – Rounded Corners – Colour – Box Shadows – Linear Gradients – Radial Gradients – Multiple Background Images Image Borders – Animations – Transitions and Transformations – Flexible Box Layout Module –Multicolumn Layout.

List of Exercise/Experiments:

1. Apply Cascading style sheets for the web pages created.

UNIT IV	JAVASCRIPT BASICS	15

Introduction to Scripting – Obtaining user input – Memory Concepts – Arithmetic – Decision Making: Equality and Relational Operators – JavaScript Control Statements – Functions – Program Modules – Programmer- defined functions – Scope rules – functions – Recursion – Arrays – Declaring and Allocating Arrays – References and Reference Parameters – Passing Arrays to Functions – Multidimensional arrays.

List of Exercise/Experiments:

1. Form Validation (Date, Email, User name, Password and Number validation) using JavaScript.

UNIT V	JAVASCRIPT OBJECTS	15

Objects – Math, String, and Date, Boolean and Number, document Object – Using JSON to Represent objects – DOM: Objects and Collections – Event Handling.

List of Exercise/Experiments:

1. Implement Event Handling in the web pages.

Mini Projects-Develop any one of the following web applications (not limited to one) using above technologies.

a. Online assessment system
b. Ticket reservation system
c. Online shopping
d. Student management system
e. Student result management system
f. Library management
g. Hospital management
h. Attendance management system
i. Examination automation system
j. Web based chat application

TOTAL: 75 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1: Apply agile development methods in software development practices.

CO2: Set up and create a GitHub repository.

CO3: Develop static and dynamic webpages using HTML.

CO4: Design interactive personal or professional webpages using CSS.

CO5: Develop web pages using Java script with event-handling mechanism.

TEXT BOOKS:

1. Roger S. Pressman, Software Engineering: A Practitioner's Approach, McGraw Hill International Edition, 9th Edition, 2020.
2. Scott Chacon, Ben Straub, Pro GIT, Apress Publisher, 3rd Edition, 2014.
3. Deitel and Deitel and Nieto, Internet and World Wide Web - How to Program, Pearson, 5th Edition, 2018.

REFERENCES:

1. Roman Pichler, Agile Product Management with Scrum Creating Products that Customers Love, Pearson Education, 1st Edition, 2010.
2. Jeffrey C and Jackson, Web Technologies A Computer Science Perspective, Pearson Education, 2011.
3. Stephen Wynkoop and John Burke, Running a Perfect Website, QUE, 2nd Edition, 1999.
4. Chris Bates, Web Programming – Building Intranet Applications, 3rd Edition, Wiley Publications, 2009.
5. Gopalan N.P. and Akilandeswari J., Web Technology, 2nd Edition, Prentice Hall of India, 2014.
6. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01338269041100 3904735_shared/overview
7. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01309442142747 03362099_shared/overview

LIST OF EQUIPMENT:

Systems with either Netbeans or

Eclipse Java/JSP/ISP

Webserver/Apache Tomcat / MySQL /

Dreamweaver or **Equivalent/ Eclipse,**

WAMP/XAMP

COURSE CODE	COURSE TITLE	L	T	P	C
22EC101	**DIGITAL PRINCIPLES AND SYSTEMS DESIGN** (Theory course with laboratory component)	3	0	2	4

COURSE OBJECTIVES:

- To acquire the knowledge in Digital fundamentals and its simplification methods.
- To familiarize the design of various combinational digital circuits using logic gates.
- To realize various sequential circuits using flip flops.
- To interpret various clocked sequential circuits.
- To elucidate various semiconductor memories and related technology.
- To build various logic functions using Programmable Logic Devices.

UNIT I	BOOLEAN ALGEBRA AND LOGIC GATES	15

Review of number systems-representation-conversions, Review of Boolean algebra-theorems, sum of product and product of sum simplification, canonical forms, min term and max term, Simplification of Boolean expressions- Karnaugh map, Implementation of Boolean expressions using logic gates and universal gates.

Experiment

1. Implementation of Boolean expression using logic gates

UNIT II	COMBINATIONAL LOGIC CIRCUITS	15

Design of combinational circuits - Half and Full Adders, Half and Full Subtractors, Binary Parallel Adder –Carry look ahead Adder, Magnitude Comparator, Decoder, Encoder, Priority Encoder, Mux/De-mux, Parity Generator/Checker

Experiments

1. Design of adders
2. Design of subtractors.
3. Design of binary adder using IC7483
4. Design of Multiplexers & Demultiplexers.
5. Design of Encoders and Decoders.
6. Implementation of a Boolean function using a multiplexer.

UNIT III	SEQUENTIAL CIRCUITS	15

Flip flops – SR, JK, T, D, Master/Slave FF – operation and excitation tables, Asynchronous and Synchronous Counters Design - Shift registers, Universal Shift Register.

Experiments

1. Design and implementation of 3 bit ripple counters.
2. Design and implementation of 3 bit synchronous counter
3. Design and implementation of shift registers.

UNIT IV	SYNCHRONOUS SEQUENTIAL CIRCUITS DESIGN	15

Design of clocked sequential circuits - Moore/Mealy models, state minimization, state assignment, circuit implementation

UNIT V	MEMORY AND PROGRAMMABLE LOGIC DEVICES	15

Basic memory structure ROM: PROM – EPROM – EEPROM –RAM – Static and dynamic RAM – Programmable Logic Devices: Programmable Logic Array (PLA) – Programmable Array Logic (PAL) – Implementation of combinational logic circuits using PLA, PAL.

TOTAL: 75 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Implement digital circuits using simplified Boolean functions.

CO2: Realize Combinational circuits for a given function using logic gates.

CO3: Demonstrate the operation of various counters and shift registers using Flip flops.

CO4: Analyze Synchronous Sequential circuits.

CO5: Summarize the various types of memory devices.

CO6: Design the Combinational circuits using Programmable Logic Devices.

CO7: Perform practical exercises as an individual and / or team member to manage the task in time.

TEXT BOOKS:

1. M. Morris Mano and Michael D. Ciletti, Digital Design, With an introduction to the Verilog HDL, VHDL, and System Verilog, 6th Edition, Pearson, 2018.
2. S.Salivahanan and S.Arivazhagan, Digital Circuits and Design, 5th Edition, Oxford University Press, 2018.

REFERENCES:

1. A.Anandkumar, Fundamental of digital circuits, 4th Edition, PHI Publication,2016.
2. William Kleitz, Digital Electronics-A Practical approach to VHDL, Prentice Hall International Inc, 2012.

3. Charles H.Roth, Jr. and Larry L. Kinney, Fundamentals of Logic Design, 7th Edition, Thomson Learning, 2014.
4. Thomas L. Floyd, Digital Fundamentals, 11th Edition, Pearson Education Inc, 2017.
5. John.M Yarbrough, Digital Logic: Applications and Design, 1st Edition, Cengage India, 2006.

NPTEL LINK:

https://nptel.ac.in/courses/108/105/108105132/

LIST OF EQUIPMENTS:

IC Trainer Kit	-15 Nos
ICs each 7400/ 7404 / 7486 / 7408 / 7432 / 7483 / 7473 / 7411/7474	- 30 Nos

COURSE CODE	COURSE TITLE	L	T	P	C
22HS101	PROFESSIONAL COMMUNICATION (Theory course with laboratory component)	2	0	2	3

COURSE OBJECTIVES:

- Strengthen basic reading and writing skills.
- Comprehend listening contexts competently.
- Inculcate reading habit and develop effective reading skills.
- Improve active and passive vocabulary.
- Acquire speech clarity with right pronunciation.
- Develop vocabulary of a general kind and enhance grammatical accuracy.
- Imbibe Content and Language Integrated Learning (CLIL).

UNIT I	FORMAL AND INFORMAL COMMUNICATION	12

Listening: Short Texts, Short Formal and Informal Conversations

Speaking: Self-Introduction, Exchanging Personal Information

Reading: Practice in Skimming, Scanning and Predicting, Reading Comprehension

Writing: Free Writing, Hints Development

Grammar: Parts of Speech, Prepositions.

Vocabulary: Compound Nouns, Technical Words. (Theory 6)

List of Exercise/Experiments

1. Familiarization of Vowel Sounds-Monophthongs, Diphthongs and Consonant Sounds
2. Listening to Formal Conversations in British and American Accents

UNIT II	GRAMMAR AND LANGUAGE DEVELOPMENT	12

Listening: Telephonic Conversations.

Speaking: Sharing information of a personal kind - Greetings – Taking leave.

Reading: Short comprehension passages - Pre-reading and Post-reading (multiple choice questions, short questions / open and close ended questions)

Writing: Instructions, Recommendations, Checklists

Grammar: Tenses, Framing 'Wh' & 'Yes' or 'No' questions

Vocabulary: Numerical Adjectives, Collocations (Theory 6)

List of Exercise/Experiments

1. Communication Etiquettes
2. Self -Introduction using SWOT Analysis (Laboratory 6)

UNIT III	BASIC TECHNICAL WRITING AND STUDY SKILLS	12

Listening: Listening to longer texts and filling up the tables **Speaking:** Asking about routine actions and expressing opinions **Reading:** Short texts (Cloze Test) **Writing:** Formal letters, E-mail writing, Interpretation of Charts and Graphs **Grammar:** Cause and Effect expressions**,** Conditional Clauses

Vocabulary: Often misspelled and confusing words (Theory 6)

List of Exercise/Experiments

1. Mechanics of Reading Skills
2. News Reading–Cloze Tests (Laboratory 6)

UNIT IV	GROUP DISCUSSION AND JOB APPLICATIONS	12

Listening: Listening to recorded dialogues of conversations and completing exercises based on them

Speaking: Discussion on Social issues.

Reading: Reading text from magazines

Writing: Purpose Expressions, Letter of Application, Minutes of Meeting.

Grammar: Modal Verbs, Subject-Verb agreement

Vocabulary: Sequence Words (Theory 6)

List of Exercise/Experiments

1. Group Presentation, Group Discussion: Do's and Don'ts of Group Discussion
2. Discussions on failure and success in interviews of famous personalities
3. Spotting Errors (Laboratory)

UNIT V	ART OF REPORTING	12

Listening: Listening to TED talks

Speaking: Debate & Presentations

Reading: Biographies

Writing: Definitions (Single line & Extended), Report Writing (Industrial visit, Accident and Feasibility reports)

Grammar: Reported speech

Vocabulary: Verbal Analogies (Theory 6)

List of Exercise/Experiments

1. Writing based on listening to academic lectures and discussions

2. Leadership skills, Negotiation skills

3. Mechanics of Report Writing (Laboratory 6).

List of Projects

1. Create a podcast on a topic that will be interesting to college students
2. Read and Review (Movie/Book/Technical Article)
3. Presentation on Social Issues

TOTAL : 60 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Comprehend conversations and short talks delivered in English.

CO2: Participate efficiently in informal conversations and develop an awareness of the self and apply well-defined techniques.

CO3: Read articles of a general kind in magazines and newspapers efficiently.

CO4: Write short general essays, personal letters and E-mails in English.

CO5: Develop vocabulary of a general kind by enriching reading skills.

TEXT BOOKS:

1. Kumar, Suresh E, & Sreehari, P. Communicative English. Orient Black Swan, 2007.
2. Richards, Jack C. Interchange Students' Book-2 New Delhi: CUP, 2015.

REFERENCES:

1. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge, 2011.
2. Dhanavel, S P. English and Soft Skills, Volume Two, Orient Black Swan.
3. Elbow, Peter. Writing Without Teachers. London: Oxford University Press, 1973.
4. Larsen, Kristine. Stephen Hawking: A Biography, Greenwood: Publishing Group, 2005.
5. Redston, Chris & Gillies Cunningham.Face2Face (Pre- intermediate Students'

WEB REFERENCES:

1. Basics of Business Communication: https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_01268876808363212830 8_shared/ overview
2. Communicating to Succeed: https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_01268665361917542464 0_shared/ overview
3. Business English: https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_01268322749815193627 9_shared/ overview
https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013267708367904768573/ overview (lab support)
4. Business Writing: https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_012689477601009664 33_shared/overview

5.Email Etiquettes: https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013294623865561088 17682_shared/overview
6.Email Writing Skills: https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_01268954363013529666_shared/ overview
7.Time Management: https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_012985921210736640721_shared/overview
8. Understanding Body Language: https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_012979737651445760246 89_shared/overview

ONLINE RESOURCES:

https://infyspringboard.onwingspan.com/web/en/page/home

COURSE CODE	COURSE TITLE	L	T	P	C
22GE201	HERITAGE OF TAMILS	1	0	0	1

COURSE OBJECTIVES:

The course is designed to

- Recognize Tamil literature and its significance in Tamil culture.
- Introduce the Tamils' rich artistic and cultural legacy.
- Familiarize the different types of folk and martial arts that are unique to Tamil Nadu.
- Acquaint the concept of Thinai in Tamil literature and culture.
- Comprehend the significance of Tamil in developing Indian culture

UNIT I	LANGUAGE AND LITERATURE	3

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

UNIT II	HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE	3

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making -- Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

UNIT III	FOLK AND MARTIAL ARTS	3

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leatherpuppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

UNIT IV	THINAI CONCEPT OF TAMILS	3

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

UNIT V	CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT	3

Contribution of Tamils to Indian Freedom Struggle – The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement – Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

TOTAL: 15 PERIODS

COURSE OUTCOMES:

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

CO1: State the role of Tamil literature in shaping Tamil Cultural roots.

CO2: Express the cultural and religious significance of Tamil art and sculptures.

CO3: Identify and describe the techniques of folk and martial arts.

CO4: Classify the role of Thinai concept in Tamil culture and literature.

CO5: Compare the idea of cultural and intellectual contributions of Tamils

TEXT BOOKS:

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

COURSE CODE	COURSE TITLE	L	T	P	C
22GE111	PRODUCT DEVELOPMENT LAB –1 (Common to all Branches)	0	0	2	1

The students may be grouped into 3 to 4 and work under a project supervisor. The device/system/component/prototype Idea to be developed by the students and a final presentation to be done by the students about the idea generated at the end of the semester.

COURSE OBJECTIVES:

Students completing this course are expected to

- Understand the functionalities and limitation of various machine/equipment.
- Demonstrate various operations that can be performed to machines.
- Summarize the basic principles of machines to convert their ideas into products

LIST OF EXPERIMENTS

I 1. Study of Manufacturing Processes (Carpentry, Plumbing, Machines and Welding).
2. Study of fundamental operations of 3D Printer and Scanner with Software.
3. Study of Smart Machining (CNC and Laser cutting) and Engraving Techniques.

II 1. Study of Fundamental of Circuit Design.
2. Study of PCB Milling Machine.
3. Study of Soldering and Desoldering.

III 1. Study of Computer Peripheral Devices (Processing Information Devices)

IV 1. Present the Product Idea Presentation - Phase – I

TOTAL: 30 PERIODS

Note: The students can select the prototype to be made of their choice after learning the above exercises.

COURSE OUTCOMES:

After successful completion of the course the students will be able to do

CO1: Understand the concept of manufacturing processes.

CO2: Describe the working of the machine element.

CO3: Discuss the various applications of engineering materials.

CO4: Summarize the basics of core engineering concepts.

CO5: Describe the process for converting ideas into products.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:		
S. No	**Equipment Name**	**Quantity**
1	CNC Router	1 No
2	3D Printer	1 No
3	3D Scanner	1 No
4	Laser cutting Machine	1 No
5	Centre lathe	2 Nos
6	Arc welding transformer with cables and holders	2 Nos
7	Plumbing tools	2 Sets
8	Carpentry tools	2 Sets
9	Multimeter	10 Nos
10	Drilling Machine	1 No
11	Solder Stations	5 Sets
12	Desoldering Machine	1 No
13	PCB Milling Machine	1 No
14	Variable Power Supply	1 No
15	Electronic Components like Resistors, Transistors, Diode, Inductor, Capacitor, etc.	10 Sets
16	Personal Desktop Computers	30 Nos

COURSE	COURSE TITLE	L	T	P	C
22CH104	ENVIRONMENTAL SCIENCE AND SUSTAINABILITY (Common to all the Branches)	2	0	0	MC

COURSE OBJECTIVES:

The Course will enable learners to:

- To gain knowledge of the environment and various natural resources.
- To identify the Scientific and Technological solutions to pollution issues and waste management.
- To understand the significance of the conservation of biodiversity.
- To recognize the needs and benefits of sustainability and its management.
- To comprehend the effects of human population on the environment

UNIT I	NATURAL RESOURCES	0

Definition, scope and importance of environment – need for public awareness. Introduction to natural resources – Types Forest resources: Use and over-exploitation, deforestation and its impacts, Food resources: effects of modern agriculture, organic farming, Renewable energy sources - Solar, Wind, Geothermal, Tidal, OTE and Biomass.

1. **Field activity -Tree plantation**

UNIT II	POLLUTION AND WASTE MANAGEMENT	0

Pollution - Definition –causes, effects and control measures of (a) Air pollution (b) Water pollution(c)Soil pollution Noise pollution (e) Nuclear hazards - nuclear accidents and holocaust - Role of an individual in prevention of pollution –Case studies. Waste management- Municipal solid wastes, e- waste, plastic waste.

1. **Field study – Solid waste management of the institution**

UNIT III	BIODIVERSITY AND ITS CONSERVATION	0

Biodiversity: types – values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity threats to biodiversity – endangered and endemic species, extinct, rare, vulnerable species of India – conservation of biodiversity: In-situ and ex-situ method.

1. **Field study – Biodiversity of the institution**

UNIT IV	SUSTAINABILITY AND MANAGEMENT	0

Sustainability-concept, needs and challenges- Circular economy - Sustainable Development Goals- Concept of Carbon footprint, Environmental Impact Assessment, Clean Development Mechanism, solutions.

1. **Field study – Carbon footprint of the institution**

UNIT V	HUMAN POPULATION	05

Introduction - Population growth, variation among nations, population explosion, Environment and human health – endemic/epidemic/pandemic – Role of information technology in environment and human health.

1. **Case Study – Pandemics of 21st century**

TOTAL: 30 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Investigate and use conservational practices to protect natural resources.

CO2: Identify the causes of pollutants and illustrate suitable methods for pollution abatement.

CO3: Adapt the values of biodiversity and its conservation methods.

CO4: Recognize suitable sustainable development practices and apply it in day-to-day life.

CO5: Assess the impacts of human population and suggest suitable solutions

TEXT BOOKS:

REFERENCES:

1. William P. Cunningham & Mary Ann Cunningham Environmental Science: A Global Concern, McGraw Hill, 14th edition, 2017.
2. Rajagopalan, R, Environmental Studies-From Crisis to Cure, Oxford University Press, 3rd edition,2015.
3. G. Tyler Miller and Scott E. Spoolman, ―Environmental Science, Cengage Learning India Pvt,Ltd., Delhi, 14th edition, 2014.
4. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall, 1st edition, 2012.
5. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning, 1st edition, 2015.
6. Environment Impact Assessment Guidelines, Notification of Government of India, 2006 and subsequent amendments, 2022.

LIST OF EQUIPMENT:

1. Standalone desktops with C/C++ compiler (or) Server with C/C++ compiler

SEMESTER II

COURSE CODE	COURSE TITLE	L	T	P	C
22MA201	TRANSFORMS AND NUMERICAL METHODS (Theory course with laboratory component)	3	0	2	4

COURSE OBJECTIVES:

The Course will enable learners to:

- Introduce the concepts of Laplace transforms and Z-transforms.
- Illustrate the application of transforms in solving differential and difference equations.
- Explain the Numerical methods for handling algebraic and transcendental equations.
- Introduce the numerical techniques for interpolation, differentiation and integration.

UNIT I	LAPLACE TRANSFORMS	15

Laplace transforms – Sufficient condition for existence – Transform of elementary functions Basic properties – Transforms of derivatives and integrals of functions – Derivatives and integrals of transforms –Transforms of unit step function and impulse functions – Transform of periodic functions. Inverse Laplace transform – Convolution theorem (Statement only).

Experiments using SCILAB:

1. Finding Laplace transform of a function.
2. Finding inverse Laplace Transforms.
3. Determine the input for given output function of Laplace Transform.

UNIT II	Z – TRANSFORMS	15

Z-transforms – Elementary properties – Inverse Z-transforms – partial fractions method – residues method Convolution theorem.

Experiments using SCILAB:

1. Finding Z –transform of a sequence.
2. Finding convolution of two sequences.
3. Plotting the input and output function of Z transform.

UNIT III	SOLUTION OF DIFFERENTIAL AND DIFFERENCE EQUATIONS	15

Solution of linear ordinary differential equation of second order with constant coefficients and first order simultaneous equations with constant coefficients using Laplace transform. Formation of difference equations – Solution of first and second order difference equations with constant

Experiments using SCILAB:

1. Solving second order Ordinary Differential Equation.
2. Finding the Laplace transform and its inverse of a function numerically.
3. Finding the Z-transform numerically

UNIT IV	SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS	15

Solution of algebraic and transcendental equations by Newton Raphson method - Solution of linear system of equations – Gauss elimination method – Gauss Jordan method – Gauss Seidel Iterative method–Eigenvalues of a matrix by Power method.

Experiments using SCILAB:

1. Finding the real roots of algebraic and transcendental equations using Newton Raphson method.
2. Finding the largest Eigenvalue by power method.
3. Solving system of linear equations using Gauss Seidel Method.

UNIT V	NUMERICAL DIFFERENTIATION AND INTEGRATION	15

Finite differences – Forward and Backward differences – Interpolation – Newton's forward and backward interpolation formulae - Lagrange's interpolation for unequal intervals - Numerical Differentiation - Newton's and Lagrange's formulae - Numerical integration using Trapezoidal and Simpson's 1/3 rules – Evaluation of double integrals by Trapezoidal and Simpson's 1/3 rules.

Experiments using SCILAB:

1. Finding approximately the missing value using Lagrange interpolation.
2. Evaluating line integrals by trapezoidal rule.
3. Evaluating line integrals by Simpson's rule

TOTAL: 75 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Determine Laplace transform and inverse transform of simple functions.

CO2: Determine Z-transform and inverse transform of simple functions.

CO3: Solve ordinary differential equations using Laplace transform and difference equation using Z-transform.

CO4: Compute the solutions of algebraic, transcendental and the system of equations.

CO5: Appreciate the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for engineering problems.

TEXT BOOKS:

1. Bali N., Goyal M. and Watkins C., Advanced Engineering Mathematics, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
2. Grewal, B.S., and Grewal, J.S., Numerical Methods in Engineering and Science, Khanna Publishers, 10th Edition, New Delhi, 2015.

REFERENCES:

1. Erwin. Kreyszig, Advanced Engineering Mathematics, John Wiley and Sons, 10th Edition, New Delhi, 2016.
2. Jain R.K. and Iyengar S. R. K., Advanced Engineering Mathematics, Narosa Publications, New Delhi, 3rd Edition, 2007.
3. Wylie, R.C. and Barrett, L.C., Advanced Engineering Mathematics, Tata McGraw Hill EducationPvt. Ltd, 6th Edition, New Delhi, 2012.
4. Mathews, J.H. Numerical Methods for Mathematics, Science and Engineering, 2nd Edition, Prentice Hall, 1992.
5. Sastry S.S, Introductory Methods of Numerical Analysis, PHI Learning Pvt. Ltd, 5th Edition, 2015.

SOFTWARE:

SCILAB : Open Source

COURSE CODE	COURSE TITLE	L	T	P	C
22EC201	**ELECTRON DEVICES AND CIRCUIT THEORY** (Theory course with laboratory component)	3	0	2	4

COURSE OBJECTIVES:

- To discuss the behavior of semiconductor diodes in various applications.
- To familiarize the operation of BJT and FET.
- To construct simple electronic circuits using special semiconductor devices.
- To understand the fundamental laws of electric circuits.
- To analyze the response of electric circuits using network theorems.

UNIT I	SEMICONDUCTOR DIODES	9+6

PN junction diode, Current equations, Energy Band diagram, Diffusion and drift current densities, forward and reverse bias characteristics, Transition and Diffusion Capacitances, Switching Characteristics, Breakdown in PN Junction Diodes, Zener diode and its applications.

Experiments

1. VI characteristics of PN diode
2. VI characteristics of Zener diode.

UNIT II	TRANSISTORS	9+6

Bipolar Junction Transistor - NPN -PNP – Operations - Early effect – Current Equations - Input and Output characteristics of CE, CB, CC – Field Effect Transistors - JFET, MOSFET- D-MOSFET, E-MOSFET- Characteristics.

Experiments

3. Input and output characteristics of CE Configuration.
4. Characteristics of JFET.

UNIT III	SPECIAL SEMICONDUCTOR DEVICES AND APPLICATIONS	9+6

Tunnel diode, Varactor diode, UJT, SCR, DIAC, TRIAC, Power BJT- Power MOSFET-MOS-VMOS. LED, Photo transistor, Opto Coupler.

Experiments

5. VI characteristics of UJT.
6. VI characteristics of SCR

UNIT IV	BASIC CIRCUIT ANALYSIS	9+6

Resistive elements - Ohms Law- Kirchhoff's current and voltage laws - series and parallel connection of independent sources - R, L and C, source transformation, Mesh current and Node voltage with AC and DC Analysis - methods of analysis, star delta conversion. Transient response of RL, RC and RLC circuits using Laplace Transform for DC input and AC sinusoidal input.

Experiments

7(a). Verification of Kirchhoff's current law.

7(b).Verification of Kirchhoff's voltage law..

UNIT V	NETWORK THEOREMS	9+6

Thevenin and Norton Theorems - Superposition Theorem - Maximum power transfer theorem - Reciprocity Theorem - Millman's theorem.

Experiments

8. Verification of superposition theorem.
9. Verification of Thevenin's theorem.
10. Verification of Norton's theorem.

TOTAL: 45 Theory + 30 Lab = 75 PERIODS

COURSE OUTCOMES:

OUTCOMES:

Upon Completion of the course, the students will be able to:

CO1: Examine the performance of electronic circuits using PN junction diode and Zener diode.

CO2: Construct electronic circuits using BJT and FET to sketch the input and output characteristics.

CO3: Demonstrate the behavior of special semiconductor devices in various applications.

CO4: Comprehend the impact of voltage and current in electric circuits using Mesh & Nodal methods.

CO5: Relate various network theorems to determine the response of the electric circuits.

CO6: Perform practical exercises as an individual and / or team member to manage the task in time.

CO7: Express the experimental results with effective presentation and report.

TEXT BOOKS:

1. Charles K. Alexander, Matthew N. O. Sadiku, Fundamentals of Electric Circuits, 7th Edition, McGraw Hill, 2022.
2. Robert L. Boylestad, Louis Nashelsky, Electronic Devices and Circuit Theory, 11th Edition, 2017

REFERENCES:

1. W.H.Hayt, J.E.Kemmerly &S.M.Durbin, Engineering Circuit Analysis, 9 Edition, McGraw Hill Education, New Delhi, India, 2019.
2. Joseph Edminister and Mahmood Nahvi, ―Electric Circuits, Schaum's Outline Series, 5th Edition Reprint,Tata McGraw Hill Publishing Company, New Delhi, 2016.
3. David A Bell, Electric Circuits and Electronic Devices, Oxford University Press, 2010.
4. Thomas L.Floyd, Electronic Devices, 9th Edition, Pearson, 2017.
5. Donald A Neaman, Semiconductor Physics and Devices, 4th Edition, McGraw Hill, 2017.
6. Dr.R.S. Sedha, A Textbook of Applied Electronics, S Chand and company limited, 2019.

NPTEL LINK:

1. https://onlinecourses.nptel.ac.in/noc22_ee93/preview
2. https://onlinecourses.nptel.ac.in/noc20_ee64/preview

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

BC 107, BC 148,2N2646, BFW10	- 25 each
1N4007, Zener diodes	- 25 each
Bread Boards	-15 Nos
CRO (30MHz)	- 10 Nos
Signal Generator /Function Generators (3 MHz)	- 15 Nos
Transistor/FET/SCR/UJT (BJT-NPN-PNP and NMOS/PMOS)	- 25 Nos
Dual power supply/ single mode power supply	- 15 Nos
Multimeter	-15 Nos
Ammeter(0-50)mA	-15 Nos
Voltmeter(0-30)V	-15 Nos

COURSE CODE	COURSE TITLE	L	T	P	C
22CH101	ENGINEERING CHEMISTRY (Theory course with laboratory component)	3	0	2	4

COURSE OBJECTIVES:

The Course will enable learners to:

- To understand the water quality criteria and interpret its applications in water purification.
- To gain insights into the basic concepts of electrochemistry and implement its applications in chemical sensors.
- To acquire knowledge on the fundamental principle of energy storage devices and relate it to electric vehicles.
- To identify the different types of smart materials and explore their applications in Engineering and Technology.
- To assimilate the preparation, properties and applications of nanomaterials in various fields.

UNIT I	WATER TECHNOLOGY	15

Sources of water – Impurities - Drinking water quality parameters – Hardness and its types, problems - Municipal water treatment and disinfection (chlorination - break-point chlorination, UV, Ozonation). Boiler troubles - Scales and sludges, Boiler feed water: Requirements - Internal treatment (phosphate, colloidal, sodium aluminate and Calgon conditioning). External treatment – Ion exchange demineralization - Principle, process and fouling. Desalination of brackish water: Reverse osmosis – principle -types of membranes, process and fouling.

List of Experiments

1. Determination of total, temporary and permanent hardness of water by EDTA method.
2. Determination of chloride content of water sample by argentometric method.
3. Determination of alkalinity in water sample.
4. Estimation of iron content of the water sample using spectrophotometer (1,10- phenanthroline/thiocyanate method)

UNIT II	ELECTROCHEMISTRY AND SENSORS	15

Introduction- Conductance- factors affecting conductance – Electrodes – origin of electrode potential – single electrode potential, standard electrode potential – measurement of single electrode potential –over voltage - reference electrodes (standard hydrogen electrode, calomel electrode)-ion selective electrode- glass electrode Nernst equation (derivation), numerical problems, Electrochemical series and its applications.

Chemical sensors – Principle of chemical sensors – Breath analyzer – Gas sensors – CO_2 sensors- Sensor for health care – Glucose sensor.

List of Experiments

1. Determination of the amount of NaOH using a conductivity meter.
2. Determination of the amount of acids in a mixture using a conductivity meter.
3. Determination of the amount of given hydrochloric acid using a pH meter.

UNIT III	ENERGY STORAGE DEVICES AND ENERGY SOURCES	15

Batteries – Primary alkaline battery - Secondary battery - Pb-acid battery, Fuel cell - H_2 – O_2 fuel cell. Batteries used in E- vehicle: Ni-metal hydride battery, Li-ion Battery, Li-air Battery Nuclear Energy – Nuclear fission, fusion, differences, characteristics – nuclear chain reactions – light water nuclear reactor – breeder reactor.

List of Experiments

1. Determination of single electrode potential of the given electrode.
2. Estimation of the iron content of the given solution using a potentiometer.
3. Determination of electrochemical cell potential (using different electrodes/ different concentrations of electrolytes)

UNIT IV	SMART MATERIALS FOR ENGINEERING APPLICATIONS	15

Polymers – Definition – Classification – smart polymeric materials - Preparation, properties and applications of Piezoelectric polymer - Polyvinylidene fluoride (PVDF), Electroactive polymer- Polyaniline (PANI) and Biodegradable polymer - Polylactic acid (PLA). Polymer composites: Definition, Classification – FRP's – Kevlar. Shape Memory Alloys: Introduction, Shape memory effect – Functional properties of SMAs – Types of SMA - Nitinol (Ni-Ti) alloys - applications. Chromogenic materials: Introduction – Types - applications.

List of Experiments

1. Determination of the molecular weight of polymer using Ostwald viscometer.
2. Application of polymeric fibers in 3D printing.

UNIT V	NANOCHEMISTRY	15

Introduction – synthesis – top-down process (laser ablation, chemical vapor deposition), bottom-up process (precipitation, electrochemical deposition) – properties of nanomaterials - types – nanotubes -carbon nanotubes, applications of CNT - nanocomposites – General applications of nanomaterials in electronics, information technology, medical and healthcare, energy, environmental remediation, construction and transportation industries.

List of Experiments

1. Determination of concentration of $BaSO_4$ nanoparticles by conductometric titrations.

Preparation of ZnO nanocrystal by precipitation method.

TOTAL: 75 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Interpret the water quality parameters and explain the various water treatment methods.

CO2: Construct the electrochemical cells and sensors.

CO3: Compare different energy storage devices and predict their relevance in electric vehicles.

CO4: Classify different types of smart materials, their properties and applications in Engineering and Technology.

CO5: Integrate the concepts of nanochemistry and enumerate its applications in various fields.

TEXT BOOKS:

1. P. C. Jain and Monika Jain, Engineering Chemistry, Dhanpat Rai Publishing Company Pvt. Ltd., New Delhi, 17th Edition, 2022.
2. Sivasankar B., Engineering Chemistry, Tata McGraw-Hill Publishing Company Ltd., New Delhi, Second reprint, 2012

REFERENCES:

1. S.S. Dara and S.S. Umare, A Textbook of Engineering Chemistry, S. Chand & Company, New Delhi, 12th Edition, 2013.
2. V.R. Gowarikar, Polymer Science, New Age International Publishers, 2nd edition, 2021.
3. J. C. Kuriacose and J. Rajaram, Chemistry in Engineering and Technology, Volume -1 & Volume -2, Tata McGraw-Hill Education Pvt. Ltd., 2010.
4. Geoffrey A. Ozin, Andre C. Arsenault and Ludovico Cademartiri, Nanochemistry: A Chemical Approach to Nanomaterials, 2nd Edition, RSC publishers, 2015.
5. Prasanna Chandrasekhar, Conducting polymers, fundamentals and applications– Including Carbon Nanotubes and Graphene, Springer Science &Business Media, New York, 2nd Edition, 2019.
6. J. Mendham, R. C. Denney, J. D. Barnes, M. J. K. Thomas and B. Sivasankar, Vogel's Quantitative Chemical Analysis, Pearson Education Pvt. Ltd., 6th edition, 2019.

LIST OF EQUIPMENT:

1. Conductivity meter
2. pH meter
3. Potentiometer

COURSE CODE	COURSE TITLE	L	T	P	C
22CS201	**DATA STRUCTURES** (Theory course with laboratory component) **(Common to CSE, CSD, EEE, ECE, IT and ADS)**	3	0	2	4

COURSE OBJECTIVES:

The Course will enable learners to:

- To understand the concepts of List ADT.
- To learn linear data structures – stacks and queues ADTs.
- To understand and apply Tree data structures.
- To understand and apply Graph structures.
- To analyze sorting, searching and hashing algorithms.

UNIT I	LINEAR DATA STRUCTURES – LIST	15

Algorithm analysis - running time calculations - Abstract Data Types (ADTs) – List ADT – array-based implementation – linked list implementation – singly linked lists - circularly linked lists - doubly-linked lists – applications of lists – Polynomial Manipulation – All operations (Insertion, Deletion, Merge, Traversal).

List of Exercise/Experiments:

1. Array implementation of List, Stack and Queue ADTs.
2. Linked list implementation of List, Stack and Queue ADTs.
    a. Applications of List – Polynomial manipulations

UNIT II	LINEAR DATA STRUCTURES – STACKS, QUEUES	15

Stack ADT – Stack Model - Implementations: Array and Linked list - Applications - Balancing symbols Evaluating arithmetic expressions - Conversion of Infix to postfix expression - Queue ADT – Queue Model - Implementations: Array and Linked list - applications of queues - Priority Queues – Binary Heap Applications of Priority Queues.

List of Exercise/Experiments:

1. Array implementation of Stack and Queue ADTs.
2. Linked list implementation of Stack and Queue ADTs.
3. Applications of List – Polynomial manipulations
4. Applications of Stack – Infix to postfix conversion and expression evaluation

UNIT III	NON-LINEAR DATA STRUCTURES – TREES	15

Tree ADT – tree traversals - Binary Tree ADT – expression trees – applications of trees – binary search tree ADT– AVL Tree.

List of Exercise/Experiments:

1. Implementation of Binary Trees and operations of Binary Trees.
2. Implementation of Binary Search Trees.
3. Implementation of Heaps using Priority Queues.

UNIT IV	NON-LINEAR DATA STRUCTURES - GRAPHS	15

Definition – Representation of Graph – Types of graph - Breadth-first traversal – Depth first traversal – Topological Sort – Applications of graphs – Bi Connectivity – Euler circuits.

List of Exercise/Experiments:

1. Graph representation and Traversal algorithms.

UNIT V	SEARCHING, SORTING AND HASHING TECHNIQUES	15

Searching- Linear Search - Binary Search - Sorting - Bubble sort - Selection sort - Insertion sort – Hashing - Hash Functions – Separate Chaining – Open Addressing – Rehashing – Extendible Hashing.

List of Exercise/Experiments:

1. Implement searching and sorting algorithms.

TOTAL: 75 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1: Implement abstract data types for list.

CO2: Solve real world problems using appropriate linear data structures.

CO3: Apply appropriate tree data structures in problem solving.

CO4: Implement appropriate Graph representations and solve real-world applications.

CO5: Implement various searching and sorting algorithms.

TEXT BOOKS:

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", 4th Edition, Pearson Education, 2014.
2. Sartaj Sahni, "Data Structures, Algorithms and Applications in C++", Silicon paper publications, 2004.

REFERENCES:

1. Rajesh K. Shukla, Data Structures using C and C++, Wiley India Publications, 2009.
2. Narasimha Karumanchi, Data Structure and Algorithmic Thinking with Python: Data Structure and Algorithmic Puzzles, CareerMonk Publications, 2020.
4. Jean-Paul Tremblay and Paul Sorenson, An Introduction to Data Structures with Application,McGraw-Hill, 2017.
5. Mark Allen Weiss, Data Structures and Algorithm Analysis in Java, Third Edition, Pearson Education, 2012.
6. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, Fundamentals of Data Structures in C, Second Edition, University Press, 2008.
7. Ellis Horowitz, Sartaj Sahni, Dinesh P Mehta, Fundamentals of Data Structures in C++, Second Edition, Silicon Press, 2007.
https://infyspringboard.onwingspan.com/web/en/app/

LIST OF REQUIREMENTS: Standalone desktops with C/C++ compiler (or) Server with C/C++ compiler

COURSE CODE	COURSE TITLE	L	T	P	C
22CS202	**JAVA PROGRAMMING** (Theory course with laboratory component) (Common to CSE, CSD, EEE, ECE, ME, IT, ADS and CSBS)	3	0	2	4

COURSE OBJECTIVES:

- To help students understand universal technical drawing standards.
- To explain object oriented programming concepts and fundamentals of Java.
- To apply the principles of packages, interfaces and exceptions.
- To develop a Java application with I/O streams, threads and generic programming.
- To build applications using strings and collections.
- To apply the JDBC concepts.

UNIT I	JAVA FUNDAMENTALS	15

An Overview of Java - Data Types, Variables, and Arrays – Operators - Control Statements – Class Fundamentals – Declaring objects – Methods – Constructors – this keyword - Overloading methods - Overloading constructors - Access Control – Static – Final.

List of Exercise/Experiments:

1. Develop a Java application to generate Electricity bill. You must use one super class called EB Bill and must have two sub classes namely Domestic Bill and Commercial Bill. Create a class with the following members: Consumer no., consumer name, previous month reading, current month reading, type of EB connection (i.e domestic or commercial). Compute the bill amount using the following tariff If the type of the EB connection is domestic, calculate the amount to be paid as follows:

   First 100 units - Rs. 1 per unit
   101-200units - Rs. 2.50 per unit 201 -500 units -Rs. 4
   per unit > 501 units - Rs. 6 per unit

   If the type of the EB connection is commercial, calculate the amount to be paid as follows: First 100 units - Rs. 2 per unit

   101-200units - Rs. 4.50 per unit

   201 -500 units -Rs. 6 per unit

   > 501 units - Rs. 7 per unit

2. Arrays Manipulations: (Use Methods for implementing these in a Class)
   a. Find kth smallest element in an unsorted array
   b. Find the sub array with given sum
   c. Matrix manipulations – Addition, Subtraction, Multiplication
   d. Remove duplicate elements in an Array
   e. Accept an integer value N and print the N^{th} digit in the integer sequence 1, 2, 3, 4, 5, 6, 7, 8,9, 10, 11, 12, 13, 14, 15 and so on till infinity.

UNIT II	INHERITANCE, INTERFACES AND EXCEPTION HANDLING	15

Inheritance: Inheritance basics, Using super, Method Overriding, Using Abstract Classes, Using final with Inheritance - Package and Interfaces: Packages, Packages and member access, Importing Packages, Interfaces, Static Methods in an Interface – Exception Handling: Exception-Handling Fundamentals, Exception Types, Uncaught Exceptions, Using try and catch, Multiple catch Clauses, Nested try Statements, throw, throws, finally, Java's Built-in Exceptions.

List of Exercise/Experiments:

3. Develop a Java application to implement currency converter (Dollar to INR, EURO to INR, Yen to INR and vice versa), distance converter (meter to KM, miles to KM and vice versa), time converter (hours to minutes, seconds and vice versa) using packages.
4. Develop a Java application with Employee class with Emp_name, Emp_id, Address, Mail_id, Mobile_no as members. Inherit the classes, Programmer, Assistant Professor, Associate Professor and Professor from employee class. Add Basic Pay (BP) as the member of all the inherited classes with 97% of BP as DA, 10 % of BP as HRA, 12% of BP as PF, 0.1% of BP for staff club fund. Generate pay slips for the employees with their gross and net salary.
5. Design a Java interface for ADT Stack. Implement this interface using array and built-in classes. Provide necessary exception handling in both the implementations.
6. Write a Java Program to create an abstract class named Shape that contains two integers and an empty method named print Area(). Provide three classes named Rectangle, Triangle and Circle such that each one of the classes extends the class Shape. Each one of the classes contains the methods print Area () that prints the area of the given shape and Number of sides() that prints the number of sides of the given shape.
7. Write a Java program to apply built-in and user defined exceptions.

UNIT III	MULTITHREADING, I/O AND GENERIC PROGRAMMING	1 5

Multithreaded Programming: Creating a Thread, Thread Priorities, Synchronization, Interthread Communication – I/O: I/O Basics, Reading Console Input, Writing Console Output, Reading and Writing Files– Generics: Introduction, Generic class, Bounded Types, Generic Methods, Generic Interfaces, Generic Restrictions.

List of Exercise/Experiments:

8. Write a Java program to read and copy the content of one file to other by handling all file related exceptions.

UNIT IV	STRING HANDLING AND COLLECTIONS	1 5

Lambda Expressions - String Handling – Collections: The Collection Interfaces, The Collection Classes Iterator – Map - Regular Expression Processing.

List of Exercise/Experiments:

9. String Manipulation:
    - Reversing a set of words and count the frequency of each letter in the string.
    - Pattern Recognition - Find the number of patterns of form 1[0]1 where [0] represents any number of zeroes (minimum requirement is one 0) there should not be any other character except 0 in the [0] sequence in a given binary string.
    - Remove all the occurrences of string S2 in string S1 and print the remaining.
    - Find the longest repeating sequence in a string
    - Print the number of unique string values that can be formed by rearranging the letters in the string S.
10. Write a Java program that correctly implements producer consumer problem using the concept of inter thread communication.
11. Collections:

    a) Write a program to perform string operations using Array List. Write functions for the following

    - Append - add at end
    - Insert – add at particular index
    - Search
    - List all string starts with given letter

    b) Find the frequency of words in a given text.

UNIT V	**JDBC CONNECTIVITY**	**15**

JDBC – Data Source, Configurations, Connection, Connection Pools, Driver Types, ResultSet, Prepared Statement, Named Parameter, Embedded SQL (Insert, Update, Delete, Join, union etc), ResultSet Navigation, Connection Close and Clean up.

List of Exercise/Experiments:

12. Mini Project (using JDBC)

TOTAL: 75 PERIODS

COURSE OUTCOMES:

After successful completion of the course, the students will be able to.

CO1: Understand the object oriented programming concepts and fundamentals of Java.

CO2: Develop Java programs with the packages, interfaces and exceptions.

CO3: Build Java applications with I/O streams, threads and generics programming.

CO4: Apply strings and collections in developing applications.

CO5: Implement the concepts of JDBC.

TEXT BOOKS:

1. Herbert Schildt, Java: The Complete Reference, 11th Edition, McGraw Hill Education, 2019.

REFERENCES:

1. Cay S. Horstmann, Gary Cornell, Core Java Volume – I Fundamentals, 11th Edition, Prentice Hall, 2019.
2. Paul Deitel, Harvey Deitel, Java SE 8 for programmers, 3rd Edition, Pearson, 2015.
3. Steven Holzner, Java 2 Black book, Dream tech press, 2011.
4. Timothy Budd, Understanding Object-oriented programming with Java, 3rd Edition, Pearson Education, 2008.
5. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_29959473947367270000_shared/overview.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

1.Systems with either Netbeans or Eclipse, JDK 1.7 and above, Linux and MySQL

COURSE CODE	COURSE TITLE	L	T	P	C
22GE302	TAMILS AND TECHNOLOGY	1	0	0	1

COURSE OBJECTIVES:

The course is designed to

- Recognize the historical significance of weaving and pottery technologies in ancient Tamil civilization.
- Highlight the concepts of design and construction technology during the Sangam age.
- Provide an overview of manufacturing technology and its role in Tamil society.
- Illustrate the agricultural and irrigation techniques employed in ancient Tamil society.
- Promote scientific Tamil and Tamil computing.

UNIT I	WEAVING AND CERAMIC TECHNOLOGY	3

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

UNIT II	DESIGN AND CONSTRUCTION TECHNOLOGY	3

Designing and Structural construction House & Designs in household materials during Sangam Age – Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram – Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.

UNIT III	MANUFACTURING TECHNOLOGY	3

Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting,steel -Copper and gold- Coins as source of history - Minting of Coins – Beads making-industries Stone beads - Glass beads - Terracotta beads

UNIT IV	AGRICULTURE AND IRRIGATION TECHNOLOGY	3

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry – Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

UNIT V	SCIENTIFIC TAMIL & TAMIL COMPUTING	3

Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project

TOTAL: 15 PERIODS

COURSE OUTCOMES:

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

CO1: Identify the role of weaving and ceramic technology in ancient Tamil Culture.

CO2: Assess the design and construction technology ideas in the current Tamil society.

CO3: Identify the different types of manufacturing technology used in Tamil society and their significance.

CO4: Classify agricultural and irrigation technologies in ancient Tamil society and its current relevance.

CO5: Discuss the fundamentals of scientific Tamil and Tamil computing.

TEXT BOOKS:

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

   கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்). 2.

3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)

4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)

5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)

6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.

7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D.Thirunavukkarasu) (Published by: International Institute of Tamil Studies).

8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)

9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation,Tamil Nadu)

10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)

11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil NaduText Bookand Educational Services Corporation, Tamil Nadu)

12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book

COURSE CODE	COURSE TITLE	L	T	P	C
22GE101	**COMPUTER AIDED ENGINEERING GRAPHICS** Laboratory Course with Theory Component (Common to I Semester CSE, CSE (CS), ADS and II Semester ECE)	1	0	2	2

COURSE OBJECTIVES:

To help students understand universal technical drawing standards.

- To provide training on drafting software to draw part models.
- To demonstrate the concepts of orthographic and isometric projections.
- To use drawing skills for communicating concepts, ideas for engineering product design.
- Use pictorial views to visualize and draw the isometric view of the objects

UNIT I	INTRODUCTION TO CONVENTIONS IN ENGINEERING DRAWING AND CONIC SECTIONS	09

Introduction to Engineering Drawing - Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning. Conic curves - Ellipse, Parabola and Hyperbola by Eccentricity method. (Theory-3)

Experiments Using CAD Software:

1. Drawing of a title block with necessary text, projection symbol and lettering using drafting software.
2. Drafting of Conic curves - Ellipse, Parabola and Hyperbola (Laboratory - 6)

UNIT II	ORTHOGRAPHIC PROJECTION	09

Visualization concepts and Orthographic Projection - Layout of views – Orthographic Projection Conversion of pictorial diagram into orthographic views. (Theory - 3)

Experiments Using CAD Software:

1. Drawing orthographic view of simple solids like Prism, Pyramids, Cylinder, Cone, etc, and dimensioning.
2. Drawing of orthographic views from the given pictorial diagram. (Laboratory -6)

UNIT III	PROJECTION OF PLANES	09

Projection of planes (polygonal and circular surfaces) inclined to both the planes by rotating object method. (Theory - 3)

Experiments Using CAD Software:

1. Drawing of plane Surface inclined to HP.
2. Drawing of plane Surface inclined to VP. (Laboratory -6)

UNIT IV	PROJECTION OF SOLIDS	09

Projection of simple solids like Prisms, Pyramids, Cylinder and Cone when the axis is inclined to HP by rotating object method. (Theory - 3)

Experiments Using CAD Software:

1. Drawing of simple solids like prism and pyramids when the axis is inclined to HP.
2. Drawing of simple solids like cylinder and cone when the axis is inclined to HP. (Laboratory -6)

UNIT V	ISOMETRIC DRAWING	09

Principles of isometric view – Isometric view of simple solids – Prism, Pyramid, Cylinder and Cone. (Theory - 3)

Experiments Using CAD Software:

1. Drawing isometric projection of simple solids.
2. Modeling of 2D to 3D objects using drafting software. (Laboratory -6)

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After successful completion of the course, the students will be able to.

CO1: Explain the various engineering standards required for drafting and explore knowledge in conic sections.

CO2: Draw the orthographic views of 3Dprimitive objects.

CO3: Describe the projection of plane surfaces by the rotating plane method.

CO4: Apply the projection concepts and drafting tools to draw projections of solids.

CO5: Sketch the pictorial views of the objects using CAD tools

TEXT BOOKS:

1. Natarajan K.V., A text book of Engineering Graphics, Dhanalakshmi Publishers, Chennai, 33rd Edition,2020.
2. Venugopal K. and Prabhu Raja V., Engineering Graphics, New Age International (P) Limited, 15th Edition, 2019

REFERENCES:

1. Bhatt N.D. ,Engineering Drawing, Charotar Publishing House, 53rd edition ,2019.
2. BasantAgarwal and Agarwal C.M., Engineering Drawing, Tata McGraw Hill Publishing Company Limited, New Delhi, 3rd Edition, 2019.
3. Engineering Drawing Practice for Schools and Colleges BIS SP46:2003 , Bureau of Indian Standards(BIS), 2008.
4. Parthasarathy. N.S and Vela Murali, Engineering Graphics, Oxford University, Press, New Delhi, 2019.
5. Gopalakrishna. K.R., Engineering Drawing Vol. 1 & 2, Subhas Publications, 27th Edition, 2017.
6. R.S Khurmi and J K Gupta, Textbook of Refrigeration and Air-conditioning (M.E.), S Chand & Co,2006

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS		
S. No.	**Description of Equipment**	**Quantity**
1	Computer nodes or systems with suitable graphics facility	30 No
2.	Software for Drafting and Modelling	30 No
3.	Laser Printer or Plotter to print / plot drawings	1 No

COURSE CODE	COURSE TITLE	L	T	P	C
22GE211	PRODUCT DEVELOPMENT LAB –2 (Common to all Branches)	0	0	2	1

The students may be grouped into a batch of strength 3 or 4 to work under a project supervisor. The student batches should study the device/system/component and will do literature review to develop prototype idea. Further at the end of the semester they will make a final presentation to exhibit the conceptual design skills and the process to develop a product.

COURSE OBJECTIVES:

Students completing this course are expected to

1. Use the innovative design methodology to articulate the product concepts.
2. Summarize the requisite Engineering Principles for transforming concepts into products.
3. Conduct basic tests to extract the qualitative and quantitative performance factors.

EXERCISES:

1. Study of Basic Engineering Design Concepts.
2. Conduct a literature survey on the implementation of the design concepts.
3. Prepare the design concepts for an identified literature gap**.**
4. Present the Product Idea Presentation –Phase II.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

After successful completion of the course, the students will be able to

CO1: Understand the working and capacity of various engineering systems.

CO2: Infer the outcomes in the product development process.

CO3: Perform basic engineering and material characterization tests.

CO4: Demonstrate the ability to provide conceptual design strategies for a product.

CO5: Implement the Science, Engineering, Technology and Mathematics (STEM) for product design.

SEMESTER III

COURSE CODE	COURSE TITLE	L	T	P	C
22MA302	**STATISTICS AND LINEAR ALGEBRA** (Theory Course with Laboratory Component)	3	0	2	4

COURSE OBJECTIVES:

The course is designed to:

- Test the hypothesis for small and large samples.
- Introduce the concept of analysis of variance.
- Understand the concept of statistical quality control.
- Define vectors space and linear transformations.

UNIT I	TESTING OF HYPOTHESIS	15

Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means - Tests based on t, F distributions for mean and variance- Chi-square test - Goodness of fit and Contingency table (test for independent).

List of Exercise/Experiments using R Programming:

1. Testing of hypothesis for given data using Z - test.
2. Testing of hypothesis for given data using t - test.

UNIT II	DESIGN OF EXPERIMENTS	15

One-way and two-way classifications - Completely randomized design - Randomized block design – Latin square design

List of Exercise/Experiments using R Programming:

1. Perform one way ANOVA test for the given data.
2. Perform two way ANOVA test for the given data.

UNIT III	STATISTICAL QUALITY CONTROL	15

Control charts for measurements $\bar{X}$ and R charts) - Control charts for attributes (p, c and np charts) Tolerance limits.

List of Exercise/Experiments using R Programming:

1. Interpret the results for $\bar{X}$-Chart for variable data.
2. Interpret the results for R-Chart for variable data.

UNIT IV	VECTOR SPACES	15

Vector spaces - Subspaces - Linear combinations and linear system of equations - Linear independence and linear dependence - Bases and dimensions.

List of Exercise/Experiments using R Programming:

1. Plot the vector subspace in 3-dimensional space.
2. Compute the null space of the matrix.

UNIT V	LINEAR TRANSFORMATION AND DIAGONALIZATION	15

Linear transformation - Null spaces and ranges - Dimension theorem - Matrix representation of linear Transformations - Eigenvalues and eigenvectors - Diagonalizability.

List of Exercise / Experiments using R Programming:
1.Write Matrix representation of linear transformations

TOTAL: 75 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Apply the concept of testing of hypothesis.

CO2: Demonstrate the different types of experimental designs.

CO3: Interpret the control charts for variables and attributes.

CO4: Identify the bases and dimensions.

CO5: Find the eigenvalues and eigenvectors using linear transformations

TEXT BOOKS:

1. R.A. Johnson, I. Miller and J. Freund, Miller and Freund's Probability and Statistics for Engineers, Pearson Education, Asia, 8th Edition, 2015
2. Friedberg, A.H., Insel, A.J. and Spence, L., Linear Algebra: A Matrix Approach 2nd Edition Prentice Hall of India, New Delhi, 2019.

REFERENCES:

1. J.L. Devore, Probability and Statistics for Engineering and the Sciences, Cengage Learning, New Delhi, 8th Edition, 2014.
2. S.M. Ross, Introduction to Probability and Statistics for Engineers and Scientists, 5th Edition, Elsevier, 2014.
3. M.R. Spiegel, J. Schiller and R.A. Srinivasan, Schaum's Outline of Theory and Problems of Probability and Statistics, Tata McGraw Hill Edition, 2004.
4. R.E.Walpole, R.H.Myers, S.L. Myers and K.Ye, Probability and Statistics for Engineers and Scientists, Pearson Education, Asia, 9th Edition, 2012.
5. J.S. Milton and J.C. Arnold, Introduction to Probability and Statistics, Tata McGraw Hill, 4th Edition, 2007.
6. Howard Anton, Anton Kaul, Elementary Linear Algebra, Wiley, 12th Edition, 2019.

COURSE CODE	COURSE TITLE	L	T	P	C
22EC301	SIGNALS AND SYSTEMS (Theory course with laboratory component)	3	0	2	4

COURSE OBJECTIVES:

- To summarize the basic properties of Signals and Systems and their classification.
- To demonstrate Continuous Time signals using Fourier series, Laplace transform and Fourier transform.
- To examine Continuous Time LTI systems using Laplace transform and Fourier transform.
- To analyze Discrete Time signals using DTFT and Z transform.
- To characterize Discrete Time LTI systems using DTFT and Z transform.

UNIT I	CLASSIFICATION OF SIGNALS AND SYSTEMS	9

Continuous time signals (CT signals) - Discrete time signals (DT signals) - Step, Ramp, Pulse, Impulse, Sinusoidal, Exponential, Operations on Signals, Classification of CT and DT signals - Periodic & Aperiodic signals, Deterministic & Random signals, Even & Odd, Causal & Non-Causal, Energy & Power signals - Continuous time systems and Discrete time systems - Classification of CT systems and DT systems – Static & Dynamic, Linear & Nonlinear, Time-variant & Time-invariant, Causal & Non-causal, Stable & Unstable.

LIST OF EXPERIMENTS

1. Generation of Continuous time and Discrete Time signals.
2. Perform amplitude-scaling and time-shifting on a given signal.
3. Compute the even and odd parts of a given signal

UNIT II	ANALYSIS OF CONTINUOUS TIME SIGNALS	9

Fourier series analysis -Spectrum of Continuous Time (CT) signals- Fourier and Laplace transforms of CT Signals - Properties.

LIST OF EXPERIMENTS

4. Compute the Fourier transform of CT signals.
5. Compute the Laplace transform of CT signals.

UNIT III	LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS	9

Differential Equation - Impulse response, Convolution integrals, Fourier and Laplace transforms in analysis of Continuous Time systems.

LIST OF EXPERIMENTS

6. Perform convolution of signals using Fourier transform.

UNIT IV	ANALYSIS OF DISCRETE TIME SIGNALS	9

Discrete Time Fourier Transform (DTFT) – Properties of DTFT - Z transform – Properties of Z transform.

LIST OF EXPERIMENTS

7. Compute the Z transform of causal signals.

UNIT V	**LINEAR TIME INVARIANT DISCRETE TIME SYSTEMS**	**9**

Difference Equations-Block diagram representation -Impulse response - Convolution sum-Discrete Fourier transform and Z transform analysis of Discrete Time systems

LIST OF EXPERIMENTS

8. Compute Linear convolution (Convolution Sum) of the given two sequences.
9. Simulate the impulse response of a system from its difference equation.
10. Find poles and zeros of Z domain signals and sketch the pole zero plot.

TOTAL: 45 PERIODS(THEORY) +30 PERIODS (LAB)=75 PERIODS

COURSE OUTCOMES:

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

CO1: Interpret the properties of Signals and Systems.

CO2: Determine Fourier series, Fourier transform and Laplace transform of Continuous Time signals.

CO3: Examine Continuous Time LTI systems using Fourier and Laplace transforms.

CO4: Employ DTFT and Z transform in Discrete Time signal analysis.

CO5: Examine the Discrete time LTI systems using DTFT and Z transform.

CO6: Demonstrate Convolution operation for Continuous and Discrete time systems.

TEXT BOOKS:

1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, Signals and Systems, 2nd Edition, Pearson, 2015.
2. Simon Haykin and Barry Van Veen, Signals & Systems, 2nd Edition, Wiley, 2018.

REFERENCES:

1. B. P. Lathi, Principles of Linear Systems and Signals, 3rd Edition, Oxford, 2017.
2. M.J.Roberts, Signals & Systems Analysis using Transform Methods & MATLAB, 3rd Edition, Tata McGraw Hill, 2019.
3. R.E.Zeimer, W.H.Tranter and R.D.Fannin, Signals & Systems - Continuous and Discrete, 4th Edition, Pearson, 2014.
4. A. Nagoor Kani, Signals and Systems, 1st Edition, McGraw Hill, 2018.
5. A. Anand Kumar, Signals and Systems, 3rd Edition, PHI Learning Private Limited, 2013.

NPTEL LINKS:
https://nptel.ac.in/courses/108/106/108106163/ https://nptel.ac.in/courses/108104100
LIST OF EQUIPMENT:

Requirements for a batch of 30 students

Sl. No.	Equipment	Quantity
1	SciLab / MATLAB	30
2	Personal Computers	30

COURSE CODE	COURSE TITLE	L	T	P	C
22EC302	ANALOG ELECTRONICS (Theory course with laboratory component)	3	0	2	4

COURSE OBJECTIVES:

- To analyze the multistage amplifiers.
- To analyze the effect of capacitances in the frequency response of BJT and MOSFET
- To discuss the effects of negative feedback on amplifier circuit
- To understand study the different Type of Oscillator circuit
- To understand the operation of various classes of power amplifier circuits.
- To design the hardware implementation of analog circuits using discrete components.

UNIT I	MULTISTAGE AMPLIFIER USING BJT AND FET	9

BJT Differential amplifier – CMRR, Multistage amplifiers –Cascade amplifier, Darlington amplifier, Cascade amplifier, Multistage Amplifiers using FET – Cascade amplifier, Cascode amplifier

LISTOFEXPERIMENTS

1. Darlington Amplifier
2. BJT Cascode / Cascade amplifier using PSPICE
3. MOSFET characteristics using PSPICE

UNIT II	FREQUENCY RESPONSE OF BJT AND MOSFET	9

Frequency response of BJT–Transistor amplifier with circuit capacitors, Short circuit current gain, Miller effect and Miller capacitance, High frequency analysis of CE amplifier, Frequency response of MOSFET–High frequency MOSFET model, Unit gain bandwidth, High frequency analysis of MOSFET CS amplifier.

LIST OF EXPERIMENTS

4. Frequency response of CE amplifier
5. Frequency response of CS amplifier using PSPICE

UNIT III	FEEDBACK AMPLIFIERS	9

Feedback Concepts – gain with feedback– effect of feedback on gain stability, distortion, bandwidth, input and output impedances; topologies of feedback amplifiers –analysis of series-series, shunt-shunt and shunt- series feedback amplifiers

LIST OF EXPERIMENTS

6. Feedback Amplifier

UNIT IV	OSCILLATORS	9

Barkhausen criterion, Colpitts, Hartley's, Clapp Oscillator, Phase shift, Wien bridge and crystal oscillators.

LIST OF EXPERIMENTS

7.LC Oscillator using PSPICE
8. RC Oscillator using PSPICE

UNIT V	POWER AMPLIFIERS	9

Classification of large signal amplifiers, Class A, B, AB, C, D, Conversion efficiency, Class C Tuned amplifier.

LIST OF EXPERIMENTS

9. Class B and Class C Tuned Amplifier
10. Class A Amplifier using PSPICE

TOTAL: 45 PERIODS(THEORY) +30 PERIODS (LAB)=75 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Design of amplifier circuits using BJT and FET

CO2: Analyze the frequency response of BJT and FET amplifiers

CO3: Investigation of various parameters of feedback amplifiers

CO4: Design of various types of oscillator circuits

CO5: Inspect the different classes of power amplifiers.

CO6: Design, of analog circuits with discrete components and simulation tool

TEXT BOOKS:

1. Donald. A. Neamen, Electronic Circuits Analysis and Design, 3rd Edition, Mc Graw Hill Education(India) Private Ltd., 2010.
2. Robert L. Boylestad and Louis Nasheresky,―Electronic Devices and Circuit Theory‖, 11th Edition, Pearson Education, 2008.

REFERENCES:

1. David A Bell , Electronic Devices and circuits, Fifth edition, Oxford 2008.
2. Millman J. and Taub H.,―Pulse Digital and Switching Waveforms, TMH, 2000.
3. Millman J, Halkias.C and SathyabradaJit, Electronic Devices and Circuits, 4th Edition, Mc Graw Hill Education (India) Private Ltd., 2015.
4. Sedra and Smith, ―Micro Electronic Circuits; Sixth Edition, Oxford University Press, 2011.
5. Floyd, Electronic Devices, Ninth Edition, Pearson Education, 2012.

NPTEL LINKS:

https://nptel.ac.in/courses/117/101/117101106/

https://archive.nptel.ac.in/courses/108/105/108105158/

LIST OF EQUIPMENTS:

Requirements for a batch of 30 students

Sl. No.	Equipment	Quantity
1	CRO(30MHz)	15
2	Signal Generator /Function Generator (3MHz)	15
3	Dual Regulated Power Supply (0-30V)	15
4	Transistor/FET(BJT-NPN-PNP and NMOS/PMOS)	50
5	Power Transistor	20
6	Resistors, Capacitors	50
7	Decade Inductance Box	10
8	Decade Capacitance Box	10
9	Bread Boards	15
10	Multimeter	15
11	Digital LCR Meter	2
12	Desktop PC with PSPICE Circuit Simulation Software	15

22CS307	ADVANCED JAVA PROGRAMMING	L	T	P	C
		3	0	2	4

OBJECTIVES:

The Course will enable learners to:

- Gain a comprehensive understanding of the Java Collections Framework and its various interfaces and implementations.
- Learn the details of Java I/O streams and utility classes for managing dates, numbers, and currencies.
- Develop a thorough understanding of the Stream API introduced in Java 8 and its various operations.
- Explore advanced object serialization and string tokenizing techniques, including pattern matching with regular expressions.
- Understand advanced Stream API features and gain proficiency in using regular expressions for text processing.

UNIT I	COLLECTIONS FRAMEWORK AND UTILITY CLASSES	9+6

Introduction to Collections Framework - Collection Interface- Methods in Collection Interface- Iterable and Iterator Interfaces - List Interface- ArrayList - LinkedList - Set Interface -HashSet- LinkedHashSet - TreeSet - Map Interface - HashMap -LinkedHashMap- TreeMap -Queue Interface -PriorityQueue - Deque Interface - Utility Classes.

List of Experiments

1. Write a program that measures the time taken for insertion, deletion, and search operations on ArrayList, LinkedList, HashSet, and TreeSet for varying sizes of input data.
2. Implement a custom data structure that combines features of a list and a set.
3. Write a Java program to create a HashMap where the keys are strings, and the values are integers Add five key-value pairs to the map. Print all the keys and values in the map. Remove an entry by key. Update the value associated with a specific key. Check if the map contains a specific key and a specific value.

UNIT II	I/O OPERATIONS, SERIALIZATION, AND DATE HANDLING	9+6

Date – Calendar – Comparable interface – Observer Interface – Streams - Types of Streams -The Byte-stream I/O hierarchy - Character Stream Hierarchy – Random Access File class – thejava.io. Console Class – Serialization – Dates - Numbers, and Currency - Working with Dates- Numbers and Currencies.

List of Experiments

1. Create a class representing a complex object with nested data structures. Serialize theobject to a file, then deserialize it back and verify that the object remains intact.
2. Write a program that formats dates and currencies according to different locales.
3. Implement a java program that allows users to open a text file, navigate through it using random access, insert, delete, and modify text at specific positions within the file.

UNIT III	STREAM API AND FUNCTIONAL PROGRAMMING PARADIGMS	9+6

Overview of Stream API - Importance of Stream API in Java 8 and Beyond – Functional Programming Concepts - Creating Streams - Stream Interface Methods - Stream Operations- Intermediate Filtering (filter)-Mapping (map, flatMap)-Sorting (sorted)-Distinct (distinct)-Limit and Skip (limit, skip) - Terminal Operations -Collecting Results (collect) - Reducing and

Summarizing (reduce, summary Statistics)-Iterating (forEach) - Matching and Finding(any Match, all Match, non eMatch, find First, find Any) -Counting (count).

List of Experiments

1. Write a program that performs stream operations like filtering, mapping, and reducing.
2. Create an infinite stream generator that generates prime numbers. Implement methods to check for primality and generate the next prime number.
3. Write a program that reads a text file containing sentences. Tokenize each sentence intowords, filter out stopwords, and print the remaining words.

UNIT IV	ADVANCED STRING PROCESSING, OBJECT SERIALIZATION, AND I/O TECHNIQUES	9+6

String Tokenizer – Parsing - Tokenizing and Formatting - Locating Data via Pattern Matching,Tokenizing - Object Serialization - Serializable Interface - Writing and Reading SerializableObjects -Transient Keyword- SerialVersionUID - Advanced I/O - Piped Streams(PipedInputStream and PipedOutputStream) – SequenceInputStream - PushbackInputStreamand PushbackReader.

List of Experiments

1. Write a program that reads a text file and tokenizes it into sentences using the StringTokenizer class.
2. Create a class hierarchy representing different types of objects (e.g., Person, Employee). Serialize instances of these classes to a file using object serialization.
3. Implement a program that uses advanced I/O techniques like PipedInputStream, PipedOutputStream, SequenceInputStream, and PushbackInputStream.

UNIT V	ADVANCED STREAM FEATURES AND REGULAR EXPRESSIONS	9+6

Importance and Use Cases of Advanced Stream Features - Creating Custom Streams - StreamGenerators (Stream.generate, Stream.iterate) - Infinite Streams -Using Spliterators – AdvancedStream Operations - FlatMapping - Chaining Stream Operations - Stream Peeking (peek) -Advanced Filtering Techniques- Introduction to Regular Expressions - Character Classes -Quantifiers - Pattern Matching - Groups and Capturing - Regex in Java - java.util.regexPackage Pattern Class - Matcher Class - String Manipulation with Regex - Splitting Strings-Replacing Text (replaceAll, replaceFirst) - Replacing with Backreferences.

List of Experiments

1. Implement custom stream generators using Stream.generate and Stream.iterate methods.
2. Write a program that demonstrates advanced stream operations like flatMapping, chaining stream operations, and peeking.
3. Develop a program that utilizes regular expressions to perform string manipulation tasks such as splitting strings, replacing text, and extracting specific patterns.

TOTAL: 45+30 = 75 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Utilize the Java Collections Framework to solve complex data structure problems.

CO2: Demonstrate proficiency in Java I/O operations and manage data efficiently.

CO3: Learn to utilize the Stream API for complex data processing by applying functional programming techniques.

CO4: Understand and implement advanced object serialization techniques.

CO5: Effectively use regular expressions for advanced text processing tasks.

CO6: Build simple applications using advanced java programming concepts.

TEXT BOOK:

1. Cay S. Horstmann, "Core Java Volume I--Fundamentals," 12th Edition, 2019.
2. Joshua Bloch, "Effective Java," 3rd Edition, 2018.
3. Raoul-Gabriel Urma, "Java 8 in Action: Lambdas, Streams, and Functional-StyleProgramming," 1st Edition, 2014.
4. Herbert Schildt, "Java: The Complete Reference," 11th Edition, 2018.
5. Alan Mycroft and Martin Odersky, "Programming in Scala," 4th Edition, 2020.

REFERENCES:

1. Bruce Eckel, "Thinking in Java," 4th Edition, 2006.
2. Herbert Schildt, "Java: A Beginner's Guide," 8th Edition, 2019.
3. Richard Warburton, "Java 8 Lambdas: Pragmatic Functional Programming," 1st Edition,2014.

LIST OF EQUIPMENTS:

JDK/Eclipse

COURSE CODE	COURSE TITLE	L	T	P	C
22EC303	ELECTROMAGNETIC FIELDS AND TRANSMISSION LINES	3	0	0	3

COURSE OBJECTIVES:

- To impart knowledge on static electric field, electric potential, static magnetic field, magnetic potential and their associated laws.
- To give insight into coupling between electric and magnetic fields through Faraday's law, displacement current and Maxwell's equations.
- To introduce the various types of transmission lines and its characteristics.
- To provide thorough understanding about high frequency line, power and impedance measurements.

UNIT I	ELECTROSTATICS	9

Coulomb's Law – Electric Field Intensity – Electric Field due to discrete charges and continuous charge distributions- Electric Field due to finite, infinite line and circular disc, Potential due to Electrical Dipole, Gauss Law and its Applications. Capacitance of various geometries using Laplace equation – Boundary conditions.

UNIT II	MAGNETOSTATICS	9

Biot-Savart Law– Magnetic Field Intensity due to finite and infinite wire, circular and rectangular loop – Ampere's Circuital Law and its applications. Lorentz Force Equation – Force and Torqueon a closed loop, Magnetic Vector Potential. Inductance of loops and Solenoid- Boundary conditions.

UNIT III	TIME VARYING FIELDS AND MAXWELL'S EQUATIONS	9

Faraday's law, Displacement Current – Ampere's Circuital Law – Maxwell's Equation in Integral and Differential form - Maxwell's equation in Phasor form. Poynting Theorem.

UNIT IV	TRANSMISSION LINE THEORY	9

Transmission lines – general solution – The infinite line, Wavelength, velocity of propagation, Waveform distortion – the distortion-less line – Loading of Lines – Line not terminated in Z_O – Reflection coefficient, Calculation of current, voltage, power delivered and efficiency of

UNIT V	HIGH FREQUENCY TRANSMISSION LINES & IMPEDANCE	9

Transmission line equations at radio frequencies - Line of Zero dissipation - Voltage and current on the dissipation-less line - Standing Waves, Nodes, Standing Wave Ratio- Input impedance of the dissipation-less line, Quarter wave transformer – Single and double stub matching using Smith chart.

TOTAL:45 PERIODS

COURSE OUTCOMES:

After successful completion of the course, the students will be able to

CO1: Compute electric fields and potentials due to static charges.
CO2: Illustrate static magnetic fields, magnetic potential and its applications.
CO3: Interpret Maxwell's equations in integral, differential and phasor forms and explain their physical meaning.
CO4: Solve transmission line equations and its parameters.
CO5: Explain standing wave ratio and input impedance in high frequency transmission lines.
CO6: Analyze impedance matching by stubs using smith charts and MATLAB programming.

TEXT BOOKS:

1. W.H.Hayt & J.A. Buck, Engineering Electromagnetics, TMH,9th Edition, 2020.
2. John D Ryder, Networks lines and fields, Pearson, 2nd Edition, 2015.

REFERENCES:

1. Matthew N.O.Sadiku, Elements of Engineering Electromagnetics, Oxford University Press,7th Edition, 2018.
2. David K. Cheng, Field and Wave Electromagnetics, Pearson, 2nd Edition, 2014.
3. Umesh Sinha, Transmission Lines and Networks, Filters & Transmission Lines, Sathya Prakash, 2010.
4. G.S.N. Raju, Electromagnetic Field Theory & Transmission Lines, Pearson Education, 2006.
5. Joseph Edminister, Mahmood Nahvi, Schaum's Outline of Electromagnetics, McGraw-Hill Education, 5th Edition, 2019.

NPTEL LINK:

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

https://archive.nptel.ac.in/courses/117/101/117101056/#

COURSE CODE	COURSE TITLE	L	T	P	C
22CS311	APTITUDE AND CODING SKILLS – I	0	0	2	1

COURSE OBJECTIVES:

- To develop vocabulary for effective communication and reading skills.
- To build the logical reasoning and quantitative skills.
- To develop error correction and debugging skills in programming.

List of Exercises:

1. **English – Phase I**

Vocabulary: Synonyms, Antonyms, Grammar: Subject-Verb Agreement, Tenses and Articles, Prepositions and Conjunctions, Speech and Voices, Comprehension: Inferential and Literal Comprehension, Contextual Vocabulary, Comprehension ordering.

2. **Logical Reasoning – Phase I**

Deductive Reasoning: Coding deductive logic, Directional sense, Blood relations, Objective Reasoning, Selection decision tables, Puzzles, Inductive reasoning: Coding pattern and Number series pattern recognition, Analogy and Classification pattern recognition, Abductive Reasoning: Logical word sequence, Data sufficiency.

3. **Quantitative Ability - Phase I**

Basic Mathematics: Divisibility, HCF and LCM, Numbers, decimal fractions and power, Applied Mathematics: Profit and Loss, Simple and Compound Interest, Time, Speed and Distance, Engineering Mathematics: Logarithms, Permutation and Combinations, Probability.

4. **Automata Fix – Phase I**

Logical, Compilation and Code reuse.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1: Develop vocabulary for effective communication and reading skills.

CO2: Build the logical reasoning and quantitative skills.

CO3: Develop error correction and debugging skills in programming.

COURSE CODE	COURSE TITLE	L	T	P	C
22EC311	PRODUCT DEVELOPMENT LAB -3	0	0	2	1

COURSE OBJECTIVES:

- To provide adequate understanding of project/product concepts and creative design process.
- To create a methodology for developing solutions to the complex systems.

S.NO.	LIST OF EXPERIMENTS
1.	Implementation of Design Process.
2.	Present the product idea.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

CO1: Develop their intellectual skills for understanding the concepts, rules or procedures.

CO2: Develop their cognitive strategy to think, organize, learn and behave.

CO3: Demonstrate the ability to provide conceptual design strategies for a product.

CO4: Describe procedure for designing a prototype.

CO5: Recognize interdisciplinary strategies for solving complex problems.

CO6: Apply integrative strategies for solving complex problems.

LIST OF EQUIPMENT:

Sl. No.	Equipment	Quantity
1.	CNC Router	1
2.	3D Printer	1
3.	3D Scanner	1
4.	Laser Cutting Machine	1
5.	Centre lathe	2
6.	Arc Welding transformer with cables and holders	2
7.	Plumbing tools	2 Sets
8.	Carpentry Tools	2 Sets
9.	Multimeter	10
10.	Drilling Machine	1
11.	Solder Stations	5 Sets
12.	Desoldering Machine	1
13.	PCB Milling Machine	1
14.	Variable Power Supply	1
15.	Electronic Components like Resistors, Transistors, Diode, Inductor, Capacitors, IC etc.,	10 Sets
16.	Personal Desktop Computers	30

SEMESTER IV

COURSE CODE	COURSE TITLE	L	T	P	C
22MA402	**PROBABILITY AND RANDOM PROCESSES** (Theory course with laboratory component)	3	0	2	4

COURSE OBJECTIVES:

The course is designed to:

- Provide the necessary basic concepts of random variables and to introduce some standard distributions.
- Understand the classification of random processes.
- Introduce the concept of auto correlation, cross correlation, and its spectral densities.
- Acquire the knowledge of linear system with random inputs.

UNIT I	ONE-DIMENSIONAL RANDOM VARIABLES	15

Basic probability definitions- Independent events- Conditional probability (revisit) - Random variable -Discrete and continuous random variables - Moments - Moment generating functions - Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

List of Exercise/Experiments using MATLAB/ R Programming:

1. Finding probability of DRV and CRV.
2. Finding mean, variance and MGF.
3. Using distributions to find probability value.

UNIT II	TWO-DIMENSIONAL RANDOM VARIABLES	15

Joint distributions - Marginal and conditional distributions - Covariance - Correlation and linear regression - Transformation of random variables.

List of Exercise/Experiments using MATLAB/ R Programming:

1. Determine mean values using regression.
2. Solving correlation problems
3. Finding covariance.

UNIT III	RANDOM PROCESSES	15

Classification - Stationary process - Poisson process - Markov process -Discrete time Markov chain- Random telegraph process.

List of Exercise/Experiments using MATLAB/ R Programming:

1. Determine asymptotic behaviour of Markov chain.
2. Solving Poisson process problems.
3. To test the stationary of a random process

UNIT IV	CORRELATION AND SPECTRAL DENSITIES	15

Auto correlation functions - Cross correlation functions - Properties - Power spectral density (continuous)- Cross spectral density (continuous) - Properties.

List of Exercise/Experiments using MATLAB/ R Programming:

1. Calculating auto correlation.
2. Finding PSD of a signal.
3. To estimate cross spectral density.

UNIT V	LINEAR SYSTEMS WITH RANDOM INPUTS	15

Linear time invariant system - System transfer function - Linear systems with random inputs - Auto correlation and cross correlation functions of input and output.

List of Exercise/Experiments using MATLAB/ R Programming:

1. Construct linear time invariant models.
2. Problem with phase of a transfer function.
3. Create random input signal.

TOTAL: 75 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Calculate the statistical measures of standard distributions.

CO2: Compute the correlation & regression for two dimensional random variables.

CO3: Find the steady state probabilities of the Markov chain.

CO4: Estimate the auto correlation and its power spectral densities of the random processes.

CO5: Determine the output power spectral density of linear system with random inputs.

TEXT BOOKS:

1. R.D. Yates and D.J. Goodman, Probability and Stochastic Processes, Wiley India Pvt. Ltd., 3rd Edition, 2021.

2. O.C. Ibe, Fundamentals of Applied Probability and Random Processes, 2nd Edition, Elsevier, 2019.

REFERENCES:

1. G.R. Cooper and C.D. McGillem, Probabilistic Methods of Signal and System Analysis, Oxford University Press, New Delhi, 3rd Indian Edition, 2012.
2. Hwei Hsu, Schaum's Outline of Theory and Problems of Probability, Random Variables and Random Processes, Tata McGraw Hill Edition, New Delhi, 2004.
3. S.L. Miller and D.G. Childers, Probability and Random Processes with Applications to Signal Processing and Communications, Academic Press, 2nd Edition 2012.
4. H. Stark. and J.W. Woods, Probability and Random Processes with Applications to Signal Processing, Pearson Education, Asia, 3rd Edition, 2002.
5. P.Z. Peebles,Probability, Random Variables and Random Signal Principles, Tata McGraw Hill, 4th Edition, New Delhi, 2002.

COURSE CODE	COURSE TITLE	L	T	P	C
22EC401	CONTROL ENGINEERING (Theory course with laboratory component)	3	0	2	4

COURSE OBJECTIVES:

- To determine the transfer function models of mechanical and electrical systems
- To develop adequate knowledge in the time response of systems and steady state error analysis
- To analyze the open loop and closed loop frequency response of linear systems
- To design the compensators for Linear Systems
- To estimate stability for Linear Systems
- To make use of state variable representation of physical systems

UNIT I	MATHEMATICAL MODEL OF PHYSICAL SYSTEMS	9

Basic elements in control systems: Open and closed loop systems – Mathematical model and Electrical analogy of mechanical systems – Transfer function – Block diagram reduction techniques – Signal flow graphs - Applications of Control system.

LIST OF EXPERIMENTS

1. Determine the transfer function of the given closed loop system using MATLAB
2. Implement unity and non-unity feedback system using MATLAB.

UNIT II	TIME RESPONSE ANALYSIS	9

Time response: Time domain specifications – Types of test input – I and II order system response – Error coefficients – Generalized error series – Steady state error – Effects of P, PI, PID modes of feedback control

LIST OF EXPERIMENTS

3. Estimate the unit step response of the given transfer functions and determine its time domain parameters using MATLAB.
4. Determine the steady state error of the given transfer function using MATLAB.
5. Simulate P, PD, PI, PID controller and verify by using hardware.

UNIT III	FREQUENCY RESPONSE ANALYSIS	9

Frequency response analysis – Bode plot – Polar plot. Determination of closed loop response from open loop response –M and N circles. Correlation between frequency domain and time domain specifications.

LIST OF EXPERIMENTS

6. Perform stability analysis of a given transfer function using gain and phase margins estimated by the Bode plot using MATLAB.
7. Estimate the relative stability of a given transfer function using gain and phase margins estimated by the Polar plot using MATLAB.

UNIT IV	STABILITY AND COMPENSATOR DESIGN	9

Characteristics equation – Routh Hurwitz criterion- Root locus construction – Effect of Lag, lead and lag-lead compensation on frequency response - Design of Lag, lead and lag lead compensator using bode plots.

LIST OF EXPERIMENTS

8. Sketch the root locus of the given transfer function and locate the closed loop poles for different values of open loop gain (K) using MATLAB.

UNIT V	**STATE VARIABLE AND STATE SPACE MODELLING**	**9**

Concept of state variables – State models for linear and time invariant Systems – Solution of state and output equation in controllable canonical form – Concepts of controllability and observability.

LIST OF EXPERIMENTS

9. Construct the State space model for the classical transfer function using MATLAB.
10. Perform analytical study of water flow measurement using flow meter.

TOTAL: 45 PERIODS(THEORY) +30 PERIODS (LAB)=75 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Develop mathematical model of linear mechanical and electrical systems

CO2: Model the time response analysis of first and second order systems

CO3: Analyze the frequency response of open and closed loop systems

CO4: Design the compensators for Linear Systems

CO5: Analyze stability methods for Linear Systems

CO6: Examine the state variables, controllability and observability of linear and time invariant systems

TEXT BOOKS:

1. Nagarath,I.J. and Gopal,M., Control Systems Engineering, Sixth Edition, New Age InternationalPublishers, 2017.
2. Benjamin C.Kuo, Automatic Control Systems, Ninth Edition, Wiley, 2014.

REFERENCES:

1. M.Gopal, Control System: Principle and Design, Fourth Edition, McGraw Hill Education, 2018.
2. Katsuhiko Ogata, Modern Control Engineering, Fifth Edition, Pearson, 2015.
3. Prof.S.D.Agashe, NPTEL Video Lecture Notes on Control Engineering, IIT Bombay.
4. S.K.Bhattacharya ,Control Systems Engineering, First Edition, Pearson, 2018.
5. Houpis C H and Sheldon S N ,Linear Control System Analysis and Design with MATLAB Fifth Edition, CRC Press Taylor and Francis, 2014.

NPTEL LINKS:

https://nptel.ac.in/courses/107106081

https://onlinecourses.nptel.ac.in/noc19_ee42

LIST OF EQUIPMENT:

Requirements for a batch of 30 students

Sl.	Equipment	Quantity
1	P,PI and PID controller Learner Kit	1
2	Water flow Measurement Kit	1
3	CRO 30MHz	10
4	Personal Computer	15
5	MATLAB	15 Users

COURSE CODE	COURSE TITLE	L	T	P	C
22EC402	LINEAR INTEGRATED CIRCUITS (Theory course with laboratory component)	3	0	2	4

COURSE OBJECTIVES:

- To describe the characteristics of operational amplifiers.
- To design Op–amp circuits for linear and nonlinear applications.
- To comprehend the working principles of ADC and DAC.
- To investigate the functions and applications of analog multipliers and PLLs.
- To construct different waveform generators and voltage regulators.

UNIT I	OPERATIONAL AMPLIFIER CHARACTERISTICS	9

Advantages of ICs over discrete components, Classification, Basic information about Op-amps – Ideal Op- amp Characteristics, Equivalent Circuit, Internal circuit diagrams of IC 741, Open and Closed loop configurations of IC 741, DC and AC performance characteristics and its compensation techniques, Slew Rate.

LIST OF EXPERIMENTS

Design and Testing of

1. Inverting, Non inverting amplifier, Differential amplifiers.

UNIT II	APPLICATIONS OF OPERATIONAL AMPLIFIERS	9

Linear Applications: Adder, Subtractor, Instrumentation Amplifier, Integrator, Differentiator, Non-linear Applications: Logarithmic Amplifier, Antilogarithmic Amplifier, Comparators, Schmitt trigger, Active Filters: First order and Higher order Low- Pass, High-Pass and Band-Pass Butterworth Filters.

LIST OF EXPERIMENTS

Design and Testing of

2. Integrator, Differentiator, Schmitt Trigger using Op-amp.
3. Instrumentation amplifier using Op-amp – PSPICE
4. Active low-pass, High-pass and band-pass filters - PSPICE

UNIT III	ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS	9

Analog and Digital Data Conversions, D/A converter – specifications - weighted resistor type, R- 2R Ladder type, Voltage Mode and Current Mode R-2R Ladder types -A/D Converters – specifications - Flash type - Successive Approximation type - Single Slope and Dual Slope.

LIST OF EXPERIMENTS

Design and Testing of

5. R-2R Ladder Type D-A Converter using Op-amp – PSPICE

UNIT IV	ANALOG MULTIPLIER AND PLL	9

Analog Multiplier ICs and their applications, PLL: Operation of the basic PLL, closed loop analysis, Voltage Controlled Oscillator IC 566, Monolithic PLL IC 565, application of PLL:FM Demodulator, FSK Demodulator, Frequency synthesizing and clock synchronization.

LIST OF EXPERIMENTS

Design and Testing of

6. PLL Characteristics IC565.
7. Frequency Synthesizer using IC 565.

UNIT V	**WAVEFORM GENERATORS AND VOLTAGE REGULATORS**	**9**

Waveform generators: Sine-wave generators – RC phase shift and Wien Bridge Oscillator- Triangular wave generator, IC 555 Timer and its modes of operation, Fixed voltage regulator– LM317 Adjustable voltage regulator- IC723 general purpose regulator

LIST OF EXPERIMENTS

Design and Testing of

8. Phase shift and Wien bridge oscillators using Op-amp.
9. Voltage regulator-IC723
10. Astable and Monostable multivibrators using NE555 Timer - PSPICE

TOTAL: 45 PERIODS(THEORY) +30 PERIODS (LAB) = 75 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Express the AC and DC characteristics of Op-amp with its compensation techniques.

CO2: Elucidate the functions of Op-amp in linear and nonlinear applications.

CO3: Classify and comprehend the working principle of data converters.

CO4: Illustrate the function of application specific ICs such as, Analog Multiplier, PLL, and its applications.

CO5: Comprehend the effect of voltage regulators in power supply.

CO6: Design and evaluate various waveform generator circuits using Op-amp.

TEXT BOOKS:

1.D.Roy Choudhry, Shail B Jain, Linear Integrated Circuits, 5th Edition, New Age International Pvt. Ltd., 2020.

2. Sergio Franco, Design with Operational Amplifiers and Analog Integrated Circuits,4th Edition, TMH, 2016.

REFERENCES:

1. Ramakant A. Gayakwad, Op-amp and Linear ICs, 4th Edition, Prentice Hall /Pearson Education,2015.
2. Robert F.Coughlin, Frederick F.Driscoll, Operational Amplifiers and LinearIntegrated Circuits, 6th Edition, PHI, 2015.
3. Gray and Meyer, Analysis and Design of Analog Integrated Circuits, 5th Edition,Wiley International, 2009.
4. William D.Stanley, Operational Amplifiers with Linear Integrated Circuits, 4th Edition, Pearson Education, 2004.
5. Salivahanan S and Kanchana Bhaaskaran V S, Linear Integrated Circuits, 3rdEdition, McGraw Hill Education, 2018.

NPTEL LINKS:

https://nptel.ac.in/courses/108/108/108108111/

LIST OF EQUIPMENT:

Requirements for a batch of 30 students

Sl. No.	Equipment	Quantity
1	CRO/DSO (Min 30MHz)	1
2	Signal Generator /Function Generators (3 MHz)	1
3	Dual Regulated Power Supplies (0 – 30V)	1
4	Digital Multimeter	1
5	IC Tester	5
6	Standalone desktops PC with SPICE	1
7	Components and Accessories	5

Components and Accessories:
Transistors, Resistors, Capacitors, Diodes, Bread Boards and wires,
Note: Op-Amps uA741, LM723, LM317, LM 555, LM 565, LM 566 may be used.

COURSE CODE	COURSE TITLE	L	T	P	C
22EC403	ANALOG AND DIGITAL COMMUNICATION (Theory course with laboratory component)	3	0	2	4

COURSE OBJECTIVES:

- To discuss the concepts of various AM modulation schemes and their spectral characteristics
- To describe the Generation and Detection of Frequency Modulation.
- To explain the performance of various Pulse coding Techniques.
- To learn principles of different pass band transmission schemes
- To calculate required parameters of Source and channel coding Techniques
- To visualize the effects of sampling and Digital Modulations Schemes

UNIT I	AMPLITUDE MODULATION	9

Need for Modulation, Amplitude modulation – frequency spectrum of AM– Power and current in AM wave – Generation of AM signal –Collector Modulator, AM demodulation - Envelope, DSB-SC, SSB-SC & VSB generation and demodulation modulation, Synchronous detection, Comparison of AM modulation systems.

LIST OF EXPERIMENTS

1. AM Modulator and Demodulator

UNIT II	ANGLE MODULATION	9

Relation between FM and PM waves — Narrow band and wide band FM, Direct and Indirect Methods of FM Generation - FM detectors- PLL Demodulators. Pre- emphasis and De-emphasis, Comparison of AM and FM. Super-heterodyne receiver (AM and FM)

LIST OF EXPERIMENTS

2. FM Modulator and Demodulator.

UNIT III	PULSE MODULATION SYSTEMS	9

Block Diagram of digital communication system, Sampling – Quantization – Uniform & non uniform quantization. –Pulse Code Modulation (PCM), Differential pulse code modulation-Delta modulation and Adaptive Delta Modulation.

LIST OF EXPERIMENTS

3. Signal Sampling and reconstruction
4. Pulse Code Modulation and Demodulation
5. Delta Modulation and Demodulation

UNIT IV	DIGITAL MODULATION TECHNIQUES	9

Geometric Representation of signals - Generation and detection of coherent systems -BASK, BFSK, BPSK, QAM, and Comparison of all digital Modulation Techniques.

LIST OF EXPERIMENTS

6. Simulation of ASK, FSK, and BPSK generation schemes
7. Simulation of ASK, FSK and BPSK detection schemes
8. Simulation of QPSK and QAM generation schemes
9. Simulation of signal constellations of BPSK, QPSK and QAM

UNIT V	**SOURCE AND CHANNEL CODING**	**9**

Definition of - Discrete Memoryless source, Information, Entropy, Channel Capacity -Hartley law, Shannon law, Source coding theorem -Shannon Fano & Huffman codes. Channel coding theorem - Linear Block codes.

LIST OF EXPERIMENTS

10. Simulation of Linear Block

TOTAL: 45 PERIODS(THEORY) +30 PERIODS (LAB)=75 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Compare the Spectral efficiency of various Amplitude Modulation Schemes.

CO2: Summarize the concepts of Generation and Detection of Frequency Modulation

CO3: Demonstrate the performance of various Pulse coding Techniques.

CO4: Differentiate the different pass band transmission schemes

CO5: Construct different Source and Error control codes

CO6: Implement different Digital modulation schemes and coding techniques

TEXT BOOKS:

1. Wayne Tomasi, Advanced Electronic Communications Systems, 6th Edition, Pearson New International Edition, Noida, India, 2014.
2. Simon Haykin, Communication Systems,5th Edition, Wiley, 2021.

REFERENCES:

1. Sanjay Sharma, Communication Systems (Analog and digital), 7th Edition, S.K. Kataria & Sons, 2022.
2. Roddy and Coolen, Electronic Communication, 4th Edition, Pearson Education, Noida, India, 2014.
3. Herbert Taub and Donald Schilling, Principles of Communication Systems, 4th Edition, McGraw Hill, 2017.
4. HweiKsu and Debjani Mitra, Analog and Digital Communication: Schaum's Outline Series, 3rd Edition, McGraw Hill Education, New Delhi, India., 2017.

NPTEL LINKS:

https://nptel.ac.in/courses/108104091
https://nptel.ac.in/courses/108104098

LIST OF EQUIPMENT:

Requirements for a batch of 30 students

Sl. No.	Equipment	Quantity
1	Kits for Signal Sampling, AM, FM, PCM,DM	02
2	CROs/DSO	15
3	Function Generators	15
4	MATLAB or equivalent software package for simulation experiments	15
5	Personal Computers	15

Note: 2 Students per experiment

COURSE CODE	COURSE TITLE	L	T	P	C
22GE301	UNIVERSAL HUMAN VALUES 2: UNDERSTANDING HARMONY	3	0	0	3

COURSE OBJECTIVES:

- Development of a holistic perspective based on self-exploration about themselves (human beings), family, society and nature/existence.
- Understanding (or developing clarity) of the harmony in the human being, family, society, and nature/existence.
- Strengthening of self-reflection.
- Development of commitment and courage to act.

UNIT I	COURSE INTRODUCTION - NEED, BASIC GUIDELINES, CONTENT AND PROCESS FOR VALUE EDUCATION	12

Purpose and motivation for the course, recapitulation from Universal Human Values-I- Self-Exploration–Its content and process-Natural Acceptance and Experiential Validation-as the process for self-exploration - Continuous Happiness and Prosperity-A look at basic Human Aspirations. Right understanding, Relationship and Physical Facility-The basic requirements for fulfillment of aspirations of every human being with correct priority- Understanding Happiness and Prosperity correctly-A critical appraisal of the current scenario. Methods to fulfill the human aspirations: Understanding and living in harmony at various levels.

Practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

UNIT II	UNDERSTANDING HARMONY IN THE HUMAN BEING – HARMONY IN MYSELF!	12

Understanding human beings as a co-existence of the sentient ‘I’ and the material ‘Body’ - Understanding the needs of Self (‘I’) and ‘Body’ - happiness and physical facility -Understanding the Body as an instrument of ‘I’ (I being the doer, seer and enjoyer) - Understanding the characteristics and activities of ‘I’ and harmony in ‘I’ - ‘Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, the meaning of Prosperity in detail - Programs to ensure Sanyam and Health.

Practice sessions: To discuss the role others have played in making material goods available to me. Identifying from one’s own life. Differentiate between prosperity and accumulation. Discuss programs for ensuring health vs dealing with the disease.

UNIT III	UNDERSTANDING HARMONY IN THE FAMILY AND SOCIETY- HARMONY IN HUMAN-HUMAN	12

Understanding values in a human-human relationship - the meaning of Justice (nine universal values in relationships) and the program for its fulfillment to ensure mutual happiness - Trust and Respect as the foundational values of relationship - Understanding the meaning of Trust; Difference between intention and competence - Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in a relationship - Understanding the harmony in the society (society being an extension of the family) - Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals - Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Practice sessions: To reflect on relationships in family, hostel and institute as extended family, real-life examples, teacher-student relationship, the goal of education etc. Gratitude as a universal value in relationships. Discuss scenarios. Elicit examples from students' lives.

UNIT IV	**UNDERSTANDING HARMONY IN NATURE AND EXISTENCE - WHOLE EXISTENCE AS COEXISTENCE**	**12**

Understanding the harmony in Nature - Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature - Understanding Existence as the Co-existence of mutually interacting units in all-pervasive Space - Holistic perception of harmony at all levels of existence.

Practice sessions: To discuss human beings as the cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

UNIT V	**IMPLICATIONS OF THE ABOVE HOLISTIC UNDERSTANDING OF HARMONY IN PROFESSIONAL ETHICS**	**12**

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

Practice Sessions / Exercises: Case Studies To discuss the conduct as an engineer or scientist etc.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of this course, the students:

CO1: Would become more aware of themselves, and their surroundings (family, society, nature).

CO2: Would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.

CO3: Would have better critical ability.

CO4: Would become sensitive to their commitment towards what they have understood (human values, human relationship, and human society).

CO5: Would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

TEXT BOOKS:

1. R R Gaur, R Sangal, G P Bagaria, Human Values and Professional Ethics, Excel Books, New Delhi, Second Edition 2019.

REFERENCES:

1. Nagaraj A, Jeevan Vidya: Ek Parichaya Jeevan Vidya Prakashan, Amarkantak, 1999.
2. E.F Schumacher, Small is Beautiful, Vintage classics, London, 1993.
3. A. N. Tripathi, Human Values, New Age Intl. Publishers, New Delhi, Third Edition 2020.
4. Maulana Abdul Kalam Azad, India Wins Freedom, Oriental blackswan private limited, Hyderabad, 2020
5. Mahatma Gandhi, Hind Swaraj or Indian Home Rule, Maheswari Publications, Delhi 2020.
6. Romain Rolland, The life of Vivekananda and the universal gospel, Publication house of Ramakrishna Math, Kolkata, Thirty second edition 2018.
7. Romain Rolland, Mahatma Gandhi: The man who become one with the universal being, Srishti Publishers & Distributors, New Delhi, Sixth Edition 2013.
8. Dennis P Heaton, The story of stuff. (2010): 553-556.
9. Mohandas Karamchand Gandhi, The story of my experiments with truth: An auto biography Om Books International, 2018.
10. Cecile Andrews, Slow is beautiful: new visions of community, leisure, and joie de vivre, New society publishers, 2006.
11. Joseph Cornelius Kumarappa, The economy of permanence. CP, All India Village Industries Assn., 1946.

COURSE CODE	COURSE TITLE	L	T	P	C
22CS411	APTITUDE AND CODING SKILLS – II	0	0	2	1

COURSE OBJECTIVES:

- To develop advanced vocabulary for effective communication and reading skills.
- To build an enhanced level of logical reasoning and quantitative skills.
- To develop error correction and debugging skills in programming.
- To apply data structures and algorithms in problem solving.

List of Exercises:

1. **English – Phase II**
   Vocabulary: Synonyms, Antonyms, Grammar: Subject-Verb Agreement, Tenses and Articles, Prepositions and Conjunctions, Speech and Voices, Comprehension: Inferential and Literal Comprehension, Contextual Vocabulary, Comprehension ordering
2. **Logical Reasoning – Phase II**
   Deductive Reasoning: Coding deductive logic, Directional sense, Blood relations, Objective Reasoning, Selection decision tables, Puzzles, Inductive reasoning: Coding pattern and Number series pattern recognition, Analogy and Classification pattern recognition, Abductive Reasoning: Logical word sequence, Data sufficiency
3. **Quantitative Ability - Phase II**
   Basic Mathematics: Divisibility, HCF and LCM, Numbers, decimal fractions and power, Applied Mathematics: Profit and Loss, Simple and Compound Interest, Time, Speed and Distance, Engineering Mathematics: Logarithms, Permutation and Combinations, Probability
4. **Automata Fix – Phase II**
   Logical, Compilation and Code reuse
5. **Automata - Phase II**
   Data Structure Concepts: Array and Matrices, Linked list, String processing and manipulation, Stack/Queue, Sorting and Searching

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1: Develop advanced vocabulary for effective communication and reading skills.

CO2: Build an enhanced level of logical reasoning and quantitative skills.

CO3: Develop error correction and debugging skills in programming.

CO4: Apply data structures and algorithms in problem solving.

COURSE CODE	COURSE TITLE	L	T	P	C
22EC411	PRODUCT DEVELOPMENT LAB-4	0	0	2	1

COURSE OBJECTIVES:

- Develop comprehensive report on the engineering facts applied to a specific problem.
- Analyze the real time problems during project/product development in engineering perspective.
- Evaluate the effectiveness of the product or a system through the knowledge acquired.
- Synthesize the business opportunities for a new product with novel design.

LIST OF EXPERIMENTS

1. Develop a prototype.
2. Demonstration of the project/product and submission of report.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1: Understand and explain the real time problems through literatures.

CO2: Analyze the methods to develop solution to the systems.

CO3: Classify, compare and analyze business opportunities for a new product.

CO4: Summarize and prepare reports for the experimental determinations.

CO5**:** Evaluate the performance and effectiveness of the existing problems.

CO6: Develop life-long learning skills for a productive career.

LIST OF EQUIPMENT:

S.NO	EQUIPMENT NAME	QUANTITY
1.	CNC Router	1
2.	3D Printer	1
3.	3D Scanner	1
4.	Laser Cutting Machine	1
5.	Centre lathe	2
6.	Arc Welding transformer with cables and holders	2
7.	Plumbing tools	2 Sets
8.	Carpentry Tools	2 Sets

9.	Multimeter	10
10.	Drilling Machine	1
11.	Solder Stations	5 Sets
12.	Desoldering Machine	1
13.	PCB Milling Machine	1
14.	Variable Power Supply	1
15.	Electronic Components like Resistors, Transistors, Diode, Inductor, Capacitors, IC etc.,	10 Sets
16.	Personal Desktop Computers	30

SEMESTER-V

COURSE CODE	COURSE TITLE	L	T	P	C
22IT201	DATABASE MANAGEMENT SYSTEM (Theory Course with Laboratory Component)	3	0	2	4

COURSEOBJECTIVES:

- To understand the basic concepts of Data modeling and Database Systems.
- To understand SQL and effective relational database design concepts.
- To learn relational algebra, calculus and normalization.
- To know the fundamental concepts of transaction processing, concurrency control techniques, recovery procedure and data storage techniques.
- To understand query processing, efficient data querying and advanced databases

UNIT I	DATABASE CONCEPTS	15

Concept of Database and Overview of DBMS - Characteristics of databases – Data Models, Schemas and Instances - Three-Schema Architecture - Database Languages and Interfaces - Introductions to data models types - ER Model- ER Diagrams - Enhanced ER Model - reducing ER to table Applications: ER model of University Database Application – Relational Database Design by ER- and EER-to-Relational Mapping.

List of Exercise/Experiments:

1. Data Definition Commands, Data Manipulation Commands for inserting, deleting, updating and retrieving Tables and Transaction Control statements

UNIT II	STRUCTURED QUERY LANGUAGE	15

SQL Data Definition and Data Types – Constraints – Queries – INSERT, UPDATE, and DELETE in SQL - Views - Integrity Procedures, Functions, Cursor and Triggers - Embedded SQL - Dynamic SQL.

List of Exercise/Experiments:

1. Database Querying – Simple queries, Nested queries, Sub queries and Joins
2. Views, Sequences, Synonyms
3. Database Programming: Implicit and Explicit Cursors

UNIT III	RELATIONAL ALGEBRA, CALCULUS AND NORMALIZATION	15

Relational Algebra – Operations - Domain Relational Calculus- Tuple Relational Calculus - Fundamental operations. Relational Database Design - Functional Dependency – Normalization (1NF, 2NF 3NF and BCNF) – Multivalued Dependency and 4NF – Joint Dependencies and 5NF - Denormalization.

List of Exercise/Experiments:

1. Procedures and Functions
2. Triggers

UNIT IV	TRANSACTIONS, CONCURRENCY CONTROL AND DATA STORAGE	15

Transaction Concepts – ACID Properties – Schedules based on Recoverability, Serializability – Concurrency Control – Need for Concurrency – Locking Protocols – Two Phase Locking – Transaction Recovery – Concepts – Deferred Update – Immediate Update. Organization of Records in Files – Unordered, Ordered – Hashing Techniques – RAID – Ordered Indexes – Multilevel Indexes - B+ tree Index Files – B tree Index Files.

List of Exercise/Experiments:

1. Exception Handling
2. Database Design using ER modeling, normalization and Implementation for any Application
3. Database Connectivity with Front End Tools

UNIT V	QUERY OPTIMIZATION AND ADVANCED DATABASES	15

Query Processing Overview – Algorithms for SELECT and JOIN operations – Query optimization using Heuristics. Distributed Database Concepts – Design – Concurrency Control and Recovery – NOSQL Systems – Document-Based NOSQL Systems and MongoDB.

List of Exercise/Experiments:

1. Case Study using real life database applications anyone from the following list
   a) Inventory Management for a EMart Grocery Shop
   b) Society Financial Management
   c) Cop Friendly App – Eseva
   d) Property Management – eMall
   e) Star Small and Medium Banking and Finance
   ● Build Entity Model diagram. The diagram should align with the business and functional goals stated in the application.
   ● Apply Normalization rules in designing the tables in scope.
   ● Prepared applicable views, triggers (for auditing purposes), functions for enabling enterprise grade features.
   ● Build PL SQL / Stored Procedures for Complex Functionalities, ex EOD Batch Processing for calculating the EMI for Gold Loan for each eligible Customer.
   ● Ability to showcase ACID Properties with sample queries with appropriate settings

TOTAL: 75 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Map ER model to Relational model to perform database design effectively.

CO2: Implement SQL and effective relational database design concepts.

CO3: Apply relational algebra, calculus and normalization techniques in database design.

CO4: Understand the concepts of transaction processing, concurrency control, recovery procedure and data storage techniques.

CO5: Apply query optimization techniques and understand advanced databases.

TEXTBOOKS:

1. Elmasri R. and S. Navathe, “Fundamentals of Database Systems”, Pearson Education, 7th Edition, 2016.
2. Abraham Silberschatz, Henry F.Korth, “Database System Concepts”, Tata McGraw Hill , 7th Edition, 2021.

REFERENCES:

1. 1. Elmasri R. and S. Navathe, Database Systems: Models, Languages, Design and Application Programming, Pearson Education, 2013.
2. Raghu Ramakrishnan, Gehrke "Database Management Systems", MCGraw Hill, 3rd Edition 2014.
3. Plunkett T., B. Macdonald, "Oracle Big Data Hand Book" , McGraw Hill, First Edition, 2013
4. Gupta G K , "Database Management Systems" , Tata McGraw Hill Education Private Limited, New Delhi, 2011.
5. C. J. Date, A.Kannan, S. Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2015.
6. Maqsood Alam, Aalok Muley, Chaitanya Kadaru, Ashok Joshi, Oracle NoSQL Database: Real-Time Big Data Management for the Enterprise, McGraw Hill Professional, 2013.
7. Thomas Connolly, Carolyn Begg, "Database Systems: A Practical Approach to Design, Implementation and Management", Pearson, 6th Edition, 2015.
8. Database Management System Part – 1 https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_012758066672828.
9. Database Management System Part – 2 https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01276730056291
10. Online Resources: https://infyspringboard.onwingspan.com/web/en/page/home

LIST OF EQUIPMENT:

MySql and Eclipse / NetBeans IDE or Equivalent

22CS203	DATABASE MANAGEMENT SYSTEM (Common to CSE/ADS/CSE(CS))	L	T	P	C
		3	0	2	4

OBJECTIVES:

TheCoursewillenablelearnersto:

- To understand the basic concepts of Data modeling and Database Systems.
- To understand SQL and effective relational database design concepts.
- To learn relational algebra, calculus and normalization.
- To know the fundamental concepts of transaction processing, concurrency control techniques, recovery procedure and data storage techniques.
- To understand query processing, efficient data querying and advanced databases.

UNIT I	DATABASE CONCEPTS	15

Concept of Database and Overview of DBMS - Characteristics of databases - Data Models, Schemas and Instances - Three-Schema Architecture - Database Languages and Interfaces - Introductions to data models types - ER Model- ER Diagrams - Enhanced ER Model - reducing ER to table Applications: ER model of University Database Application – Relational Database Design by ER- and EER-to-Relational Mapping.

List of Exercise/Experiments:

1. Data Definition Commands, Data Manipulation Commands for inserting, deleting, updating and retrieving Tables and Transaction Control statements

UNIT II	STRUCTURED QUERY LANGUAGE	15

SQL Data Definition and Data Types – Constraints – Queries – INSERT, UPDATE, and DELETE in SQL - Views - Integrity Procedures, Functions, Cursor and Triggers - Embedded SQL - Dynamic SQL.

List of Exercise/Experiments:

1. Database Querying – Simple queries, Nested queries, Sub queries and Joins
2. Views, Sequences, Synonyms
3. Database Programming: Implicit and Explicit Cursors

UNIT III	RELATIONAL ALGEBRA, CALCULUS AND NORMALIZATION	15

Relational Algebra – Operations - Domain Relational Calculus- Tuple Relational Calculus - Fundamental operations.

Relational Database Design - Functional Dependency – Normalization (1NF, 2NF 3NF and BCNF) – Multivalued Dependency and 4NF – Joint Dependencies and 5NF - De-normalization.

List of Exercise/Experiments:

1. Procedures and Functions
2. Triggers

UNIT IV	TRANSACTIONS, CONCURRENCY CONTROL AND DATA STORAGE	15

Transaction Concepts – ACID Properties – Schedules based on Recoverability, Serializability – Concurrency Control – Need for Concurrency – Locking Protocols – Two Phase Locking – Transaction Recovery – Concepts – Deferred Update – Immediate Update.

Organization of Records in Files – Unordered, Ordered – Hashing Techniques – RAID – Ordered Indexes – Multilevel Indexes - B+ tree Index Files – B tree Index Files.

List of Exercise/Experiments:

1. Exception Handling
2. Database Design using ER modeling, normalization and Implementation for any application
3. Database Connectivity with Front End Tools

UNIT V	QUERY OPTIMIZATION AND ADVANCED DATABASES	15

Query Processing Overview – Algorithms for SELECT and JOIN operations – Query optimization using Heuristics.
Distributed Database Concepts – Design – Concurrency Control and Recovery – NOSQL Systems – Document-Based NOSQL Systems and MongoDB.

List of Exercise/Experiments:

1. Case Study using real life database applications anyone from the following list
a) Inventory Management for a EMart Grocery Shop
b) Society Financial Management
c) Cop Friendly App – Eseva
d) Property Management – eMall
e) Star Small and Medium Banking and Finance

● Build Entity Model diagram. The diagram should align with the business and functional goals stated in the application.
● Apply Normalization rules in designing the tables in scope.
● Prepared applicable views, triggers (for auditing purposes), functions for enabling enterprise grade features.
● Build PL SQL / Stored Procedures for Complex Functionalities, ex EOD Batch Processing for calculating the EMI for Gold Loan for each eligible Customer.
● Ability to showcase ACID Properties with sample queries with appropriate settings

TOTAL: 75 PERIODS

OUTCOMES:

Uponcompletionofthecourse, thestudentswill beable to:

CO1: Map ER model to Relational model to perform database design effectively.
CO2: Implement SQL and effective relational database design concepts.
CO3: Apply relational algebra, calculus and normalization techniques in database design.
CO4: Understand the concepts of transaction processing, concurrency control, recovery procedure and data storage techniques.
CO5: Apply query optimization techniques and understand advanced databases.

TEXTBOOKS:

1. Elmasri R. and S. Navathe, “Fundamentals of Database Systems”, Pearson Education, 7th Edition, 2016.
2. Abraham Silberschatz, Henry F.Korth, “Database System Concepts”, Tata McGraw Hill , 7th Edition, 2021.

REFERENCES:

1. Elmasri R. and S. Navathe, Database Systems: Models, Languages, Design and Application Programming, Pearson Education, 2013.Raghu Ramakrishnan, Gehrke "Database Management Systems", MCGraw Hill, 3rd Edition 2014.
2. Plunkett T., B. Macdonald, "Oracle Big Data Hand Book" , McGraw Hill, First Edition, 2013
3. Gupta G K , "Database Management Systems" , Tata McGraw Hill Education Private Limited, New Delhi, 2011.
4. C. J. Date, A.Kannan, S. Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2015.
5. MaqsoodAlam, AalokMuley, ChaitanyaKadaru, Ashok Joshi, Oracle NoSQL Database: Real-Time Big Data Management for the Enterprise, McGraw Hill Professional, 2013.
6. Thomas Connolly, Carolyn Begg, "Database Systems: A Practical Approach to Design, Implementation and Management", Pearson, 6th Edition, 2015.
7. Database Management System Part – 1
https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01275806667282022456_shared/overview
8. Database Management System Part – 2
https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01276730056291942241_shared/overview
9. Online Resources:
https://infyspringboard.onwingspan.com/web/en/page/home

LIST OF EQUIPMENTS:

1. MySql and Eclipse / NetBeans IDE or Equivalent

COURSE CODE	COURSE TITLE	L	T	P	C
22EC501	DIGITAL VLSI DESIGN (Theory Course with Laboratory Component)	3	0	2	4

COURSE OBJECTIVES:

- To study the fundamental principles of VLSI circuit design in digital domain
- To analyze the delay using various delay models
- To learn the design and realization of combinational digital circuits.
- To learn the design and realization of sequential digital circuits.
- To design the arithmetic building blocks and subsystems.

UNIT I	INTRODUCTION TO MOS TRANSISTOR	15

MOS Transistor, CMOS logic, Inverter, Long-Channel I-V Characteristics, C-V Characteristics, Non ideal I-V Effects, DC Transfer characteristics, Scaling, CMOS Power Dissipation.

LIST OF EXPERIMENTS

1. Design of Inverter using LT-SPICE
2. Design of NOR and NAND gates

UNIT II	STICK, LAYOUT DIAGRAMS AND DELAY MODEL	15

Layout Design Rules, Gate Layouts, Stick Diagrams, RC Delay Model, Elmore Delay, Linear Delay Model, Logical effort, Parasitic Delay, Delay in Logic Gate.

LIST OF EXPERIMENTS

3. Layout verification of CMOS Inverter
4. Layout verification of CMOS NOR and NAND gates

UNIT III	COMBINATIONAL MOS LOGIC CIRCUITS	15

Circuit Families: Static CMOS, Ratioed Circuits, Cascade Voltage Switch Logic, Dynamic Circuits, Pass Transistor Logic, Transmission Gates, Domino, Dual Rail Domino, CPL, DCVSPG, DPL, Design of combinational circuits using Verilog.

LISTOFEXPERIMENTS

5. Design of Adder and subtractor
6. Design of Multiplexer and demultiplexer

UNIT IV	SEQUENTIAL CIRCUIT DESIGN	15

Static latches and Registers, Dynamic latches and Registers, Pulse Registers, Pipelining, Schmitt Trigger, Monostable Sequential Circuits, Astable Sequential Circuits. Timing Issues: Timing Classification of Digital System, Synchronous Design, Design of sequential circuits using Verilog.

LIST OF EXPERIMENTS

7. Design of counter and shift registers using Flipflops
8. Design of Mealy and Moore State Machines

UNIT V	DESIGN OF ARITHMETIC BUILDING BLOCKS AND SUBSYSTEM	15

Arithmetic Building Blocks: Data Paths, Adders, Multipliers, Shifters, ALUs, power and speed tradeoffs, Designing Memory and Array structures: Memory Architectures and Building Blocks, Memory Core, Memory Peripheral Circuitry.

LIST OF EXPERIMENTS

9. Design of Arithmetic Logic Unit
10. Design of Adders

TOTAL: 45 PERIODS (THEORY) + 30 PERIODS (LAB) = 75 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Understand the fundamental principles of VLSI circuit design in digital domain

CO2: Analyze the delay of MOS transistors using various delay models.

CO3: Realize the combinational circuits using different logic families

CO4: Understand the memory design in sequential logic circuits

CO5: Analyze the architectural choice and performance tradeoff involved in data path unit design.

CO6: Design, simulate to verify the functionality of logic modules using EDA tools and familiarize fusing of logical modules on FPGAs.

TEXTBOOKS:

1. Neil H.E. Weste, David Money Harris CMOS VLSI Design: A Circuits and Systems Perspective, 4th Edition, Pearson, 2017.
2. Jan M. Rabaey, Anantha Chandrakasan, Borivoje. Nikolic, Digital Integrated Circuits: A Design perspective, 2nd Edition, Pearson, 2016.

REFERENCES:

1. M.J.Smith, Application Specific Integrated Circuits, Addisson Wesley, 1997.
2. Sung-Mokang, Yusufleblebici, ChulwooKim — CMOS Digital Integrated Circuits: Analysis & Design, 4th Edition Mc Graw Hill Education, 2013.
3. Wayne Wolf, Modern VLSI Design: System On Chip, Pearson Education, 2007.
4. John Fwalkerly, Digital Design Principles and Practices, 3rd Edition., PHI/Pearson Education, 2005.
5. Samir Palnitkar,Verilog HDL:A Guide to Digital Design and Synthesis, Prentice Hall PTR, 2nd Edition, 2003

NPTEL LINK:

https://onlinecourses.nptel.ac.in/*noc21*_ee09/preview

LIST OF EQUIPMENT:		
Requirements for a batch of 30 students		
Sl.No.	**Equipment**	**Quantity**
1	Xilinx ISE /Altera Quartus / equivalent EDA Tools	10
2	Xilinx/Altera/equivalent FPGA Boards	10
3	Cadence/Synopsis/Mentor Graphics/Tanner/equivalent EDA Tools	10
4	Personal Computer	30

COURSE CODE	COURSE TITLE	L	T	P	C
22EC502	MICROCONTROLLER AND INTERFACING (Theory Course with Laboratory Component)	3	0	2	4

COURSEOBJECTIVES:

- To examine the architecture and functionality of 8085 and 8086 Microprocessor
- To explore memory organization and various addressing modes of the 8051 Microcontroller
- To develop proficiency in assembly language programming for the 8051Microcontroller
- To design and develop the typical applications of microcontrollers
- To understand the architecture of PIC Microcontroller

UNIT I	FUNDAMENTALS OF MICROPROCESSOR	15

8085 Microprocessor Architecture – Pin Diagram – 8086 Microprocessor Architecture – Pin Diagram- Compare Microprocessor and Microcontroller

LIST OF EXPERIMENTS

1. Arithmetic and Logical Operations using 8085
2. Arithmetic and Logical Operations using 8086

UNIT II	INTRODUCTIONT OF 8051 MICROCONTROLLER	15

Overview of 8051 Microcontroller – Architecture – Special Function Registers (SFRs) -I/O Ports – Memory Organization -Addressing Modes and Instruction set of 8051

LIST OF EXPERIMENTS

3. One's and two's complement of a number using8051
4. Block data transfer using8051

UNIT III	8051 PROGRAMMING IN ASSEMBLY LANGUAGE	15

Arithmetic operations – Logical operations - Branching, bit level instructions and programs - I/O Port Programs -Interrupts, Serial Communication, Timers and Counters Programming

LIST OF EXPERIMENTS

5. Arithmetic and Logical Operations using 8051
6. Timer/Counter Interface using 8051

UNIT IV	PERIPHERAL INTERFACING WITH 8051	15

Memory Interfacing - 7-Segment LED Display – LCD and Keyboard Interfacing - ADC and DAC interfacing –Stepper Motor Interfacing

LIST OF EXPERIMENTS

7. 7-Segment LED display using 8051
8. Stepper Motor Interfacing using 8051

UNIT V	INTRODUCTION TO ADVANCED MICROCONTROLLER	15

PIC Microcontroller Architecture – memory organization – addressing modes – instruction set – Basic arithmetic and logical operations in assembly language using PIC Microcontroller

LIST OF EXPERIMENTS

9. Arithmetic operations using PIC Microcontroller
10. Logical operations using PIC Microcontroller

TOTAL: 75 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Acquire knowledge on the architecture of 8085 and 8086 Microprocessor.
CO2: Analyze the architecture, addressing modes and instruction set of 8051 Microcontroller.
CO3: Evaluate the program of 8051 in assembly language for the given operations.
CO4: Interpret the program by using timer, interrupt and serial ports/parallel ports.
CO5: Interface the memory and I/O devices to 8051 Microcontroller.
CO6: Explore the architecture of PIC Microcontroller.

TEXTBOOKS:

1. Krishna Kant, "Microprocessors & Microcontrollers", Prentice Hall of India, 2014.
2. Muhammad Ali Mazidi, Rolin D.Mckinlay, Danny Causey 'PIC Microcontroller and Embedded Systems using Assembly and C for PIC18', Pearson Education2008.

REFERENCES:

1. Ramesh S. Gaonkar, 'Microprocessor Architecture Programming and Application', Penram International (P) ltd., Mumbai, 6th Education, 2013.
2. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, 'The 8051Microcontroller and Embedded Systems: Using Assembly and C, 2nd Edition, Pearson Education, 2011.
3. Scott Mac Kenzie, Raphael Chung-Wei Phan, 'The 8051 Microcontroller', 4th Edition, Pearson Education, 2008.

NPTELLINK:

https://archive.nptel.ac.in/courses/117/104/117104072/

COURSE CODE	COURSE TITLE	L	T	P	C
22EC503	COMPUTER NETWORKS	3	0	0	3

COURSE OBJECTIVES:

- To study the fundamental concepts of computer networks and physical layer.
- To gain the knowledge of various protocols and techniques used in the data linklayer.
- To learn the services of network layer and network layer protocols.
- To describe different protocols used in the transport layer.
- To understand the application layer protocols

UNIT I	INTRODUCTION AND PHYSICAL LAYER	9

Data Communications – Network Types – Protocol Layering – Network Models (OSI, TCP/IP) Networking Devices: Hubs, Bridges, Switches – Performance Metrics – Transmission media - Guided media -Unguided media- Switching-Circuit Switching - Packet Switching

UNIT II	DATA LINK LAYER	9

Introduction – Link-Layer Addressing- Error Detection and Correction - DLC Services – Data Link Layer Protocols – HDLC – PPP - Wired LANs: Ethernet - Wireless LANs – Introduction – IEEE 802.11, Bluetooth

UNIT III	NETWORK LAYER	9

Network Layer Services – Packet switching – Performance – IPV4 Addresses – Forwarding of IP Packets - Network Layer Protocols: IP, ICMP v4 – Unicast Routing Algorithms – Protocols – Multicasting Basics – IPV6 Addressing – IPV6 Protocol.

UNIT IV	TRANSPORT LAYER	9

Introduction – Transport Layer Protocols – Services – Port Numbers – User Datagram Protocol – Transmission Control Protocol – SCTP.

UNIT V	APPLICATION LAYER	9

Application layer-WWW and HTTP – FTP – Email –Telnet –SSH – DNS – SNMP

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1: Describe the fundamental concepts of computer networks.

CO2: Explain the basics of Transmission Media and Switching Techniques.

CO3: Demonstrate the various protocols and techniques used in the data link layer.

CO4: Learn the network layer services and network layer protocols.

CO5: Discuss the various protocols used in the transport layer.

CO6: Analyze the various application layer protocols.

TEXT BOOKS:

1.Data Communications and Networking, Behrouz A. Forouzan, McGraw Hill Education,5th Edition., 2017.

2. Computer Networks, Andrew S. Tanenbaum, Sixth Edition, Pearson, 2021.

REFERENCES:

1. Computer Networking- A Top-Down Approach, James F. Kurose, University of Massachusetts and Amherst Keith Ross, 8th Edition, 2021.
2. Data Communications and Computer Networks, P.C. Gupta, Prentice-Hall of India,2006.
3. Computer Networks: A Systems Approach, L. L. Peterson and B. S. Davie, Morgan Kaufmann, 3rd ed., 2003.

NPTEL LINK:

https://nptel.ac.in/courses/106105183

COURSE CODE	COURSE TITLE	L	T	P	C
22CS511	ADVANCED APTITUDE AND CODING SKILLS – I	0	0	2	1

COURSE OBJECTIVES:

- To develop vocabulary for effective communication and reading skills.
- To build the logical reasoning and quantitative skills.
- To develop error correction and debugging skills in programming.

LIST OF EXERCISES:

- **ENGLISH – PHASE II ADVANCED**
  Vocabulary: Synonyms, Antonyms, Grammar: Subject-Verb Agreement, Tenses and Articles, Prepositions and Conjunctions, Speech and Voices, Comprehension: Inferential and Literal Comprehension, Contextual Vocabulary, Comprehension ordering
- **LOGICAL REASONING – PHASE II ADVANCED**
  Deductive Reasoning: Coding deductive logic, Directional sense, Blood relations, Objective Reasoning, Selection decision tables, Puzzles, Inductive reasoning: Coding pattern and Number series pattern recognition, Analogy and Classification pattern recognition, Abductive Reasoning: Logical word sequence, Data sufficiency.
- **QUANTITATIVE ABILITY - PHASE II ADVANCED**
  Basic Mathematics: Divisibility, HCF and LCM, Numbers, decimal fractions and power, Applied Mathematics: Profit and Loss, Simple and Compound Interest, Time, Speed and Distance, Engineering Mathematics: Logarithms, Permutation and Combinations, Probability.
- **AUTOMATA – PHASE II ADVANCED**
  Logical, Compilation and Code reuse
- **AUTOMATA FIX – PHASE II ADVANCED**
  Data Structure Concepts: Array and Matrices, Linked list, String processing and manipulation, Stack/Queue, Sorting and Searching Advanced Design and Analysis Techniques: Greedy Algorithms, Minimum Spanning Trees, String Matching, Divide and Conquer, Computational Geometry

TOTAL:30 PERIODS

COURSE OUTCOMES:

CO1: Develop advanced vocabulary for effective communication and reading skills.

CO2: Build an enhanced level of logical reasoning and quantitative skills.

CO3: Develop error correction and debugging skills in programming.

CO4: Apply data structures and algorithms in problem solving.

SUGGESTED BOOKS AND RESOURCES:

1. https://prepinsta.com/home/
2. https://www.hackerrank.com/
3. https://www.indiabix.com/
4. "A Modern Approach to Verbal & Non-Verbal Reasoning" by R.S. Agarwal
5. "Quantitative Aptitude for Competitive Examinations" by RS Agarwal/ S Chand
6. "A Modern Approach to Logical Reasoning" by R.S. Agarwal
7. "The C Programming Language" by Brian Kernighan and Dennis Ritchie
8. "Java: A Beginner's Guide" by Herbert Schildt

COURSE CODE	COURSE TITLE	L	T	P	C
22EC511	INTERNSHIP	0	0	2	1

COURSE OBJECTIVES:

- To define, formulate and analyze real world problem in the field of Electronics and Communication.
- To acquire knowledge in terms of innovation and product design development process of the project.
- To interpret and associate the team members to work as a team efficiently.
- To create, an Industrial environment and culture within the institution.
- To develop a professional attitude towards appearance and behavior in the workplace, time management skills and the ability to prioritize assignments.

An internship is the form of experiential learning that integrates knowledge and theory learned in the classroom with practical application and skills development in a professional setting. The students can opt for internship in any industry/academic institute/R&D/PSU/Government or semi-government organizations. This caters students, the opportunity to gain valuable applied experience and explore networks in professional fields they are considering for career paths; and give employers the opportunity to guide and evaluate talent. This will not only help students in gaining professional know-how but also benefits, corporate on fresh perspectives on business issues and even discovering future business leaders.

TOTAL:30 PERIODS

COURSEOUTCOMES:

On successful completion of this course, the student will be able to

CO1: Solve the real time problems using hardware, software, Computational tools.

CO2: Integrate software and the assembled components in the designed PCB.

CO3: Summarize the knowledge inferred through technical report.

CO4: Communicate a practical understanding of how a business organization actually operates.

CO5: Exhibit the ability to effectively work in professional environment and demonstrate work ethic and commitment in a work-based environment.

CO6: Reflect on personal and professional development needs and set strategic goals for advancing along an intended career path.

COURSE CODE	COURSE TITLE	L	T	P	C
22MC501	INDIAN CONSTITUTION	1	0	0	0

COURSE OBJECTIVES:

- Teach history and philosophy of Indian Constitution.
- Describe the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- Summarize powers and functions of Indian government.
- Explain emergency rule.
- Explain structure and functions of local administration.

UNIT I	INTRODUCTION	3

History of Making of the Indian Constitution-Drafting Committee- (Composition & Working) - Philosophy of the Indian Constitution-Preamble-Salient Features

UNIT II	CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES	3

Fundamental Rights-Right to Equality-Right to Freedom-Right against Exploitation Right to Freedom of Religion-Cultural and Educational Rights-Right to Constitutional Remedies Directive Principles of State Policy-Fundamental Duties

UNIT III	ORGANS OF GOVERNANCE	3

Parliament-Composition-Qualifications and Disqualifications-Powers and Functions-Executive President-Governor-Council of Ministers-Judiciary, Appointment and Transfer of Judges, Qualifications Powers and Functions.

UNIT IV	EMERGENCY PROVISIONS	3

Emergency Provisions - National Emergency, President Rule, Financial Emergency

UNIT V	LOCAL ADMINISTRATION	3

District's Administration head- Role and Importance-Municipalities- Introduction- Mayor and role of Elected Representative-CEO of Municipal Corporation-Pachayati raj- Introduction- PRI- Zila. Panchayat - Elected officials and their roles- CEO Zila Pachayat- Position and role-Block level Organizational Hierarchy (Different departments)-Village level- Role of Elected and Appointed officials-Importance of grass root democracy.

TOTAL: 15 PERIODS

COURSE OUTCOMES:

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

CO1: Able to understand history and philosophy of Indian Constitution.

CO2: Able to understand the premises informing the twin themes of liberty and freedom

from a civil rights perspective.

CO3: Able to understand powers and functions of Indian government.

CO4: Able to understand emergency rule

CO5: Able to understand structure and functions of local administration.

TEXT BOOKS:

1. Basu D D, Introduction to the Constitution of India, Lexis Nexis, 2015.

2. Busi S N, Ambedkar B R framing of Indian Constitution, 1st Edition, 2015.

REFERENCES:

1. Jain M P, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
2. The Constitution of India (Bare Act), Government Publication,1950
3. Durga Das Basu, "Introduction to the Constitution of India ", Prentice Hall of India, New Delhi..
4. R.C.Agarwal, (1997) "Indian Political System", S.Chand and Company, New Delhi.
5. Sharma, Brij Kishore, "Introduction to the Constitution of India", Prentice Hall of India, New Delhi

NPTEL LINK:

https://onlinecourses.nptel.ac.in/noc20_lw03/preview

SEMESTER - VI

COURSE CODE	COURSE TITLE	L	T	P	C
22EC601	DIGITAL SIGNAL PROCESSING (Theory Course with Laboratory Component)	3	0	2	4

COURSE OBJECTIVES:

- To describe signals mathematically and understand how to perform mathematical operations on signals.
- To learn discrete Fourier transform, properties of DFT and its application in linear filtering.
- To understand the characteristics of digital filters, design digital IIR and FIR filters and apply these filters to sieve undesirable signals in various frequency bands.
- To understand the effects of finite precision representation on digital filters
- To understand the fundamental concepts of multi-rate signal processing and its applications.

UNIT I	DISCRETE FOURIER TRANSFORM	15

DFT and its properties - Periodicity, Symmetry and Circular Convolution, – FFT algorithms – Radix-2 FFT algorithms – Decimation in Time – Decimation in Frequency algorithms – Overlap - add & overlap-save methods.

EXPERIMENTS

1. To compute N point DFT in Direct computation and by using radix-2 FFT for the given sequence using MATLAB
2. To perform Linear and Circular Convolution using MATLAB

UNIT II	IIR FILTER DESIGN	15

Analog filters - Butterworth filters, Chebyshev Type I filters (upto 3rd order), Transformation of analog filters into equivalent digital filters using Impulse invariant method and Bilinear transformation method-Realization structures for IIR filters - direct, cascade, parallel forms.

EXPERIMENTS

3. Design of Digital Butterworth IIR filters for the given specification.
4. Design of Digital Chebyshev IIR filters for the given specification.

UNIT III	FIR FILTER DESIGN	15

Design of linear phase FIR filters using Fourier series, Windowing and Frequency sampling methods – Rectangular, Hamming and Hanning Realization structures for FIR filters – Transversal and Linear phase structures- Comparison of FIR & IIR filters.

EXPERIMENTS

5. Design of Digital Low Pass/High Pass FIR filter using windows
6. Design of Digital BPF/BSF Pass FIR filter using windows

UNIT IV	FINITE WORD LENGTH EFFECTS	15

Fixed point and floating point number representation - ADC - quantization - truncation and rounding - quantization noise - input / output quantization - coefficient quantization error - product quantization

error - overflow error - limit cycle oscillations due to product quantization and summation – Signal scaling to prevent overflow.

EXPERIMENTS

7. Quantization of Discrete analog signals by Truncation.

8. Quantization of Discrete analog signals by Rounding.

UNIT V	**APPLICATIONS OF DSP**	**15**

Multi-rate digital signal processing: Decimators, interpolators, Sample-rate convertors. Speech Processing – Vocoder: Sub Band Coding.

EXPERIMENTS

9. Perform the down-sampling of the given signal. Plot the original and down sampled sequence.

10. Perform the up-sampling of the given signal. Plot the original and up sampled sequence.

TOTAL: 75 PERIODS

COURSE OUTCOMES:

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

CO1: Analyze computation of DFT using Direct computation & FFT Algorithm.

CO2: Design IIR filter for the given specification.

CO3: Implement the FIR filter in DSP Systems.

CO4: Organize the errors occurred due to finite word length effects in digital filters.

CO5: Experiment the Multi-rate DSP.

CO6: Summarize the applications of DSP in Speech Signal

TEXT BOOKS:

1. John G. Proakis, Dimitris G. Manolakis, Digital signal processing -principles, algorithms and applications, Pearson Education, Fourth Edition, 2013.
2. A.V.Oppenheim, R.W. Schafer and J.R. Buck, Discrete Time Signal Processing , Pearson, Eighth Indian Reprint, 2004.

REFERENCES:

1. I.C.Ifeachor and B.W. Jervis, Digital Signal Processing A Practical Approach, Pearson, Wiley & sons, Singapore, 2002.
2. M.H.Hayes, Digital Signal Processing, Schaum's outlines, Tata McGraw Hill, 2007.
3. NagoorKani, Digital Signal Processing , McGraw Hill Education, Second Edition, 2017
4. Salivahanan S, Digital Signal Processing, McGraw Hill Education, Fourth Edition, 2019.
5. P.P.Vaidyanathan, Multirate Systems & Filter Banks, Prentice Hall, Englewood cliffs, NJ, 2008.

NPTEL LINK:

https://nptel.ac.in/courses/117/102/117102060/

COURSE CODE	COURSE TITLE	L	T	P	C
22EC602	EMBEDDED SYSTEMS & IOT DESIGN (Theory Course with Laboratory Component)	3	0	2	4

COURSE OBJECTIVES:

- To understand the basics of Embedded Systems and its design process.
- To learn the architecture and programming of ARM Processor.
- To be exposed to the basic concepts of real time operating system and scheduling.
- To understand the fundamental concepts of IoT and its protocols.
- To implement projects based on case studies using Embedded systems and IoT.

UNIT I INTRODUCTION TO EMBEDDED SYSTEMS 15

Complex Systems and Microprocessors –Embedded system design process –Formalisms for System Design - Design example: Model train controller- Design methodologies- Design flows- Designing with computing platforms.

LIST OF EXPERIMENTS

1. Study of ARM Evaluation system.
2. Interface 8 LEDs using ARM Microcontroller.

UNIT II ARM PROCESSOR AND PERIPHERALS 15

ARM Architecture Versions – ARM 7 Architecture – Instruction Set –Features of the LPC 214X Family – Peripherals and Programing – The Timer Unit – Pulse Width Modulation Unit – UART - Block Diagram of ARM Cortex M3 MCU.

LIST OF EXPERIMENTS

3. Interface Pulse width modulation using ARM Microcontroller.
4. Implementing interrupt in ARM processor

UNIT III REAL TIME OPERATING SYSTEM (RTOS) AND NETWORKS 15

Introduction – Multiple tasks and multiple processes – Multirate systems- Preemptive real time operating systems- Priority based scheduling- Example Real time operating systems - POSIX - Windows CE. Networks for embedded Systems – CAN & I^2C.

LIST OF EXPERIMENTS

5. Interfacing EPROM using ARM Microcontroller
6. Interfacing Stepper using ARM Microcontroller

UNIT IV EMBEDDED DEVICES FOR IOT 15

Introduction to Internet of things - Design principles of connected devices- Sensors technology and actuators for IoT- IoT Protocols- IEEE 802.15.4-LoRaWAN- Clouds for IoT.

LIST OF EXPERIMENTS

7. Interfacing LED and switch with Rasperry-Pi
8. Interfacing a Light sensor (LDR) with Rasperry-Pi

UNIT V IOT PHYSICAL DEVICES AND CASE STUDY 15

Basic building blocks of an IoT device and endpoints- Raspberry Pi -Board - Linux on Raspberry Pi - Raspberry Pi Interfaces -Programming Raspberry Pi with Python- Clouds for IoT - Case study- Home automation - Environment-Agriculture.

LIST OF EXPERIMENTS

9. IoT based Home automation.
10. Handling of mosquitto or Paho for handing of MQTT operations

TOTAL: 75 PERIODS

COURSE OUTCOMES:

CO1: Summarize the embedded system design process and methodologies.

CO2: Illustrate the ARM processor architecture and programming.

CO3: Infer the networks used for embedded systems

CO4: Apply scheduling algorithms for process-based scheduling.

CO5: Interpret IoT device architecture and protocols for IoT.

CO6: Construct a real time application using IoT based on case study.

TEXT BOOKS:

1. Marilyn Wolf, ―Computers as Components - Principles of Embedded Computing System Design‖, Third Edition ―Morgan Kaufmann Publisher (An imprint from Elsevier), 2012.
2. Lyla B.Das, ―Embedded Systems : An Integrated Approach‖ Pearson Education, 2013.
3. Arshdeep Bahga, Vijay Madisetti, ―Internet of Things – A hands-on approach‖, Universities Press, 2015

REFERENCES:

1. Shibu, K. V., "Introduction to embedded systems", 1st edition, Tata McGraw-Hill Education, 2009.
2. Vahid, Frank, and Tony D. Givargis. "Embedded system design: a unified hardware/software introduction", 1st edition, John Wiley & Sons, 2006.
3. Zhu Y., "Embedded Systems with ARM Cortex-M3 Microcontrollers in Assembly Language and C", E-Man Press, 2014.
4. Wolf W., "FPGA-based system design", Pearson education, 2004 Jun 15.
5. David Etter, "IoT (Internet of Things Programming: A simple and fast way of Learning IoT", Kindle edition, 2016
6. Fei H.U., "Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations", 1st Edition, CRC Press, 2016
7. Colin Walls, Embedded RTOS Design Insights and Implementation. 1st edition. Elsevier, December 2020.

NPTEL LINK:

https://onlinecourses.nptel.ac.in/noc24_cs25/preview

https://onlinecourses.nptel.ac.in/noc24_cs33/preview

https://onlinecourses.swayam2.ac.in/ntr24_ed01/preview

COURSE CODE	COURSE TITLE	L	T	P	C

22CS611	ADVANCED APTITUDE AND CODING SKILLS – II	0	0	2	1

COURSE OBJECTIVES:

- To develop advanced vocabulary for effective communication and reading skills.
- To build an enhanced level of logical reasoning and quantitative skills.
- To develop error correction and debugging skills in programming.
- To apply data structures and algorithms in problem solving.

LIST OF EXERCISES:

- **ENGLISH – PHASE II ADVANCED**

  Vocabulary: Synonyms, Antonyms, Grammar: Subject-Verb Agreement, Tenses and Articles, Prepositions and Conjunctions, Speech and Voices, Comprehension: Inferential and Literal Comprehension, Contextual Vocabulary, Comprehension ordering
- **LOGICAL REASONING – PHASE II ADVANCED**

  Deductive Reasoning: Coding deductive logic, Directional sense, Blood relations, Objective Reasoning, Selection decision tables, Puzzles, Inductive reasoning: Coding pattern and Number series pattern recognition, Analogy and Classification pattern recognition, Abductive Reasoning: Logical word sequence, Data sufficiency.
- **QUANTITATIVE ABILITY - PHASE II ADVANCED**

  Basic Mathematics: Divisibility, HCF and LCM, Numbers, decimal fractions and power, Applied Mathematics: Profit and Loss, Simple and Compound Interest, Time, Speed and Distance, Engineering Mathematics: Logarithms, Permutation and Combinations, Probability.
- **AUTOMATA – PHASE II ADVANCED**

  Logical, Compilation and Code reuse
- **AUTOMATA FIX – PHASE II ADVANCED**

  Data Structure Concepts: Array and Matrices, Linked list, String processing and manipulation, Stack/Queue, Sorting and Searching Advanced Design and Analysis Techniques: Greedy Algorithms, Minimum Spanning Trees, String Matching, Divide and Conquer, Computational Geometry

TOTAL:30 PERIODS

COURSE OUTCOMES:

CO1:Developadvancedvocabularyforeffectivecommunicationandreadingskills.

CO2: Build an enhanced level of logical reasoning and quantitative skills.

CO3: Develop error correction and debugging skills in programming.

CO4: Apply data structures and algorithms in problem solving.

SUGGESTED BOOKS AND RESOURCES:

1. https://prepinsta.com/home/
2. https://www.hackerrank.com/
3. https://www.indiabix.com/
4. “A Modern Approach to Verbal & Non-Verbal Reasoning” by R.S.Agarwal
5. “Quantitative Aptitude for Competitive Examinations” by R S Agarwal/S Chand
6. “A Modern Approach to Logical Reasoning” by R.S.Agarwal
7. “The C Programming Language” by Brian Kernighan and Dennis Ritchie
8. “Java: A Beginner's Guide” by Herbert Schildt

COURSE	COURSE TITLE	L	T	P	C

CODE					
22EC611	**MINI PROJECT**	**0**	**0**	**2**	**1**

COURSE OBJECTIVES:

- To define, formulate and analyze real world problem in the field of Electronics and Communication.
- To acquire knowledge in terms of innovation and product design development process of the project.
- To interpret and associate the team members to work as a team efficiently.
- To create an Industrial environment and culture within the institution.
- To develop a professional attitude towards appearance and behavior in the workplace, time management skills and the ability to prioritize assignments.

1. Students should select a problem which addresses some basic home, office or other real life applications.
2. The electronic circuit for the selected problem should have at least 20 to 25 components.
3. Students should understand testing of various components.
4. Soldering of components should be carried out by students.
5. Students should develop a necessary PCB for the circuit.
6. Students should see that final circuit submitted by them is in working condition.
7. 5-10 pages report to be submitted by students.
8. Group of maximum three students can be permitted to work on a single mini project.
9. The mini project must have hardware part. The software part is optional.
10. Department may arrange demonstration with poster presentation of all Mini projects developed by the students at the end of semester.
11. It is desirable that the electronic circuit/systems developed by the students have some novel features.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Understand and explain the real time problems through literatures.
CO2: Analyze the methods to develop solution to the systems.
CO3: Classify, compare and analyze business opportunities for a new product.
CO4: Summarize and prepare reports for the experimental determinations.
CO5: Evaluate the performance and effectiveness of the existing problems.
CO6: Develop life-long learning skills for a productive career.

COURSE CODE	COURSE TITLE	L	T	P	C
22EC701	ANTENNAS AND MICROWAVE ENGINEERING (THEORY COURSE WITH LABORATORY COMPONENT)	3	0	2	4

COURSEOBJECTIVES:

- To give insight of the fundamental characteristics and parameters of antennas.
- To give a thorough understanding of the radiation characteristics of different types of VHF, UHF and Microwave antennas in various types of communication.
- To understand operating principles and design concepts of antenna arrays.
- To instill knowledge on the properties of various microwave components.
- To understand the design principles of Microwave systems.

UNIT I	FUNDAMENTALS OF RADIATION	9+6

Definition of antenna parameters – Radiation Pattern, Gain, Directivity, Radiation Resistance, Effective aperture, Effective length, Band width, Beam width, Input Impedance, Polarization, Baluns, Antenna temperature, Frii's Transmission formula.

LIST OF EXPERIMENTS

1.Study of all the antenna parameters using HFSS

UNITII	VHF, UHF AND MICROWAVE ANTENNAS	9+6

Wire Antennas - Short dipole, Halfwave dipole, Horn antenna, Parabolic Reflector antenna, Principle of frequency independent antennas – Helical antenna, Log periodic antenna, Microstrip antennas.

LIST OF EXPERIMENTS

2. Design and simulate a dipole antenna and analyse the 3D radiation pattern in both E-plane and H-plane
3. Radiation Pattern of Horn Antenna
4. Design a Simple Microstrip patch antenna and plot its Reflection coefficient and VSWR

UNIT III	ANTENNA ARRAYS	9+6

Two element array, N element linear array –Broadside and End fire array, Pattern multiplication, Non-uniform excitation- Binomial array, Concept of Phased arrays, Adaptive array, Smart antennas.

LIST OF EXPERIMENTS

5. Radiation Pattern of Broadside and End fire Array antenna

UNIT IV	PASSIVE MICROWAVE DEVICES	9+6

Passive Devices: Hybrid Junctions (E plane, H plane & Magic Tees), Circulator, Isolator, Directional coupler, Termination, Attenuator.

LIST OF EXPERIMENTS

6. E Plane Tee
7.H Plane Tee
8.Magic Tee
9.Directional Coupler

UNIT V	ACTIVE MICROWAVE DEVICES AND MEASUREMENTS	9+6

Active Devices: Gunn diode, IMPATT diode, PIN diode, Varactor diode and Schottky diode, Klystron, TWT, Magnetron, VSWR and Frequency Measurements

LIST OF EXPERIMENTS

10.VI Characteristics of GUNN Diode

TOTAL: 45+30=75 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Identify basic antenna parameters and contrast radiation pattern of antenna.
CO2: Comprehend the radiation mechanism of VHF, UHF and Microwave Antennas.
CO3: Design and analyse antenna arrays.
CO4: Demonstrate the characteristics of passive microwave components
CO5: Summarize the characteristics of active microwave devices
CO6: Appropriate identification of an antenna for a specific application

TEXTBOOKS:

1. J.D.Krauss, R.J.Marhefkaand A.S.Khan, Antenna and Wave Propagation, 4th Edition, Tata Mc Graw - Hill, New Delhi, India, 2012.
2. Reinhold Ludwig and Gene Bogdanov, RF Circuit Design: Theory and Applications, Pearson Education Inc.,2011

REFERENCES:

1. Constantine.A.Balanis, Antenna Theory Analysis and Design, 3rd Edition, Wiley & Sons, New York, USA, 2016.
2. David M.Pozar, Microwave Engineering, Wiley India (P) Ltd, New Delhi,2008.
3. Thomas H Lee, Planar Microwave Engineering: A Practical Guide to Theory, Measurements and Circuits, Cambridge University Press, 2004.
4. Edward C.Jordanand Keith G.Balmain, Electromagnetic Waves and Radiating Systems, 2nd Edition, Prentice Hall of India, 2015.

NPTELLINK:

https://onlinecourses.nptel.ac.in/noc21_ee72

https://onlinecourses.nptel.ac.in/noc22_ee22/preview

COURSE CODE	COURSE TITLE	L	T	P	C
22EC702	WIRELESS COMMUNICATION	3	0	0	3

COURSEOBJECTIVES:

- To infer the principles of a wireless channel.
- To understand cellular system concepts and to classify various multiple access techniques.
- To Design and implement various signaling schemes for fading channel.
- To Compare multipath mitigation techniques and analyze their Performance.
- To Gain knowledge on multiple antenna technique.

UNIT I	WIRELESS CHANNELS	9

Large scale path loss – Path loss models: Free Space and Two-Ray models -Link Budget design – Small scale fading- Parameters of mobile multipath channels – Time dispersion parameters – Coherence bandwidth – Doppler spread & Coherence time, Fading due to Multipath time delay spread – flat fading – frequency selective fading – Fading due to Doppler spread – fast fading – slow fading.

UNITII	CELLULAR ARCHITECTURE	9

Multiple Access techniques - FDMA, TDMA, CDMA – Capacity calculations–Cellular concept Frequency reuse - channel assignment- hand off- interference & system capacity- trunking & grade of service - Coverage and capacity improvement.

UNIT III	DIGITAL SIGNALING FOR FADING CHANNELS	9

Structure of a wireless communication link, Principles of Offset-QPSK, $\pi/4$-DQPSK, Minimum Shift Keying, Gaussian Minimum Shift Keying, Error performance in fading channels, OFDM principle – Cyclic prefix, Windowing, PAPR.

UNIT IV	MULTIPATH MITIGATION TECHNIQUES	9

Equalization – Adaptive equalization, Linear and Non-Linear equalization, Zero forcing and LMS Algorithms. Diversity – Micro and Macro diversity, Diversity combining techniques, Error probability in fading channels with diversity reception, Rake receiver.

UNIT V	MULTIPLE ANTENNA TECHNIQUES	9

MIMO systems – spatial multiplexing -System model -Pre-coding - Beam forming - transmitter diversity, receiver diversity- Channel state information-capacity in fading and non-fading channels.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Analyze the basics and fundamentals of wireless channels.
CO2: Familiarize with the concepts of cellular system
CO3: Explore the fundamentals of multiple access techniques
CO4: Design and implement various signaling schemes for fading channel
CO5: Compare Various multipath mitigation techniques and analyze their performance
CO6: Apply the fundamentals of various multiple antenna techniques

TEXT BOOKS:

1. Rappaport, T.S, Wireless communications, Second Edition, Pearson Education India,2014.
2. Andreas.F. Molisch, Wireless Communications, Second Edition, John Wiley India, 2010.

REFERENCES:

1. Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2007.
2. Theodore S. Rappaport, Wireless Communications -Principles Practice, SecondEdition, Prentice Hall of India, New Delhi, 2010.
3. Upena Dalal, Wireless Communication, Oxford University Press,2009
4. Simon Haykin & Michael Mohar, Modern Wireless Communications, PearsonEducation, 2007.
5. David Tse and Pramod Viswanath, Fundamentals of Wireless Communication, Cambridge University Press, 2005
6. https://www.mins.ee.ethz.ch/pubs/files/allerton03.pdf
7. https://central.baclac.gc.ca/.item?id=NR21841&op=pdf&app=Library&oclc_number=373315508

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https://onlinecourses.nptel.ac.in/noc21_ee66/preview

COURSE CODE	COURSE TITLE	L	T	P	C
22EC703	PROFESSIONAL ETHICS IN ENGINEERING	3	0	0	3

COURSE OBJECTIVES:

- To familiarize with Engineering Ethics and Human Values.
- To impart knowledge on codes of ethics, safety, responsibilities and rights of engineers.
- To create awareness on global issues related to environmental ethics, computer ethics, weapons development and corporate social responsibility.

UNIT I	HUMAN VALUES	9

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

UNIT II	ENGINEERING ETHICS	9

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles –Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

UNIT III	ENGINEERING AS SOCIAL EXPERIMENTATION	9

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law- The Challenger Case Study.

UNIT IV	SAFETY, RESPONSIBILITIES AND RIGHTS	9

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Case Studies: Chernobyl and Bhopal Disasters - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights– Intellectual Property Rights(IPR)–Discrimination.

UNITV	GLOBAL ISSUES	9

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership – Code of Conduct –Corporate Social Responsibility.

TOTAL:45PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Summarize the importance of human values in work place.

CO2: Discuss the senses of engineering ethics, moral dilemmas, moral autonomy and uses of ethical theories

CO3: Describe the role of engineers as responsible experimenters and necessity of codes of ethics in engineering.

CO4: Explain safety, risk, responsibilities and rights in the society.

CO5: Analyze the global issues related to environmental ethics, computer ethics, weapons development and the role of engineers as expert witnesses and advisors.

CO6: Apply ethics in society and discuss the ethical issues related to engineering.

TEXTBOOKS:

1. Mike W.Martinand Rol and Schinzinger, Ethics in Engineering, Tata Mc Graw Hill, New Delhi, 2014.
2. Govindarajan M, Natarajan S, Senthil KumarV.S, Engineering Ethics, Prentice Hall of India, New Delhi,2013.

REFERENCES:

1. Charles B.Fleddermann, Engineering Ethics, Pearson Prentice Hall, New Jersey, 2012.
2. Charles E.Harris, Michael S.Pritchard and Michael J.Rabins, Engineering Ethics –Concepts and Cases, Cengage Learning, 2018.
3. John R Boatright, Ethics and the Conduct of Business, Pearson Education, New Delhi, 2012.
4. Edmund G Seebauer and Robert L Barry, Fundamentals of Ethics for Scientists and Engineers Oxford University Press, Oxford, 2001.

COURSE CODE	COURSE TITLE	L	T	P	C
22EC711	PROFESSIONAL READINESS FOR INNOVATION, EMPLOYABILITY AND ENTREPRENEURSHIP	0	0	6	3

COURSEOBJECTIVES:

- To expose the students to industry environment and to take upon site assignment as trainees or interns.
- To interpret and associate the team members to work as a team efficiently
- Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed.
- Final development of product/process, testing, results, conclusions and future directions.
- Develop a project in the suggestive area of work and prepare a detailed report.

COURSEEVALUATION

Project	Weight
Project final report	40%
Presentation	20%
Internship Report	20%
Viva voce	20%

TOTAL: 90 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Able to integrate existing and new technical knowledge for industrial application.

CO2: Analyze the technical aspects of the project with a comprehensive and systematic approach.

CO3: Have an exposure to industrial practices and to work in teams.

CO4: Know the impact of engineering solutions in a global, economic, environmental and societal context.

CO5: Able to understand software evaluation used with industry.

CO6: Understand lifelong learning processes through critical reflection of internship experiences.

COURSE CODE	COURSE TITLE	L	T	P	C
22MC711	ESSENCE OF INDIAN KNOWLEDGE TRADITION	1	0	0	0

COURSE OBJECTIVES:

- To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system.
- To make the students understand the traditional knowledge and analyse it and apply it to their day to day life

UNIT I	INTRODUCTION TO TRADITIONAL KNOWLEDGE	9

Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, the physical and social contexts in which traditional knowledge develop, the historical impact of social change on traditional knowledge systems. Indigenous Knowledge (IK), characteristics, traditional knowledge vis-à-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge vis-à-vis formal knowledge.

UNIT II	PROTECTION OF TRADITIONAL KNOWLEDGE	9

The need for protecting traditional knowledge Significance of TK Protection, the value of TK in the global economy, Role of Government to harness TK.

UNIT III	LEGAL FRAMEWORK AND TRADITIONAL KNOWLEDGE	9

The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmers Rights Act, 2001 (PPVFR Act); The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016. Geographical indications act 2003.

UNIT IV	TRADITIONAL KNOWLEDGE AND INTELLECTUAL PROPERTY	9

Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Certain non IPR mechanisms of traditional knowledge protection, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge, global legal FORA for increasing protection of Indian Traditional Knowledge.

UNIT V	TRADITIONAL KNOWLEDGE IN DIFFERENT SECTORS	9

Traditional knowledge and engineering, Traditional medicine system, TK and biotechnology, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Understand the concept of Traditional knowledge and its importance.

CO2: Know the need and importance of protecting traditional knowledge.

CO3: Know the various enactments related to the protection of traditional knowledge.

CO4: Understand the concepts of Intellectual property to protect the traditional knowledge.

CO5: Understand the traditional knowledge in different sectors.

TEXT BOOKS:

1. Traditional Knowledge System in India, by Amit Jha, 2009.
2. Traditional Knowledge System and Technology in India by Basanta Kumar Mohanta and Vipin Kumar Singh, Pratibha Prakashan 2012.

REFERENCES:

1. Traditional Knowledge System in India by Amit Jha Atlantic publishers, 2002.
2. Traditional Knowledge "Knowledge Traditions and Practices of India" Kapil Kapoor, Michel Danino

E-RESOURCES:

1. https://www.youtube.com/watch?v=LZP1StpYEPM
2. http://nptel.ac.in/courses/121106003/

SEMESTER-VIII

COURSE CODE	COURSE TITLE	L	T	P	C
22EC811	PROJECT WORK	0	0	16	8

COURSE OBJECTIVES:

- Make use of acquired knowledge for the problem identification and definition related to industry/research/societal need.
- Analyze the technical aspects of the project with a comprehensive and systematic approach.
- Select the appropriate modern tool(s) and technique(s) for problem-solving.
- Propose and select the appropriate and cost-effective solution.
- Appraise the importance of an individual/team for effective execution.

PROJECT GUIDELINES

- Review and finalization of the Approach to the Problem relating to the assigned topic.
- Preparing an Action Plan for conducting the investigation, including teamwork.
- Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed.
- Final development of product/process, testing, results, conclusions and future directions.
- Develop a project in the suggestive area of work and prepare a detailed report.

COURSE EVALUATION

Project	Weight
Project final report	30%
Presentation	30%
Internship Report	20%
Viva voce	20%

TOTAL: 90 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1:Understand the issues related to the recent trends in the field of engineering and its applications.

CO2: Relate engineering issues to broader societal context and able to find the solution for the issues.

CO3: Compile and conclude the project with effective communication amongst peers, mentors, and society.

CO4: Apply the theoretical concepts to solve industrial problems with team work.

CO5: Able to understand advanced technology and research in engineering.

CO6: Develop life-long learning skills for a productive career.

PROFESSIONAL ELECTIVE I

SEMESTER V

COURSE CODE	COURSE TITLE	L	T	P	C
22EC901	INTRODUCTION TO INTERNET OF THINGS	3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals of Internet of Things
- To learn about the IoT architecture
- To familiarize various IoT Protocols
- To build a small low-cost embedded system using Raspberry Pi.
- To apply the concept of Internet of Things in the real-world scenario.

UNIT I	INTRODUCTION TO IoT	9

Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates - Domain Specific IoTs - IoT and M2M.

UNIT II	IoT ARCHITECTURE	9

M2M high-level ETSI architecture - IETF architecture for IoT - OGC architecture - IoT reference model – Domain model - information model - functional model - communication model – IoT reference architecture.

UNIT III	IoT PROTOCOLS	9

Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus – Zigbee Architecture – 6LowPAN – CoAP.

UNIT IV	BUILDING IoT WITH RASPBERRY PI & ARDUINO	9

Building IOT with RASPERRY PI- IoT Systems - Logical Design using Python – IoT Physical Devices & Endpoints - IoT Device -Building blocks -Raspberry Pi -Board - Linux on Raspberry Pi - Raspberry Pi Interfaces - Programming Raspberry Pi with Python - Other IoT Platforms - Arduino.

UNIT V	CASE STUDIES AND REAL-WORLD APPLICATIONS	9

Real world design constraints – Applications - Industrial automation, smart grid, Commercial building automation Data Analytics for IoT – Software & Management Tools for IoT Cloud Storage Models & Communication APIs Cloud for IoT - Amazon Web Services for IoT.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Identify IoT enabling technologies

CO2: Discover different IoT Architecture.

CO3: Understand communication, network and security protocols

CO4: Develop IoT based applications with Raspberry Pi

CO5: Infer the applications of IoT in Real-world scenario.

CO6: Discover the advancements of IoT in various sectors

TEXT BOOKS:

1. Arshdeep Bahga, Vijay Madisetti, ―Internet of Things – A hands-on approach‖, Universities Press, 2015
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), ―Architecting the Internet of Things, Springer, 2011.

REFERENCES:

1. Honbo Zhou, ―The Internet of Things in the Cloud: A Middleware Perspective‖, CRC Press, 2012.
2. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle, - From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence, Elsevier,2014
3. Olivier Hersent, David Boswarthick, Omar Elloumi, ―The Internet of Things – Key applications and Protocol, Wiley, 2012
4. David E. Goldberg, - IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, Cisco Press, 2017.
5. Maciej Kranz - Building the Internet of Things: Implement New Business Models, Disrupt Competitors, Transform Your Industry, John Wiley & Son, 2016.

NPTEL LINK:

https://archive.nptel.ac.in/courses/106/105/106105166/

COURSE CODE	COURSE TITLE	L	T	P	C
22EC902	FPGA ARCHITECTURE AND APPLICATIONS	3	0	0	3

COURSE OBJECTIVES:

- To understand FPGA design flow and technology mapping
- To articulate the logic implementation of the FSM
- To identify the building blocks of commercially available FPGA/CPLDs.
- To explore FPGA Fabrics by understanding various routing architecture designs.
- To understand basic ASIC design using FPGAs

UNIT I	INTRODUCTION TO FPGA	9

FPGAs Field Programmable Gate Arrays–Logic blocks, Evolution of programmable devices, FPGA Design flow, Applications of FPGA, Technology Mapping for FPGAs.

UNIT II	DESIGN EXAMPLES USING FSMs	9

Finite State Machines (FSM)- Top-down Design–State Transition Table, state assignments for FPGAs, Problem of initial state assignment for one hot encoding. K Application of One Hot method. System level design controller, data path and functional partition.

UNIT III	BUILDING BLOCKS OF FPGAS	9

Programming Technologies, commercially available FPGAs, AMD Xilinx's Virtex and Spartan, micro semi/Lattice FPGA, Intel Altera's FPGA- Configurable Logic block functionality, Input/output Block, Impact of logic block functionality on FPGA performance, Model for measuring delay.

UNIT IV	ROUTING ARCHITECTURES	9

Routing terminology, general strategy for routing in FPGAs, routing for row – based FPGAs, introduction to segmented channel routing, routing for symmetrical FPGAs, example of routing in a symmetrical FPGA, general approach to routing in symmetrical FPGAs, independence from FPGA routing architectures, FPGA routing structures.

UNIT V	APPLICATIONS AND CASE STUDY	9

Case Studies: Combinational Circuits: Parallel adder cell, parallel adder and multiplexers. sequential circuits: counters, parallel controllers

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: To discover FPGA Design flow

CO2: To realize and design the finite state machines

CO3: To develop VHDL/Verilog models and synthesize targeting for Virtex, SpartanFPGAs

CO4: To analyze various FPGA routing architectures

CO5: To understand the widespread implementation of FPGAs using short case studies

CO6: To distinguish the architectural and resource difference between Altera and Xilinx

TEXT BOOKS:

1. Stephen D. Brown. Field Programmable Gate Array, Springer US, 1992.
2. Stephen.M. Trimberger, Field Programmable Gate Array Technology, KluwerAcademic Publications,1994.

REFERENCES:

1. Digital Design-An Embedded systems approach using Verilog, Peter J.Ashendun, Morgan Kaufmann Publishers,2008
2. Design Warriors guide for FPGA-Clive Maxfield,2004
3. John V. Old Field, Richard C. Dorf, Field Programmable Gate Arrays, Wiley,2008.
4. Trimburger, Introduction to CAD for VLSI, Kluwer Academic publisher, 2002
5. Richard F.Tinder, Engineering Digital Design, Academic press,2000

NPTEL LINK:

https://onlinecourses.nptel.ac.in/noc23_ee25/preview

COURSE CODE	COURSE TITLE	L	T	P	C
22EC903	WIRELESS SENSOR NETWORKS	3	0	0	3

COURSE OBJECTIVES:

- To enable the student to understand the role of sensors and the networking of sensed data for different applications.
- To expose the students to the sensor node essentials and the architectural details, the medium access and routing issues and the energy constrained operational scenario.
- To enrich the student to understand the challenges in synchronization and localizationof sensor networks.
- To explain topology management for effective and sustained communication
- To understand the data management and security aspects for different applications in wireless sensor networks

UNIT I	OVERVIEW OF WIRELESS SENSOR NETWORKS	9

Challenges for Wireless Sensor Networks- Characteristics requirements-required mechanisms, WSN standards, Difference between mobile ad-hoc and sensor networks, Applications of sensor networks, Enabling Technologies for Wireless Sensor Networks.

UNIT II	ARCHITECTURES	9

Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes, Operating Systems and Execution Environments, Network Architecture - Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts. Physical Layer and Transceiver Design Considerations

UNIT III	MAC AND ROUTING	9

MAC Protocols for Wireless Sensor Networks, Zigbee, Low Duty Cycle Protocols and Wakeup Concepts - S-MAC, Mediation device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols- Energy-Efficient Routing, Geographic Routing

UNIT IV	INFRASTRUCTURE ESTABLISHMENT	9

Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control, Case study.

UNIT V	DATA MANAGEMENT AND SECURITY	9

Data management in WSN, Storage and indexing in sensor networks, Query processing insensor, Data aggregation, Directed diffusion, Tiny aggregation, greedy aggregation, Security Protocols, security in WSN

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Understand the fundamentals of wireless sensor networks and its application.

CO2: Explain the architectures of sensor networks and its parameters.

CO3: Discuss the various protocols and routing algorithm at different layer.

CO4: Understand the issues pertaining to sensor networks and the challenges involvedin managing a sensor network.

CO5: Design energy efficient sensor nodes and protocols.

CO6: Illustrate the storage, query processing, data management and different aggregation methods for wireless sensor networks.

TEXT BOOKS:

1. Holger Karl & Andreas Willig, Protocols and Architectures for Wireless Sensor Networks, JohnWiley,2005
2. Feng Zhao & Leonidas J. Guibas, Wireless Sensor Networks- An Information Processing Approach, Elsevier, 2007.

REFERENCES:

1. Kazem Sohraby, Daniel Minoli, & Taieb Znati, Wireless Sensor Networks -Technology Protocols and Applications, John Wiley, 2007.
2. Anna Hac, Wireless Sensor Network Designs, John Wiley, 2003.
3. Jun Zheng, Abbas Jamalipour, Wireless Sensor Networks: A Networking Perspective, John Wiley, 2009.
4. Jochen Schiller, Mobile Communications, Pearson Education, 2nd Edition, 2003.
5. William Stallings, Wireless Communications and Networks, Pearson Education – 2004

NPTEL LINK:

https://nptel.ac.in/courses/106105160

COURSE CODE	COURSE TITLE	L	T	P	C
22EC904	MEDICAL ELECTRONICS	3	0	0	3

COURSE OBJECTIVES:

- To illustrate the concepts of Bio-potential electrodes
- To illustrate the concepts of Biopotential recording
- To describe the techniques used for measurement of non-electrical parameters used in diagnosis
- To summarize the applications of IOT in medicine
- To familiarize the impact of data analytics in medical instrumentation.

UNIT I	BIO POTENTIAL ELECTRODES	9

Origin of bio potential and its propagation, Electrode-electrolyte interface, Polarization, Polarizable and Non-polarizable electrodes, Electrode behavior and Circuit models, Electrode–skin interface, Types of electrodes - Surface, Needle and Micro electrodes

UNIT II	ELECTRO-PHYSIOLOGY AND BIO-POTENTIAL RECORDING	9

Bio signals characteristics – Frequency and Amplitude ranges. ECG – Einthoven's triangle, Standard12 lead system. EEG – 10-20 electrode system, Unipolar, Bipolar and Average mode. EMG– Unipolar and Bipolar mode.

UNIT III	MEASUREMENT OF NON-ELECTRICAL PARAMETERS	9

Colorimeter, Flame photometer, Spectrophotometer, Blood flow meters, Cardiac output, Respiratory, Blood pressure, Temperature and Pulse measurements.

UNIT IV	IOT IN MEDICINE	9

Components of IOT healthcare, Remote health care, Real time monitoring, Internet of Medical Things (IoMT), IoMT basic architecture, Health care systems using IOT – case studies - An IoT Model for Neuro sensors, Secured architecture for IoT enabled Personalized Healthcare Systems.

UNIT V	RECENT TRENDS IN MEDICAL INSTRUMENTATION	9

Healthcare Application Development in Mobile and Cloud Environments, Approach to predict Diabetic Retinopathy through data analytics, Diagnosis of chest diseases using artificial neural networks.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1: Illustrate the concepts of Bio-potential electrodes

CO2: Analyze bioelectric signals for diagnosis of diseases

CO3: Summarize the concepts of non-electrical parameters measurement techniques in the medical field.

CO4: Design IOT systems for real time medical scenarios

CO5: Illustrate the applications of data analytics in medical instrumentation

CO6: Develop solutions for real time biomedical applications

TEXT BOOKS:

1. Leslie Cromwell, Biomedical Instrumentation and Measurement, Prentice Hall ofIndia, New Delhi, 2012.
2. Venkata Krishna, Sasikumar Gurumoorthy, Mohammad S. Obaidat, Internet of Things and Personalized Healthcare Systems, Springer Briefs in Applied Sciences, and Technology, Forensic and Medical Bioinformatics, 2019.

REFERENCES:

1. J. G. Webster, Medical Instrumentation Application and Design Wiley Publication, 2015.
2. Khandpur, R.S., Handbook of Biomedical Instrumentation, Third edition, Mc Graw-HillEducation, 2014.

NPTEL LINK:

https://onlinecourses.nptel.ac.in/noc22_bt56/preview

COURSE CODE	COURSE TITLE	L	T	P	C
22EC905	DIGITAL IMAGE AND VIDEO PROCESSING	3	0	0	3

COURSE OBJECTIVES:

- To familiarize the image enhancement concepts
- To explain noise models and image restoration process.
- To exercise various segmentation techniques in images.
- To learn the concept of image compression techniques.
- To visualize the 3D formation models and noise filtering methods

UNIT I	IMAGE ENHANCEMENT	9

Digital image fundamentals, Concept of pixels and gray levels, Image enhancement: point processing-Contrast stretching –Gray level slicing, intensity transformations, histogram Equalization, image averaging, image subtraction, spatial domain methods- smoothing linear filters, sharpening filters- the Laplacian.

UNIT II	IMAGE RESTORATION	9

Degradation model, Noise models - Gaussian, Rayleigh, Exponential, Uniform, Impulse, Periodic, Restoration in the presence of noise only - Spatial filtering -Mean filters- Arithmetic mean filter, Geometric mean filter, Harmonic mean filter, Contraharmonic mean filter, Inverse filtering, Wiener filtering.

UNIT III	IMAGE SEGMENTATION	9

Detection of discontinuities - point, line and edge and combined detection, Thresholding - Intensity thresholding and basic global thresholding, Region oriented segmentation - basic formulation, region growing by pixel aggregation, region splitting and merging, Watershed Algorithm.

UNIT IV	IMAGE COMPRESSION	9

Need for image compression, coding redundancy, spatial and temporal redundancy, fundamentals of information theory, image compression methods- Run length coding, Huffman coding, LZW coding, Wavelet coding, Image compression standard-JPEG Standards

UNIT V	VIDEO PROCESSING	9

Analog Video, Digital Video, Time-Varying Image Formation models: Three- Dimensional Motion Models, Geometric Image Formation, Photometric Image Formation, Noise Filtering - Intraframe filtering-LMMSE, Adaptive LMMSE, directional, Compression standards and formats (MPEG & H.XXX)

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1: Comprehend the enhancement techniques in spatial domain

CO2: Illustrate the noise models and techniques for restoration of images.

CO3: Interpret the different segmentation process involved in image processing.

CO4: Implement the compression techniques for redundancy removal in images.

CO5: Implement video processing in real-time applications

CO6: Develop new state of the art image and video processing methods.

TEXT BOOKS:

1. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, Pearson, Education, Inc., Second Edition, 2008.
2. A. Murat Tekalp, Digital Video Processing, Prentice Hall, Second Edition, 2015.

REFERENCES:

1. JohnW.Woods, Multidimensional Signal, Image and Video Processing , Elsevier, Second Edition 2011.
2. Thomas. B. Moeslund, “Introduction to Video and Image Processing, Springer, 2012
3. Yao Wang, Jorn Ostermann and Ya Qin Zhang, Video Processing and Communications, Prentice Hall Publishers, 2002.
4. JohnW.Woods, Multidimensional Signal, Image and Video Processing , Elsevier, Second Edition 2011.
5. Thomas. B. Moeslund, Introduction to Video and Image Processing, Springer, 2012
6. Yao Wang, Jorn Ostermann and Ya Qin Zhang, Video Processing and Communications, Prentice Hall Publishers, 2002.

NPTEL LINK:

https://onlinecourses.nptel.ac.in/noc22_bt56/preview

COURSE CODE	COURSE TITLE	L	T	P	C
22EC906	SOFT COMPUTING	3	0	0	3

COURSE OBJECTIVES:

- To become familiar with various techniques like neural networks, genetic algorithms and fuzzy systems
- To introduce hybrid soft computing systems
- To apply soft computing techniques to solve problems.
- To acquire knowledge on hybrid systems.

UNIT I	INTRODUCTION TO SOFT COMPUTING	9

Artificial Neural Network: Introduction, Characteristics, Learning Methods, Evolution of Neural Networks, Basic Models – Fuzzy Logic: Introduction, Crisp Sets, Fuzzy Sets, Fuzzy Relations, Non-Iterative Fuzzy Sets – Genetic Algorithm: Introduction, Biological Background, Traditional Optimization and Search Techniques – Swarm Intelligent Systems.

UNIT II	NEURAL NETWORKS	9

Mcculloch-Pitts Neuron – Linear Separability – Hebb Network – Supervised Learning Network: Perceptron Networks – Adaptive Linear Neuron, Multiple Adaptive Linear Neuron, BPN, RBF, Associative Memory Network, BAM, Hopfield Networks – Unsupervised Learning Networks, Kohonen, Self-Organizing Feature Maps, LVQ – CP Networks, ART Network.

UNIT III	FUZZY LOGIC	9

Membership Functions: Features, Fuzzification, Methods of Membership Value Assignments – Defuzzification: Lambda Cuts – Methods – Fuzzy Arithmetic and Fuzzy Measures – Extension Principle – Fuzzy Integrals – Fuzzy Rule Base and Approximate Reasoning: Truth Values and Tables, Formation of Rules – Decomposition and Aggregation of Fuzzy Rules, Fuzzy Reasoning – Fuzzy Inference Systems – Overview of Fuzzy Expert System – Fuzzy Decision Making

UNIT IV	GENETIC ALGORITHM	9

Basic Concepts – Working Principles – Encoding – Fitness Function – Reproduction – Inheritance Operators – Cross Over – Inversion and Deletion – Mutation Operator – Bit-Wise Operators – Convergence of Genetic Algorithm

UNIT V	HYBRID SYSTEMS	9

Hybrid Systems – Neural Networks, Fuzzy Logic and Genetic – GA Based Weight Determination – LR- Type Fuzzy Numbers – Fuzzy Neuron – Fuzzy BP Architecture – Learning in Fuzzy BP – Inference by Fuzzy BP – Fuzzy ARTMAP – GA in Fuzzy Logic Controller Design.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1: Choose suitable soft computing techniques for various applications
CO2: Design learning algorithms for neural networks in pattern classification and regression problems
CO3: Use fuzzy logic in decision making systems
CO4: Apply Genetic Algorithms for optimization of engineering problems.
CO5: Integrate various soft computing techniques for complex engineering problems
CO6: Analyze the characteristics of hybrid systems.

TEXT BOOKS:

1. Jyh-Shing Roger Jang, Chuen-Tsai Sun and Eiji Mizutani, Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence, Prentice Hall of India, 2004.
2. Sivanandam S N and Deepa S N, Principles of Soft Computing, Wiley India Pvt. Ltd., Second edition.

REFERENCES:

1. Timothy J Ross, Fuzzy Logic with Engineering Applications, Wiley Publishers, Third Edition,2010.
2. George J Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic: Theory and Applications, Prentice Hall,1995.
3. James A Freeman and David M Skapura, Neural Networks: Algorithms, Applications, and Programming Techniques, Addison Wesley, 2003.
4. Introduction to Soft Computing: Neuro-fuzzy and Genetic Algorithms, Samir Roy. Udit Chakraborty, Pearson India, 2013
5. Davis E Goldberg, Genetic Algorithms: in Search, Optimization and MachineLearning, Addison Wesley
6. Padhy N P and Simon S P, Soft Computing: With MATLAB Programming, OxfordUniversity, Press, 2015.

NPTEL LINK:

https://nptel.ac.in/courses/106105173

PROFESSIONAL ELECTIVE II

SEMESTER V

COURSE CODE	COURSE TITLE	L	T	P	C
22EC907	SENSORS AND ACTUATOR DEVICES	3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamental principles and operating mechanisms of sensorsand actuator devices.
- To familiarize the basic electronic circuits and systems used to interfacesensors and actuator devices.
- To acquire the skills to create, construct, and validate basic sensor and actuatordevices.
- To analyze, troubleshoot, and debug sensor and actuator systems.
- To develop real-time IoT based applications with sensors and actuators.

UNIT I	SENSORS AND ACTUATORS	9

Introduction to Sensors and Actuator- Sensor and Actuator Characteristics- Types of sensors and actuators - Calibration, accuracy, and precision of sensors - Signal conditioning and amplification of sensor signals.

UNIT II	SEVEN GENERATIONS OF IOT SENSORS	9

Introduction to IoT Sensors- First-generation sensors: temperature, light, and motion sensors - Second generation sensors: proximity sensors, pressure sensors, and gas sensors -Third-generation sensors: biosensors, chemical sensors, and magnetic sensors - Fourth- generation sensors: intelligent sensors, micro electromechanical systems (MEMS) - Fifth- generation sensors: nanosensors, biometric sensors - Sixth-generation sensors: printed sensors, flexible sensors - Seventh-generation sensors: quantum sensors, carbon nanotube sensors, and neural sensors.

UNIT III	ACTUATORS AND ADVANCED SENSING TECHNIQUES	9

Electro mechanical and electro thermal actuators: differences, characteristics, and use cases - Types of actuators: motors, solenoids, relays, and others - Control of actuator devices: DC, AC, and stepper motor control - H-bridge motor driver circuits.

UNIT IV	SENSORS FOR AUTOMOTIVE AND SMART CITIES	9

Introduction to automotive sensors and their applications - Types of automotive sensors: temperature, pressure, speed, position - Sensor requirements for automotive applications: reliability, durability, and accuracy. Introduction to sensors for smart city applications - Types of smart city sensors: air quality, noise, traffic, weather, and others - Sensor requirements for smart city applications: energy efficiency, data accuracy, and real-time monitoring.

UNIT V	**DEVELOPING AN IOT BASED APPLICATIONS**	**9**

Smart Energy Monitor Based on IoT, develop a Face Recognizing Robot, Build an IoT based Smart Home System, IoT Based Air Quality Index Monitoring, IoT Based Contactless Body Temperature Monitor.

TOTAL: 45 PERIODS

COURSE OUTCOMES

At the end of this course, the students will be able to:
CO1: Build schematic for IoT solutions with sensors.

CO2: Design and develop IoT based sensor systems.

CO3: Select the appropriate sensors for various industrial applications

CO4: Evaluate the wireless sensor technologies for IoT.

CO5: Design and develop an IoT Prototype project.

CO6: Identify the appropriate actuators for IoT.

TEXT BOOKS:

1. D. Patranabis, Sensors and Transducers, 2nd edition, PHI Learning PrivateLimited, 2021.
2. Maggie Lin and Qiang Lin., Internet of Things Ecosystem: 2nd Edition, 2021.

REFERENCES:

1. Chou, - Precision: Principles, Practices and Solutions for the Internet of Things, Cloudbook Inc., USA, 2020.
2. Ravindra P. Singh and Narayan C. Kar, Smart Sensors and MEMS: Intelligent Devices and Timothy Microsystems for Industrial Applications, CRC Press, 2014.
3. A.J. Siti Shafrah, R. Badlishah Ahmad, and I.A. Halim, Sensors and Actuators: Control System Instrumentation, Penerbit UTM Press, 2018.
4. Sanjay Sharma, Sensors and Actuators: Engineering System Instrumentation, Second Edition, CRC Press, 2015.
5. Clarence W. de Silva (Author) Sensors and Actuators: Engineering System Instrumentation, Second Edition, CRC Press.

NPTEL LINK:

https://onlinecourses.nptel.ac.in/noc24_cs35/preview

https://onlinecourses.nptel.ac.in/noc21_ee32/preview

COURSE CODE	COURSE TITLE	L	T	P	C
22EC908	RTL DESIGN WITH VHDL/VERILOG HDL	3	0	0	3

COURSE OBJECTIVES:

- To understand the logic design fundamentals in RTL using Verilog
- To analyze the practical issues and scenarios for the design of combinational logic using Verilog RTL
- To design efficient RTL for sequential design using Verilog coding guidelines
- To understand the Complex Designs Using Verilog RTL
- To write a test bench program for functional verification

UNIT I	INTRODUCTION TO SIMULATION AND SYNTHESIS FLOW FOR THE VERILOG RTL	9

Integrated Circuit Design and Methodologies: RTL Design, Functional Verification, Synthesis, Physical Design. Verilog HDL. Verilog Design Description: Structural Design, Behavior Design. Synthesizable RTL Design. Key Verilog Terminologies

UNIT II	DESIGN OF COMBINATIONAL LOGIC USING VERILOG RTL	9

Introduction to Combinational Logic, Logic Gates and Synthesizable RTL, Arithmetic Circuits, Multiplexers, Decoders, Encoders, Combinational Design Guidelines: Blocking Assignments, Continuous Versus Procedural Assignments, If-Else Versus Case Statements.

UNIT III	DESIGN OF SEQUENTIAL LOGIC USING VERILOG RTL	9

Introduction to Sequential Logic, Flip-Flop, Synchronous and Asynchronous Reset, Synchronous Counters: Up Counter, Down Counter, Up-Down and Ring Counter. Shift Register. Sequential Design Guidelines: Blocking and Non-blocking Assignments, Synchronous Versus Asynchronous Reset, If-Else Versus Case Statements

UNIT IV	COMPLEX DESIGNS USING VERILOG RTL	9

ALU Design, Parity Generators and Detectors, Barrel Shifters, Finite State Machines: Mealy and Moore-Design of RAM and ROM-UART interface

UNIT V	VERIFICATION AND TEST BENCHES	9

Introduction to Test bench program for timing & functional verification: Adder, Comparators, Decoder, ALU, Registers and Case Studies on Memory Design for processor.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able

CO1: Understand the basics of Verilog RTL Simulation and Synthesis flow.

CO2: Design combinational Logic circuit for the real time and practical scenario

CO3: Understand the synthesizable sequential design issues

CO4: Design Complex structure for the required functionality

CO5: Write a test bench code for functional verification

CO6: Understand the basics of Verilog RTL Simulation and Synthesis flow.

TEXT BOOKS:

1. Vaibbhav Taraate, Digital Logic Design Using Verilog Coding and RTL Synthesis, Springer India 2016.
2. Sanjay Churiwala and Sapan Garg, Principles of VLSI RTL Design - A Practical Guide, Springer 2012.

REFERENCES:

1. P. Uyemura, Introduction to VLSI Circuits and Systems, John Wiley, 2009
2. Neil H. E. Weste and David Money Harris, CMOS VLSI Design - A Circuits and Systems Perspective, 4th Edition, Pearson, 2010.
3. Samir Palanitkar, Verilog HDL A Guide to Digital Design and synthesis, second Edition, 2007
4. M. Morris Mano and Mechael D. Ciletti, Digital Design: with an introduction toVerilog HDL 5th Edition, Pearson Education, 2013.
5. Michael D Ciletti, Advanced Digital Design with the Verilog HDL, 2nd edition, Pearson education, 2017

NPTEL LINK:

https://onlinecourses.nptel.ac.in/noc23_ee29/preview

COURSE CODE	COURSE TITLE	L	T	P	C
22EC909	OPTICAL COMMUNICATION AND NETWORKING	3	0	0	3

COURSE OBJECTIVES:

- To acquire the knowledge of optical fiber transmission mechanisms and various fiber types.
- To study the factors which produce signal degradation in fibers.
- To learn the concept of optical sources and optical detectors
- To familiarize and study the power coupling in optical communication
- To gain knowledge on fiber splicing techniques
- To explore the trends of optical fiber measurement systems.
- To enrich the idea of optical fiber networking.

UNIT I	INTRODUCTION TO OPTICAL FIBERS	9

Elements of an Optical Fiber Transmission link-Basic Optical Laws and Definitions-Total internal reflection, Acceptance angle, Numerical aperture, Skew rays - Optical fiber modes and Configurations - Single mode fibers-Graded Index fiber structure –Mode theory of Circular waveguides- Overview of modes, Modes in Step-Index fibers, Linearly Polarized modes.

UNIT II	SIGNAL DEGRADATION IN OPTICAL FIBERS	9

Attenuation - Absorption, Scattering losses, Bending losses, Core and Cladding losses. Signal distortion in Optical Wave guides- Group delay, Material dispersion, Waveguide dispersion, Signal distortion in SM fibers, Polarization mode dispersion, Intermodal dispersion - Dispersion Optimization of SM Fibers Characteristics of RI profiles and cut-off wavelength.

UNIT III	FIBER OPTICAL SOURCES AND COUPLING	9

Direct and indirect band gap materials-LED structures -Light source materials -Quantum efficiency and LED power, Modulation of a LED. Lasers diodes-modes and Threshold condition -Rate equations - External quantum efficiency -Resonant frequencies - Temperature effects. Introduction to Quantum laser. Power launching and coupling-Lensing schemes-Fiber -to-Fiber joints-Fiber splicing.

UNIT IV	FIBER OPTIC RECEIVER AND MEASUREMENTS	9

Principles of Photodetectors – PIN & APD - Fundamental receiver operation- Receiver configuration– Digital receiver performance- Probability of error – Quantum limit, Pre amplifiers. Fiber attenuation measurements- Dispersion measurements – Fiber refractive index profile measurements– Fiber diameter measurements.

UNIT V	OPTICAL NETWORKS AND SYSTEM TRANSMISSION	9

Basic networks – SONET / SDH – Broadcast and select WDM networks –Wavelength routed networks – Link power budget -Rise time budget- Operational principles of WDM and EDFA system – Solitons – Optical CDMA – Ultra high-capacity networks- Introduction to Li-Fi and LIDAR.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Describe basic elements in optical fibers, different modes and configurations.

CO2: Summarize the transmission characteristics associated with dispersion and polarization techniques.

CO3: Illustrate the Characteristics of various fiber optical sources.

CO4: Comprehend the optical receiver performance and measure various fiber parameters for designing optical fiber.

CO5: Elucidate the Characteristics of various fiber optical detectors.

CO6: Estimate the power budget required for optical network design and improve the performance of WDM/EDFA system.

TEXT BOOKS:

1. Gerd Keiser, Optical Fiber Communications, McGraw -Hill International, Fourth Edition, 2010.
2. John. M. Senior, Optical Fiber Communications, Principles and Practice, Prentice Hall of India,Third Edition, 2008.

REFERENCES:

1. Ramaswami, Sivarajan and Sasaki, Optical Networks, Morgan Kaufmann, 2009.
2. Govind P. Agrawal, Fiber-Optic Communication Systems, John Wiley & Sons, 5th Edition,2021.
3. Chakrabarti P, Optical Fiber communication, McGraw Hill Education (India) Private Limited,2019.
4. Gower J, Optical Communication System, Prentice Hall of India, 2001.

NPTEL LINK:

1, https://nptel.ac.in/courses/108106167

2. https://nptel.ac.in/courses/117104127

3. https://nptel.ac.in/courses/117101002

COURSE CODE	COURSE TITLE	L	T	P	C
22EC910	HUMAN ASSIST DEVICES	3	0	0	3

COURSE OBJECTIVES:

- To discuss various cardiac assist devices.
- To explain the function of dialysers.
- To familiarize the hearing tests and hearing aids.
- To describe the various orthotic devices and prosthetic devices.
- To explain the electrical stimulation techniques used in clinical applications.
- To understand AI techniques used in Medical Assist devices.

UNIT I	CARDIAC ASSIST DEVICES	9

Cardiac Pacemaker- Internal and External Pacemaker– Batteries, AC and DC Defibrillator- Internal and External Principle of External counter pulsation techniques–Intra-aortic balloon pump–Auxiliary ventricle and schematic for temporary bypass of left ventricle–Prosthetic heart valves.

UNIT II	HEMODIALYSERS	9

Artificial kidney–Dialysis action–Hemodialyser unit– Membrane dialysis– Portable dialyser monitoring and functional parameters.

UNIT III	HEARING AIDS	9

Common tests – Audiograms – Air conduction –Bone conduction – Masking techniques– SISI– Hearing aids – Principles –Drawbacks in the conventional unit –DSP based hearingaids.

UNIT IV	PROSTHETIC AND ORTHODIC DEVICES	9

Hand and arm replacement – Different types of models– Externally powered limb prosthesis– Feedback in orthotic system– Functional electrical stimulation– Sensory assist devices.

UNIT V	RECENT TRENDS	9

Transcutaneous electrical nerve stimulator– Bio-feedback– Case study of AI optimized Medical Assist devices.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Demonstrate the function of cardiac assist devices.

CO2: Describe the principle of artificial kidney.

CO3: Summarize the different types of hearing aids.

CO4: Explain the different types for prosthetic and orthotic devices.

CO5: Discuss the electrical simulations techniques used in biomedical instruments.

CO6: Develop AI based algorithms for medical Assist devices.

TEXT BOOKS:

1. Albert M.Cook and Webster J.G, Therapeutic Medical Devices, Prentice Hall Inc., New Jersey, 1982
2. Levine S.N. (ed), Advances in Biomedical Engineering and Medical Physics', Vol. I,II, IV, Inter university publications, New York, 1968

REFERENCES:

1. Joseph D. Bronzino, Donald R. Peterson. Medical Devices and Human Engineering, CRC Press, New York, 2015.
2. Kolff W.J, Artificial Organs, John Wiley and sons, New York, 1976.
3. Peter Ogrodnik, Medical Device Design Innovation from Concept to Market 2nd Edition – Elsevier, October 26, 2019.
4. Rory A Cooper, An Introduction to Rehabilitation Engineering, Taylor and Francics ,CRC Press,2006
5. Andreas.F. Von racum, Hand book of Bio material Evaluation, Mc.Millan Publishers, Edition1980

NPTEL LINK:

https://archive.nptel.ac.in/courses/127/106/127106232

COURSE CODE	COURSE TITLE	L	T	P	C
22EC911	MULTIMEDIA COMPRESSION AND COMMUNICATION	3	0	0	3

COURSE OBJECTIVES:

- To understand the compression schemes for text, voice, image and video
- To understand various encoding techniques of audios and videos in multimedia systems
- To understand the QoS issues in multimedia network
- To introduce communication protocols for multimedia networking.
- To analyse and design multimedia communication networks

UNIT I	AUDIO COMPRESSION	9

Multimedia components and their characteristics, Sampling and Quantization of Speech (PCM) - Adaptive differential PCM - Delta Modulation - Linear predictive coding (LPC) - Code excited Linear predictive Coding (CELP)

UNIT II	IMAGE AND VIDEO COMPRESSION	9

Graphics Interchange format- Tagged image file format- Digitized pictures- JPEG-Video Encoding-Motion estimation –Overview of H.263 and MPEG.

UNIT III	TEXT COMPRESSION	9

Static and Dynamic Huffman coding – Arithmetic coding –Lempel- Ziv coding – LZW coding.

UNIT IV	GUARANTEED SERVICE MODEL	9

Best Effort service model – Scheduling and Dropping policies – Network Performance Parameters – Quality of Service and metrics – WFQ and its variants – Random Early Detection –Admission Control – Resource Reservation – RSVP - Traffic Shaping Algorithms

UNIT V	MULTIMEDIA COMMUNICATION	9

Stream characteristics for Continuous media – Temporal Relationship – Object Stream Interactions, Recovering from packet loss – RTSP — Multimedia Communication Standards – RTP/RTCP – SIP and H.263.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Understand the basic ideas of compression algorithms related to multimedia components.

CO2: Understand the principles and standards of Text and Audio CompressionTechnique

CO3: Understand the principles and standards of Image and Video CompressionTechniques

CO4: Apply the various techniques in real-time applications

CO5: Implement various applications using compression algorithms

CO6: To carry out research and development in the field of multimedia systems and algorithms

TEXT BOOKS:

1. Fred Halsall, Multimedia communication- Applications, Networks, Protocols and Standards, Pearson Education, 2007.
2. Tay Vaughan, Multimedia Making it work, McGraw-Hill Osborne Media, 2007

REFERENCES:

1. Kurose and W. Ross, Computer Networking A Top Down Approach, Pearson education, Third Edition, 2012
2. KR. Rao,Z S Bojkovic, D A Milovanovic, ―Multimedia Communication Systems: Techniques, Standards, and Networks‖, Pearson Education 2007
3. R. Steimnetz, K. Nahrstedt, Multimedia Computing, Communications and Applications‖, Pearson Education, First Edition, 1995.
4. Nalin K Sharda, Multimedia Information Networking, Prentice Hall of India, 1999
5. Aura Ganz, Zvi Ganz and Kitti Wongthawaravat, Multimedia Wireless Networks: Technologies, Standards and QoS, Prentice Hall, 2003
6. Ellen Kayata Wesel, Wireless Multimedia Communications: Networking Video, Voice and Data, Addision Wesley, 1998.

NPTEL LINK:

https://nptel.ac.in/courses/117/105/117105083/

COURSE CODE	COURSE TITLE	L	T	P	C
22EC912	QUANTUM COMPUTING	3	0	0	3

COURSE OBJECTIVES:

- To know the background of classical computing and quantum computing.
- To gain knowledge about the basic hardware and mathematical models of quantum computation.
- To learn the fundamental concepts behind quantum computation.
- To study the details of quantum mechanics and the relation to Computer Science.
- To learn the basics of quantum information and the theory behind it.

UNIT I	FUNDAMENTAL CONCEPTS	9

Global Perspectives – Quantum Bits – Quantum Computation – Quantum Algorithms – Experimental Quantum Information Processing – Quantum Information.

UNIT II	QUANTUM MECHANICS AND OVERVIEW OF COMPUTATIONAL MODELS	9

Quantum Mechanics: Linear Algebra – Postulates of Quantum Mechanics – Application: Superdense Coding – Density Operator – The Shmidt Decomposition and Purifications – EPR and the Bell Inequality – Computational Models: Turing Machines – Circuits – Analysis of Computational Problems.

UNIT III	QUANTUM COMPUTATION	9

Quantum Circuits: Quantum Algorithms – Universal Quantum Gates – Quantum Circuit Model of Computation – Simulation – Quantum Fourier Transform and Applications – Quantum Search Algorithms – Quantum Computers

UNIT IV	QUANTUM INFORMATION THEORY	9

Data Compression- Shannons noise less channel coding theorem- Schumacher's Quantum noise less channel coding theorem - Classical Information Over Noisy Quantum Channels.

UNIT V	QUANTUM CRYPTOGRAPHY	9

Classical cryptography basic concepts- Private key cryptography-Shor's factoring algorithm-Quantum Key distribution-BB84-Ekart 91

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Understand the basics of quantum computing

CO2: Understand the background of Quantum Mechanics.

CO3: Analyse the computation models.

CO4: Model the circuits using quantum computation

CO5: Understand the quantum operations such as noise and error–correction.

CO6: Appreciate the need of quantum computing

TEXT BOOKS:

1. Michael A. Nielsen, Issac L. Chuang, "Quantum Computation and Quantum Information", Tenth Edition, Cambridge University Press, 2010.
2. Thomas *G.* Wong, "Introduction to Classical and Quantum Computing" Rooted Grove, 2022

REFERENCES:

1. Scott Aaronson, "Quantum Computing Since Democritus", Cambridge University Press, 2013.
2. N. David Mermin, "Quantum Computer Science: An Introduction", Cambridge University Press, 2007.

NPTEL LINK:

https://archive.nptel.ac.in/courses/106/106/106106232/

PROFESSIONAL ELECTIVE III

SEMESTER VI

COURSE CODE	COURSE TITLE	L	T	P	C
22EC913	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	3	0	0	3

COURSE OBJECTIVES:

- To impart artificial intelligence principles, techniques and its history.
- To assess the applicability, strengths, and weaknesses of the basic knowledge representationin solving engineering problems.
- To develop a basic understanding of problem solving and learning methods of AI
- To develop a basic knowledge in Data Science concepts
- To develop intelligent systems by assembling solutions to concrete computational problems

UNIT I	INTRODUCTION TO ARTIFICIAL INTELLIGENCE	9

Definitions - Importance of AI, Evolution of AI - Applications of AI, Introduction to Python - Basic Libraries in Python (Pandas, Numpy, Matplotlib) - Conditional- Iterative Statements and Function.

UNIT II	INTRODUCTION TO MACHINE LEARNING	9

Introduction to Machine Learning - Types of Machine Learning – Supervised and Unsupervised - Data exploration - Target Variables, Independent Numerical Variables, Categorical Variables - Splitting of Data.

UNIT III	INTRODUCTION TO DATA SCIENCE	9

Introduction to Data science - Introduction to Statistics – Central Tendency - Data Distribution - Probabilities of Discrete and Continuous Variables- Introduction to Inferential Statistics - Hypothesis Testing - T tests - Chi Squared Tests. Understanding the types of Predictive Models - Treating Missing Values - Transforming the Variables.

UNIT IV	LINEAR REGRESSION AND LOGISTIC REGRESSION	9

Linear Regression - Introduction to Linear Regression, Gradient Descent, Feature Engineering - Building First Predictive Model using Regression and Evaluate Performance. Logistic Regression - Basics of Logistic Regression, Evaluation Metrics.

UNIT V	DECISION TREE, ENSEMBLE MODEL AND CLUSTERING	9

Introduction to Decision Tree - Improving Model Performance by Pruning/Hyperparameters Tuning. Basics of Ensemble Techniques - Random Forest - Implementation of Bagging and Random Forest. Clustering - Understanding K-means - Implementation of K-means.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Understand the basics of quantum computing

CO2: Understand the background of Quantum Mechanics.

CO3: Analyse the computation models.

CO4: Model the circuits using quantum computation

CO5: Understand the quantum operations such as noise and error–correction.

CO6: Appreciate the need of quantum computing

TEXT BOOKS:

1. Andrew Ng, Machine Learning Yearning, 2018.
2. Poole, D. and Mackworth, A., Artificial Intelligence: Foundations of Computational Agents, Cambridge University Press, 2010.

REFERENCES:

1. Sebastian Raschka and Vahid Mirjalili, Python Machine Learning: Machine Learning and Deep Learning with Python, scikit-learn, and TensorFlow, 2nd Edition, Packet Publishing, 2017.
2. Kevin P. Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012.
3. Alpaydin, E., Introduction to Machine Learning. 3rd edition, The MIT Press, 2020
4. Trevor Hastie, Robert Tibshirani, and Jerome Friedman, The Elements of Statistical Learning: Data Mining, Inference, and Prediction, Springer, 2009.
5. Russell, S. and Norvig, P. 2015. Artificial Intelligence - A Modern Approach, 3rd edition, Prentice Hall.

NPTEL LINK:

https://archive.nptel.ac.in/courses/106/106/106106139/

COURSE CODE	COURSE TITLE	L	T	P	C
22EC914	LOW POWER VLSI DESIGN	3	0	0	3

COURSE OBJECTIVES:

- To identify sources of power in an IC.
- To identify the power reduction techniques based on technology independent and technology dependent methods
- To identify suitable techniques to reduce the power dissipation
- To estimate power dissipation of various MOS logic circuits
- To develop algorithms for low power dissipation

UNIT I	POWER DISSIPATION IN CMOS	9

Hierarchy of Limits of Power – Sources of Power Consumption – Physics of Power Dissipation in CMOS FET Devices – Basic Principle of Low Power Design

UNIT II	POWER OPTIMIZATION	9

Logic Level Power Optimization – Circuit Level Low Power Design – Gate Level Low Power Design –Architecture Level Low Power Design – VLSI Subsystem Design of Adders, Multipliers, PLL, Low Power Design

UNIT III	DESIGN OF LOW POWER CMOS CIRCUITS	9

Computer Arithmetic Techniques for Low Power System – Reducing Power Consumption in Combinational Logic, Sequential Logic, Memories – Low Power Clock – Advanced Techniques – Special Techniques, Adiabatic Techniques – Physical Design, Floor Planning, Placement and Routing.

UNIT IV	POWER ESTIMATION	9

Power Estimation Techniques, Circuit Level, Gate Level for NAND and NOR, Architecture Level, Behavioral Level, – Logic Power Estimation – Simulation Power Analysis –Probabilistic Power Analysis

UNIT V	SYNTHESIS AND SOFTWARE DESIGN FOR LOW POWER CMOS CIRCUITS	9

Synthesis for Low Power – Behavioral Level Transform –Algorithms for Low Power – Software Design for Low Power.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1: To know the sources of power consumption in CMOS circuits

CO2: To design and analyze various MOS logic circuits

CO3: To apply low power techniques for low power dissipation

CO4: To estimate thepower dissipation of ICs

CO5: Able to develop algorithms to reduce power dissipation by software

CO6: To learn the design concepts of low power circuits

TEXT BOOKS:

1. Kaushik Roy and S.C.Prasad, Low power CMOS VLSI circuit design, John Wiley & Sons, 2013.
2. Dimitrios Soudris, Christians Pignet, Costas Goutis, Designing CMOS Circuits for Low Power, Springer,2011

REFERENCES:

1. A.P.Chandrasekaran and R.W.Brodersen, Low power digital CMOS design, SpringerUS, 2012.
2. Gary Yeap, Practical low power digital VLSI design, Springer US, 2012.
3. Abdelatif Belaouar, Mohamed.I.Elmasry, Low power digital VLSI design: Circuitsand Systems, Springer Verlag, 2012.
4. James B.Kulo, Shih-Chia Lin, Low voltage SOI CMOS VLSI devices and Circuits, John Wiley & sons,2011.
5. Steven M.Rubin, Computer Aids for VLSI Design, 3rd edition, R.L. Ranch Press, 2012.

NPTEL LINK:

https://archive.nptel.ac.in/courses/106/105/106105034/#

COURSE CODE	COURSE TITLE	L	T	P	C
22EC915	4G/5G COMMUNICATION NETWORKS	3	0	0	3

COURSE OBJECTIVES:

- To learn the evolution of cellular networks.
- To know about technology and evolution of LTE networks.
- To study the 5G architecture and its protocols.
- To study spectrum sharing and spectrum trading.
- To learn the security features in 4G and 5G networks.

UNIT I	INTRODUCTION	9

Network Evolution - 2G, 3G, 4G, evolution of radio access networks, need for 5G, 4G versus 5G, Next Generation core (NG-Core). Virtualized evolved packet core (vEPC)

UNIT II	4G NETWORK ARCHITECTURE	9

Network architecture changes from 3G TO 5G - 3GPP Packet Data Networks - Network Architecture - Packet Data Protocol (PDP) Context - Configuring PDP Addresses on Mobile Stations - Accessing IP Networks through PS Domain – LTE network Architecture - Roaming Architecture- Protocol Architecture

UNIT III	5G NETWORK ARCHITECTURE AND PROTOCOLS	9

5G architecture and core, network slicing, multi access edge computing (MEC) visualization of 5G components, end-to-end system architecture, service continuity, relation to EPC, and edge computing. 5G protocols: 5G NAS, NGAP, GTP-U, IPSec and GRE.

UNIT IV	DYNAMIC SPECTRUM MANAGEMENT AND MM-WAVES	9

Mobility management, Command and control, spectrum sharing and spectrum trading, cognitive radio based on 5G, millimeter waves.

UNIT V	SECURITY AND APPLICATIONS OF 4G AND 5G	9

Issues and Challenges in Security Provisioning for 4G and 5G, Network Security Attacks, possible solutions for jamming, tampering, black hole attack, flooding attack in heterogeneous 4G and 5G networks. 4K/8K streaming, AR/VR, Real time interactive gaming, IoT and smart cities, Satellite Internet.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Understand the evolution of cellular networks

CO2: Learn the concepts of 4G networks.

CO3: Comprehend the 5G architecture and protocols

CO4: Understand the dynamic spectrum management.

CO5: Learn the security aspects in 4G and 5G networks

CO6: Learn the applications in 4G and 5G Networks.

TEXT BOOKS:

1. Ayman El-Nashar, Mohamed El-saidny, Mahmoud Sherif, Design, Deployment and Performance of 4G-LTE Networks: A Practical Approach, John Wiley& Sons, 2014
2. An Introduction to 5G Wireless Networks: Technology, Concepts and Use cases, Saro Velrajan, First Edition, 2020.

REFERENCES:

1. 5G Simplified: ABCs of Advanced Mobile Communications Jyrki. T.J.Penttinen, Copyrighted Material.
2. 5G system Design: An end to end Perspective, Wan Lee Anthony, Springer Publications,2019.
3. Jyh-Cheng Chen and Tao Zhang, IP-Based Next-Generation Wireless Networks Systems, Architectures, and Protocols, First Edition, John Wiley & Sons, Inc. Publication, 2010.
4. Harri Holma, Antti Toskala, Takehiro Nakamura, 5G Technology :3GPP New Radio, JohnWiley, & Sons, 2019
5. Harri Holma, Antti Toskala, WCDMA for UMTS: HSPA Evolution and LTE, Fifth EditionJohn Wiley & Sons, Inc. Publication, 2010.

NPTEL LINK:

https://onlinecourses.nptel.ac.in/noc22_ee56/preview

COURSE CODE	COURSE TITLE	L	T	P	C
22EC916	WEARABLE DEVICES	3	0	0	3

COURSE OBJECTIVES:

- To describe the hardware required for wearable systems.
- To understand signal processing and energy harvesting with respect to wearable devices.
- To familiarize the applications of wearable devices in the field of medicine.
- To discuss the need for development of wearable devices and its implications on various sectors.
- Comprehend the design and development of various wearable inertial sensors, wearable bioelectrode and physiological activity monitoring devices for use in various applications.
- Implement various biochemical and gas sensors in wearable devices.

UNIT I	INTRODUCTION TO WEARABLE SYSTEMS AND SENSORS	9

Wearable Systems- Introduction, Need for Wearable Systems, Drawbacks of Conventional Systems for Wearable Monitoring, Applications and Types of Wearable Systems, Components of wearable Systems. Sensors for wearable systems-Inertia movement sensors, Respiration activity sensor, Impedance plethysmography, Wearable ground reaction force sensor.

UNIT II	SIGNAL PROCESSING AND ENERGY HARVESTING FOR WEARABLE DEVICES	9

Wearability issues -physical shape and placement of sensor, Technical challenges - sensor design, signal acquisition, sampling frequency for reduced energy consumption, Rejection of irrelevant information. Power Requirements- Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles.

UNIT III	WIRELESS HEALTH SYSTEMS	9

Definition of Body area network, BAN and Healthcare, BAN Architecture – Introduction, Need for wireless monitoring, Technical Challenges- System security and reliability, Wireless communication Techniques.

UNIT IV	SMART TEXTILE	9

Introduction to smart textile- Passive smart textile, active smart textile. Fabrication Techniques- Conductive Fibres, Treated Conductive Fibres, Conductive Fabrics, Conductive Inks. Case study- smart fabric for monitoring biological parameters - ECG, respiration.

UNIT V	APPLICATIONS OF WEARABLE SYSTEMS	9

Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, neural recording, Gait analysis, Sports Medicine.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Describe the concepts of wearable system.

CO2: Explain the energy harvestings in wearable device.

CO3: Apply the concepts of BAN in health care.

CO4: Illustrate the concept of smart textile.

CO5: Compare the performance of various wearable devices in healthcare system.

CO6: Implement wearable systems for real-time applications

TEXT BOOKS:

1. Annalisa Bonfiglo and Danilo De Rossi, Wearable Monitoring Systems, Springer, 2011
2. Edward Sazonov and Micheal R Neuman, Wearable Sensors: Fundamentals, Implementation and Applications, Elsevier, 2014

REFERENCES:

1. Sandeep K.S, Gupta, Tridib Mukherjee and Krishna Kumar Venkatasubramanian, Body Area Networks Safety, Security, and Sustainability, Cambridge University Press, 2013.
2. Guang-Zhong Yang, Body Sensor Networks, Springer, 2006.

NPTEL LINK:

https://onlinecourses.nptel.ac.in/noc21_ee32/preview

COURSE CODE	COURSE TITLE	L	T	P	C
22EC917	SPEECH PROCESSING	3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals of the speech processing
- Explore the various speech models
- Gather knowledge about the phonetics and pronunciation processing
- Perform wavelet analysis of speech
- To understand the concepts of speech recognition

UNIT I	INTRODUCTION	9

Introduction - knowledge in speech and language processing - ambiguity - models and algorithms - language - thought - understanding - regular expression and automata - words & transducers – N grams

UNIT II	SPEECH MODELLING	9

Word classes and part of speech tagging – hidden markov model – computing likelihood: the forward algorithm – training hidden markov model – maximum entropy model – transformation based tagging – evaluation and error analysis – issues in part of speech tagging – noisy channel model for spelling

UNIT III	SPEECH PRONUNCIATION AND SIGNAL PROCESSING	9

Phonetics - speech sounds and phonetic transcription - articulatory phonetics - phonological categories and pronunciation variation - acoustic phonetics and signals - phonetic resources - articulatory and gestural phonology.

UNIT IV	SPEECH IDENTIFICATION	9

Speech synthesis - text normalization - phonetic analysis - prosodic analysis – diphone waveform synthesis - unit selection waveform synthesis - evaluation.

UNIT V	SPEECH RECOGNITION	9

Automatic speech recognition - architecture - applying hidden markov model - feature extraction: mfcc vectors - computing acoustic likelihoods - search and decoding - embedded training - multipass decoding: n-best lists and lattices- a* (_stack‘) decoding - context-dependent acoustic models: triphones - discriminative training - speech recognition by humans

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Understand the fundamentals of the speech processing

CO2: Create new algorithms with speech processing

CO3: Derive new speech models

CO4: Perform various language phonetic analysis

CO5: Create a new speech identification system

CO6: Generate a new speech recognition system

TEXT BOOKS:

1. Daniel Jurafsky and James H. Martin, ― Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition‖, Pearson education, 2013.

REFERENCES:

1. Kai-Fu Lee, ―Automatic Speech Recognition‖, The Springer International Series in Engineering and Computer Science, 1999.
2. Himanshu Chaurasiya, ―Soft Computing Implementation of Automatic Speech Recognition, LAP Lambert Academic Publishing, 2010.
3. Claudio Becchetti, Klucio Prina Ricotti, ―Speech Recognition: Theory and C++ implementation‖,Wiley publications 2008.
4. Ikrami Eldirawy , Wesam Ashour, ―Visual Speech Recognition, Wiley publications, 2011

COURSE CODE	COURSE TITLE	L	T	P	C
22EC918	ROBOTICS AND APPLICATIONS	3	0	0	3

COURSE OBJECTIVES:

- To develop knowledge in basic functioning of robot and its types.
- To realize forward and inverse kinematics equations and its general solutions.
- To study the various object recognition techniques.
- To familiarize the role of Artificial Intelligence in Robotic Applications
- To impart knowledge on recent advancements in different sectors which employs Robots

UNIT I	FUNDAMENTALS OF ROBOTICS	9

Introduction to robotics – Basic Laws of Robotics – Anatomy of a Robot – classification of a Robot – types of robots – Specifications of robot – Open kinematics vs Closed kinematics chain – degrees of Freedom – Robot configuration (PPP, RPP, RRP, RRR).

UNIT II	ROBOT KINEMATICS	9

Position Analysis – Matrix representation – forward and inverse kinematics equations (Position, Orientation) – Denavit-Hatenberg (DH) Representation of Forward Kinematic Equations – General solutions of inverse kinematic equations. Trajectory Planning – path vs trajectory – join space trajectory planning – cartesian space trajectories.

UNIT III	ACTUATORS AND SENSORS	9

Actuators – Characteristics of actuating system – comparison of actuating system – hydraulic actuators – pneumatic actuators. Sensors – Characteristics of sensors – Position Sensor – Velocity sensor – Acceleration sensor – force and pressure sensor – Touch and Tactile Sensor – Proximity sensor and range finders.

UNIT IV	MACHINE VISION AND ARTIFICIAL INTELLIGENCE	9

Introduction to machine vision – sensing and digitizing function in machine vision – image processing and analysis – Training and vision system – Object recognition by features (basic features, moments, template matching, computed tomography) – Role of AI in Robots – Goals of AI Research – AI Techniques.

UNIT V	FUTURE APPLICATIONS OF ROBOT	9

Applications of Robots – Industrial Applications, medical, household, marine, defense and disaster management – Micro and Nano Robots – Future Applications – Cyber Risks in Robots

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to:

CO1: Summarize various classification and specification of robots for the given application.

CO2: Compute position and orientation of manipulator using forward and inverse kinematics.

CO3: Identify appropriate gripper and sensor for a specific requirement

CO4: Apply suitable machine vision technique for object recognition

CO5: Infer the role of Artificial Intelligence in Robotic Applications

CO6: Discover the advancements of robotic Applications in various sectors

TEXT BOOKS:

1. Introduction to Robotics Analysis, Systems and Applications by Saeed B.Niku, 3rd edition –Wiley publications – 2019
2. Industrial Robotics Technology, Programming and Applications by Mikell P. Groover, 3rd edition - McGraw Hill Publications – 2008

REFERENCES:

1. S.R. Deb, Robotics Technology and flexible automation, Tata McGraw-Hill Education.,2009.
2. Richard D. Klafter, Thomas .A, ChriElewski, Michael Negin, Robotics Engineering anIntegrated Approach, PHI Learning., 2009.
3. Craig. J. J. Introduction to Robotics- mechanics and control, Addison- Wesley, 1999
4. Barry Leatham - Jones, Elements of industrial Robotics PITMAN Publishing, 1987.
5. Francis N. Nagy, Andras Siegler, Engineering foundation of Robotics, Prentice Hall Inc.,1987.
6. Fu K.S. Gonzaleaz R.C. and Lee C.S.G., Robotics Control Sensing, Vision and Intelligence,McGraw Hill International Editions, 1987.

NPTEL LINK:

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PROFESSIONAL ELECTIVE IV

SEMESTER VI

COURSE CODE	COURSE TITLE	L	T	P	C
22EC919	APPLICATION OF IOT IN ROBOTICS	3	0	0	3

COURSE OBJECTIVES:

- To Grasp the fundamentals of IoT and robotics, including their components and architectures
- To Learn about various types of IoT sensors and actuators used in robotics, and develop criteria for selecting and integrating them into robotic systems.
- To Gain practical experience in using IoT platforms and middleware to integrate IoTdevices with robotic systems, AWS IoT and Azure IoT.
- To Acquire skills in collecting and processing data from IoT sensors and actuators inreal-time, employing techniques such as filtering, aggregation, and normalization.
- To Enhance robotic perception capabilities through IoT sensors, integrate cameras and LiDAR.

UNIT I	INTRODUCTION TO ROBOTICS AND IOT	9

Introduction of Robotics: Definition, history, and applications - Introduction to IoT: Definition, components, and architecture - Intersection of Robotics and IoT: Potential applications and benefits - Evolution of Internet of Things, Enabling Technologies -
Functional blocks of an IoT ecosystem.

UNIT II	IOT SENSORS AND ACTUATORS	9

Types of IoT Sensors: Temperature, humidity, proximity - Actuators in IoT: Motors, servos, solenoids - Selection criteria and considerations for integrating sensors and actuators into robotic systems - Enhancing perception capabilities of robots with IoT sensors - Integration of cameras, LiDAR with IoT - Real-time control of robotic actuators using IoT data.

UNIT III	DESIGN PRINCIPLES FOR CONNECTED DEVICES	9

IoT/M2M System Layers and Design Standardisation - Communication Technologies - Data Enrichment, Data Consolidation and Device Management at Gateway - Web communication Protocols for connected Devices – Message Communication Protocols for Connected Devices – Internet Connectivity – IP Addressing in the IoT.

UNIT IV	IOT PLATFORMS AND MIDDLEWARE	9

Introduction to IoT platforms: AWS IoT, Azure IoT, Google Cloud IoT - Middleware solutions for integrating IoT devices and robotics - Hands-on experience with setting up and using IoT platforms for robotics applications - Introduction to edge computing and its relevance in robotics.

UNIT V	DATA ACQUISITION AND PROCESSING	9

Data acquisition from IoT sensors and actuators in robotic systems - Data processing techniques: Filtering, aggregation, normalization - Real-time data processing and analysis inrobotics applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Demonstrate an understanding of IoT principles, technologies, and protocols relevantto robotics applications.

CO2: Integrate a variety of IoT sensors and actuators into robotic systems to enhanceperception, control, and autonomy

CO3: Develop the skills necessary to design, implement, and deploy IoT- enabled robotic systems for real-world applications.

CO4: Demonstrate proficiency in acquiring, processing, and analyzing data from IoT sensorsto make informed decisions and optimize the performance of robotic systems.

CO5: Integrate the security and privacy challenges associated with IoT-enabled robotics and be able to implement best practices to mitigate risks and safeguard sensitive data.

CO6: Applying IoT principles to enable intelligent and adaptive behavior in roboticsystems

TEXT BOOKS:

1. Raj Kamal, INTERNET OF THINGS Architecture and Design Principles, McGraw Hill International Editions, 2017.
2. Mark R. Miller Robots, Robotics Principles, Systems, and Industrial Applications, McGrawHill International Editions, 2017.

REFERENCES:

1. Adrian McEwen & Hakim Cassimally, “Designing the Internet of Things”, Wiley,Nov 2013, (1st edition).
2. S.R. Deb, Robotics Technology and flexible automation, Tata McGraw-Hill Education., 2009.
3. Richard D. Klafter, Thomas.A, Chri Elewski, Michael Negin, Robotics Engineeringan Integrated Approach, PHI Learning., 2009.

4. Barry Leatham - Jones, Elements of industrial Robotics PITMAN Publishing, 1987.
5. Francis N. Nagy, Andras Siegler, Engineering foundation of Robotics, Prentice Hall Inc., 1987.
6. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key Applications and Protocols, 2nd Edition, Wiley Publications

NPTEL LINK:

https://nptel.ac.in/courses/107106090

https://nptel.ac.in/courses/127105386

COURSE CODE	COURSE TITLE	L	T	P	C
22EC920	DESIGN VERIFICATION AND DEBUGGING	3	0	0	3

COURSE OBJECTIVES:

- To introduce logic and fault simulation and testability measures.
- To study the design for testability.
- To know about interfacing and testing of memory
- To introduce power management techniques in testing
- To study testability in analog circuits

UNIT I	TEST REQUIREMENTS AND METRICS	9

Validation platforms- SOC design methodology, IP components, Integration, Clocking, I/Os and interfaces, Device modes, Logic, memories, analog, I/Os, power management; Test requirements-Test handoffs, Testers Where DUT and DFT fit into design / framework; Test-ATPG, DFT, BIST, COF, TTR; Test cost metrics and test economics; Logic fault models-SAF, TDF, PDF, Iddq, StBDG, Dy-BDG, SDD; Basics of test generation and fault simulation- Combinational circuits, Sequential; Specific algorithmic approaches, CAD framework, Optimizations.

UNIT II	SCAN DESIGN AND BIST	9

Scan Design- Scan design requirements, Types of scan and control mechanisms, Test pattern construction for scan, Managing scan in IPs and SOCs, Scan design optimisations, Partitioning, Clocking requirements for scan and delay fault testing, Speed of operation; BIST – Framework, Controller configurations, FSMs, LFSRs, STUMPS architecture, Scan compression and bounds, Test per cycle, Test per scan, Self-testing and self-checking circuits, Online test.

UNIT III	MEMORY TEST AND TEST INTERFACES	9

Memory Test -Memory fault models, Functional architecture as applicable to test, Test of memories, Test of logic around memories, BIST controller configuration, Test of logic around memories, DFT and architecture enhancements, Algorithmic optimisations; Test Interfaces-Test control requirements, Test interfaces - 1500, JTAG, Hierarchical, serial control, Module / IP test, SOC test, Board test, System test, Boundary scan.

UNIT IV	DESIGN CONSIDERATIONS AND POWER MANAGEMENT DURING TEST	9

Design Considerations- Design considerations, Physical design congestion, Partitioning, Clocks, Test modes, Pins, Test scheduling, Embedded test, Architecture improvements, Test in the presence of security; Power management during test- Methods for low power test, ATPG methods, DFT methods, Scan methods, Low power compression, Test of power

management, Implications of power excursions, Optimisations.		
UNIT V	**ANALOG TEST**	**9**
Test requirements. DFT methods. BIST methods. Test versus measurement. Defect tests versus performance tests. Tests for specific modules - PLL, I/Os, ADC, DAC, SerDes, etc. RF test requirements.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Understand logic and fault simulation requirements and testability measures.

CO2: Understand the Design for Testability.

CO3: Develop interfacing and memory testing.

CO4 Understand the various design consideration during test.

CO5: Perform testing with power management techniques.

CO6: Carry-out fault Detection in analog circuits

TEXT BOOKS:

1. M. L. Bushnell and V.D. Agrawal, Essentials of Electronic Testing for Digital Memory and Mixed Signal VLSI Circuits, Springer, 2005
2. M. Abramovici, M.A. Breuer and A.D. Friedman, "Digital Systems and Testable Design", Jaico Publishing House
3. Swarup Bhunia, Sandip Ray and Susmita Sur-kolay, Fundamentals of IP and SoC Security: Design Verification and Debug, Springer 2017.

REFERENCES:

1. H. Fujiwara, Logic Testing and Design for Testability, MIT Press, 1985
2. M. Abramovici, M. Breuer, and A. Friedman, Digital System Testing and Testable Design, IEEE Press, 1994.
3. M. Huth and M. Ryan, Logic in Computer Science, Cambridge Univ. Press, 2004.
4. T. Kropf, Introduction to Formal Hardware Verification, Springer Verlag, 2000.
5. P.K. Lala, "Digital Circuit Testing and Testability", Academic Press, 2002

NPTEL LINK:

https://onlinecourses.nptel.ac.in/noc20_ee76/preview

COURSE CODE	COURSE TITLE	L	T	P	C
22EC921	MASSIVE MIMO NETWORKS	3	0	0	3

COURSE OBJECTIVES:

- To gain knowledge about massive MIMO networks.
- To understand the massive MIMO propagation channels.
- To learn about channel estimation in single cell massive MIMO systems.
- To learn about channel estimation in multicell massive MIMO systems.
- To comprehend the concepts of massive MIMO deployment in the context of singlecell and multicell deployment.

UNIT I	MASSIVE MIMO NETWORKS	9

Definition of Massive MIMO, Correlated Rayleigh Fading, System Model for Uplink and Downlink, Basic Impact of Spatial Channel Correlation, Channel Hardening and Favourable Propagation, Local Scattering Spatial Correlation Model

UNIT II	THE MASSIVE MIMO PROPAGATION CHANNEL	9

Favorable Propagation and Deterministic Channels-Capacity Upper Bound-Distance from Favorable Propagation-Favorable Propagation and Linear Processing-Singular Values and Favorable Propagation, Favorable Propagation and Random Channels-Independent Rayleigh Fading-Uniformly Random Line-of-Sight (UR-LoS)-Independent Rayleigh Fading versus UR-LoS - Finite-Dimensional Channels

UNIT III	SINGLE-CELL SYSTEMS	9

Uplink Pilots and Channel Estimation - Orthogonal Pilots- De-Spreading of the Received Pilot Signal-MMSE Channel Estimation, Uplink Data Transmission - Zero-Forcing - Maximum-Ratio, Downlink Data Transmission-Linear Precoding-Zero-Forcing-Maximum- Ratio, Discussion-Interpretation of the Effective SINR Expressions-Implications for Power Control-Scaling Laws and Upper Bounds on the SINR - Near-Optimality of Linear Processing when M >> K - Net Spectral Efficiency - Limiting Factors: Number of Antennas
and Mobility.

UNIT IV	MULTI-CELL SYSTEMS	9

Uplink Pilots and Channel Estimation, Uplink Data Transmission - Zero-Forcing -Maximum-Ratio, Downlink Data Transmission -Zero-Forcing - Maximum-Ratio, Discussion - Asymptotic Limits with Infinite Numbers of Base Station Antennas - The Effects of Pilot Contamination - Non-Synchronous Pilot Interference.

UNIT V	CASE STUDIES	9

Single-Cell Deployment Example: Fixed Broadband Access in Rural Area, Multi-Cell Deployment: Preliminaries and Algorithms, Multi-Cell Deployment Examples: Mobile Access - Dense Urban Scenario - Suburban Scenario - Minimum Per-Terminal Throughput Performance -Additional Observations - Comparison of Power Control Policies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Understand and explain massive MIMO networks.

CO2: Analyze massive MIMO propagation channels and their capacity bounds

CO3: Examine channel estimation techniques for single cell system.

CO4: Analyze channel estimation techniques for multi cell system.

CO5: Explain the concepts underlining the deployment of single and multicell massive MIMO systems.

TEXT BOOKS:

1. Emil Bjornson, Jakob Hoydis and Luca Sanguinetti (2017), "Massive MIMO Networks: Spectral, Energy, and Hardware Efficiency", Foundations and Trends, Now, 2017.
2. Thomas L. Marzetta, Erik G. Larsson, Hong Yang, Hien Quoc Ngo, "Fundamentals of Massive MIMO", Cambridge University Press 2016.

REFERENCES:

1. Long Zhao, Hui Zhao, Kan Zheng, "Wei Xiang Massive MIMO in 5G Networks: Selected Applications", Springer 2018.The Constitution of India (Bare Act), Government Publication,1950
2. Leibo Liu, Guiqiang Peng, Shaojun Wei, "Massive MIMO Detection Algorithm and VLSI Architecture", Springer 2019.
3. Shahid Mumtaz, Jonathan Rodriguez, Linglong Dai, "mmWave Massive MIMO A Paradigm for 5G", Elsevier, 2017.
4. H. Yang and T. S. Quek, Massive MIMO meets Small Cell: Backhaul and operation, Springer, 2016.
5. R. S. Kshetrimayum, Fundamentals of MIMO Wireless Communications, Cambridge University Press, 2017.

NPTEL LINK:

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COURSECODE	COURSE TITLE	L	T	P	C
22EC922	BODY AREA NETWORKS	3	0	0	3

COURSE OBJECTIVES:

- To introduce the fundamentals of Body Area Networks
- To explain the hardware required for BAN
- To familiarize the students with the communication protocols and standards
- To describe the interference and regulatory details
- To introduce the applications of BAN
- To explain the security and sustainability issues

UNIT I	INTRODUCTION	9

Definition, BAN and Healthcare, Technical Challenges- Sensor design, biocompatibility, Energy Supply, optimal node placement, number of nodes, System security and reliability,BAN Architecture

UNIT II	HARDWARE FOR BAN	9

Wireless communication - RF communication in Body, Antenna design and testing, Matching Network, Propagation, Materials, Base Station, Power considerations, Wireless communication technologies for wearable systems, Body Area Network – Human Applications.

UNIT III	NETWORK TOPOLOGIES, PROTOCOLS AND STANDARDS	9

Network Topologies - Stand –Alone BAN, Wireless personal Area Network Technologies. Standards - IEEE 802.15.1, IEEE P802.15.13, IEEE 802.15.14, Zigbee, Healthcare system standards

UNIT IV	INTERFERENCE AND SECURITY ISSUES WITH BAN	9

Interferences – Intrinsic - Extrinsic, Effect on transmission, Regulatory issues – Medical Device regulation in Asia, Security and Self-protection - Bacterial attacks, Virus infection, secured protocols, Self-protection.

UNIT V	APPLICATIONS OF BAN	

Monitoring patients with chronic disease, Hospital patients, Elderly patients, Cardiac arrhymias monitoring, Multi patient monitoring systems, Multichannel Neural recording, Gait analysis, Smart Garments, Electronic pill.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Explain the fundamentals of Body Area Networks

CO2: Apply the communication protocol standards to Body Area Networks

CO3: Apply the BAN Architecture for healthcare application

CO4: Analyze the issues in the Body Area Networks.

CO5: Evaluate the efficiency of BAN

CO6: Design a Body Area Network for a simple application

TEXT BOOKS:

1. Sandeep K.S. Gupta,Tridib Mukherjee, Krishna Kumar Venkata Subramanian, "Body Area Networks Safety, Security, and Sustainability'', Cambridge University Press, 2013
2. Guang-Zhong Yang(Ed.), "Body Sensor Networks", Springer, Second Edition, 2014.

REFERENCES:

1. Mehmet R. Yuce, Jamil Y.Khan, "Wireless Body Area Networks Technology, Implementation, and Applications", Pan Stanford Publishing Pte. Ltd., Singapore, 2012
2. Zhang, Yuan-Ting, "Wearable Medical Sensors and Systems'', Springer, 2013.

NPTEL LINK:

https://archive.nptel.ac.in/courses/106/105/106105160/

COURSE CODE	COURSE TITLE	L	T	P	C
22EC923	WIRELESS NETWORKS	3	0	0	3

COURSE OBJECTIVES:

- To understand the concept about Wireless networks
- To describe the protocol stack and standards of Wireless networks
- To understand and analyse the network layer solutions for Wireless networks
- To understand the fundamentals of 3G Services, its protocols and applications
- To study the fundamentals of WLAN and WWAN
- To learn about evolution of 4G Networks, its architecture and applications.

UNIT I	WIRELESS LAN	9

Introduction-WLAN technologies: - IEEE802.11: System architecture, protocol architecture, 802.11b, 802.11a – Hiper LAN: WATM, BRAN, HiperLAN2 – Bluetooth: Architecture, WPAN – IEEE 802.15.4, Wireless USB, Zigbee, 6LoWPAN, Wireless HART

UNIT II	MOBILE NETWORK LAYER	9

Introduction - Mobile IP: IP packet delivery, Agent discovery, tunnelling and encapsulation, IPV6-Network layer in the internet- Mobile IP session initiation protocol - mobile ad-hoc network: Routing: Destination Sequence distance vector, IoT: CoAP

UNIT III	3G OVERVIEW	9

Overview of UTMS Terrestrial Radio access network-UMTS Core network Architecture: 3GPP Architecture, User equipment, CDMA2000 overview- Radio and Network components, Network structure, Radio Network, TD-CDMA, TD – SCDMA.

UNIT IV	INTERNETWORKING BETWEEN WLANS AND WWANS	9

Internetworking objectives and requirements, Schemes to connect WLANS and 3G Networks, Session Mobility, Internetworking Architecture for WLAN and GPRS, System Description, Local Multipoint Distribution Service, Multichannel Multipoint Distribution System.

UNIT V	4G & BEYOND	9

Introduction – 4G vision – 4G features and challenges - Applications of 4G – 4G Technologies: Multicarrier Modulation, Smart antenna techniques, IMS Architecture, LTE, Advanced Broadband Wireless Access and Services, MVNO.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Realize the concept of Wireless networks, protocol stack and standards

CO2: Analyse the network layer solutions for wireless networks

CO3: Illustrate the fundamentals of 3G Services, its protocols and applications

CO4: Elucidate the internetworking between WLAN and WWANs

CO5: Comprehend the features of 4G

CO6: Illustrate the features of LTE, MVNO

TEXT BOOKS:

1. Jochen Schiller, Mobile Communications, Second Edition, Pearson Education 2012 (Unit I,II,III)
2. Vijay Garg, Wireless Communications and networking, First Edition, Elsevier 2007 (Unit IV,V)

REFERENCES:

1. Erik Dahlman, Stefan Parkvall, Johan Skold and Per Beming, "3G Evolution HSPA and LTE for Mobile Broadband‖, Second Edition, Academic Press, 2008.
2. Anurag Kumar, D.Manjunath, Joy kuri, Wireless Networking, First Edition, Elsevier 2011.
3. Simon Haykin, Michael Moher, David Koilpillai, Modern Wireless Communications, First Edition, Pearson Education, 2013.
4. Young Kyun Kim, Ramjee Prasad, “4G Roadmap and Emerging Communication Technologies”, First Edition, Artech House Publishers, 2006.
5. Adarch Pandey, “Information 5G v/s 4G : Speed Limit Breakers: A Journey Through 4G to 5G Networks”, Neutral Sensors, 2023.

NPTEL LINK:

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COURSE CODE	COURSE TITLE	L	T	P	C
22EC924	AUGMENTED REALITY/ VIRTUAL REALITY	3	0	0	3

COURSE OBJECTIVES:

- To gain the knowledge of historical and modern overviews and perspectives on virtual reality.
- To learn the fundamentals of sensation, perception, and perceptual training.
- To have the scientific, technical, and engineering aspects of augmented and virtual reality systems.
- To learn the Evaluation of virtual reality from the lens of design.
- To learn the technology of augmented reality and implement it to have practical knowledge.
- Discuss and Examine VR/AR Technologies.

UNIT I	INTRODUCTION	9

Introduction to Augmented-Virtual and Mixed Reality, Taxonomy, technology and features of augmented reality, difference between AR ,VR and MR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality

UNIT II	INTRODUCTION TO VIRTUAL REALITY (VR) AND INPUT AND OUTPUT DEVICES	9

Virtual Reality and Virtual Environment, Computer graphics, Real time computer graphics,Flight Simulation, Virtual environment requirement, benefits of virtual reality, Historical development of VR, Scientific Landmark.

UNIT III	VIRTUAL ENVIRONMENT	9

Input/Output Devices: Input (Tracker, Sensor, Digital Gloves, Movement Capture,Videobased Input, 3D Menus & 3D Scanner, etc.), Output (Visual/Auditory/Haptic Devices)Generic VR system: Introduction, Virtual environment, Computer environment, VR technology, Model of interaction, VR Systems, Animating the Virtual Environment: Introduction, The dynamics of numbers, Linear and Nonlinear interpolation, the animation ofobjects, linear and non-linear translation, shape & object in between, free from deformation, particle system Physical Simulation: Introduction, Objects falling in a gravitational field, Rotating wheels, Elastic collisions, projectiles, simple pendulum, springs, Flight dynamics of an aircraft

UNIT IV	AUGMENTED REALITY DEVELOPMENT TOOLS AND FRAMEWORK	9
Human factors: Introduction, the eye, the ear, the somatic senses Hardware: Introduction, sensor hardware, Head-coupled displays, Acoustic hardware, Integrated VR systems Software: Introduction, Modelling virtual world, Physical simulation, VR toolkits, Introduction to VRML		
UNIT V	**AR / VR APPLICATION**	**9**
Introduction, Engineering, Entertainment, Science, Training, Game Development		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Describe how VR and AR systems work and list the applications.

CO2: Understand the design and implementation of the hardware that enables VR systems tobe built.

CO3: Explain the concepts of motion and tracking in VR and AR systems

CO4: Explore different input and output devices used in AR.

CO5: Describe the importance of interaction and audio in VR systems.

CO6: Understand the real-time application of AR/VR system.

TEXT BOOKS:

1. Coiffet, P., Burdea, G. C., (2003), "Virtual Reality Technology," Wiley-IEEE Press, ISBN: 9780471360896
2. Schmalstieg, D., Höllerer, T., (2016), "Augmented Reality: Principles & Practice," Pearson, ISBN: 9789332578494

REFERENCES:

1. Craig, A. B., (2013), "Understanding Augmented Reality, Concepts and Applications," Morgan Kaufmann, ISBN: 9780240824086.
2. Craig, A. B., Sherman, W. R., Will, J. D., (2009), "Developing Virtual Reality Applications, Foundations of Effective Design," Morgan Kaufmann, ISBN: 9780123749437.

NPTEL LINK:

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PROFESSIONAL ELECTIVE V

SEMESTER VII

COURSE CODE	COURSE TITLE	L	T	P	C
22EC925	UAV AND DRONE TECHNOLOGY	3	0	0	3

COURSE OBJECTIVES:

- To know about a various type of UAV and drone technology, drone fabrication and programming.
- To learn aerodynamics basics and apply Computational Fluid Dynamics for UAV aerodynamic analysis and execute the suitable operating procedures for functioninga drone.
- To master the process of designing, assembling, and testing UAVs
- To explore UAVs and Drone technology applications in industrial and engineeringsectors.
- To understand the regulations and standardization in drone technology.

UNIT I	INTRODUCTION TO UAV AND DRONE	9

Types of UAV and Characteristics - Fixed Wing, Rotary Wing and Flapping Wing - BasicParts of UAV and Specifications - Pay loads of UAV and Applications. Drone Concept and Vocabulary Terminology - History of drone, Types of current generation of drones based on their method of propulsion - Opportunities/applications for entrepreneurship and employability.

UNIT II	AERODYNAMICS AND AIRFRAME CONFIGURATION	9

Lift-induced Drag - Parasitic Drag - Rotary-wing Aerodynamics - Response to Air Turbulence - Airframe Configuration -Aspects of Airframe Design - Scale Effects - Packaging Density – Aerodynamics - Structures and Mechanisms - Selection of power-plants - Modular Construction.

UNIT III	MISSION PLANNING CONTROL STATION AND PAYLOAD CONTROL	9

MPCS Architecture - Local Area Networks - Levels of Communication - Physical Configuration - Planning and Navigation - MPCS Interfaces – Modes of Control – Piloting the Air Vehicle – Controlling payloads – Imaging Sensors – Stabilization of the Line of Sight

UNIT IV	UAVs AND DRONE TECHNOLOGY APPLICATIONS	9

UAVs for Industrial Applications - UAVs for Powerline Inspection - Telecom Structure Inspection and Radiation Measurement - Bridge and Heritage Structure Inspection - Collection of Sea Weeds using UAV. Choosing a drone based on the application -Drones in the insurance sector- Drones in delivering mail, parcels and other cargo- Drones in agriculture- Drones in inspection of transmission lines and power distribution -Drones in filming and panoramic picturing.

UNIT V	FUTURE DRONES AND SAFETY	9

The safety risks- Guidelines to fly safely -Specific aviation regulation and standardization - Drone license- Miniaturization of drones- Increasing autonomy of drones -The use of drones in swarms

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will able to

CO1: Understand various UAV and drone types, applications, and entrepreneurial opportunities.

CO2: Apply aerodynamics principles and Computational Fluid Dynamics for UAVdesign and optimization.

CO3: Develop practical skills in UAV design, assembly, integration, and testing,ensuring functional and reliable systems and assembling drone with its configurations

CO4: Evaluate UAV effectiveness in industrial tasks and application of drones.

CO5: Investigate future drone trends and safety protocols, ensuring responsible andsafe drone operation.

CO6: Demonstrate a comprehensive understanding of UAV and drone technology, including their types, applications, design principles, and industrial use cases.

TEXT BOOKS:

1. Austin, R. (2011). Unmanned aircraft systems: UAVS design, development anddeployment. John Wiley & Sons.
2. Sebbane, Y. B. (2022). A first course in aerial robots and drones. CRC Press.

REFERENCES:

1. Terry Kilby and Belinda Kilby, "Make:Getting Started with Drones ", Maker Media, Inc,2016.
2. Fahlstrom P, Gleason T (2012) Introduction to UAV systems, 4th edn. Wiley, UK
3. Daniel Tal and John Altschuld, "Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation", 2021 John Wiley & Sons, Inc.

NPTEL LINK:
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COURSE CODE	COURSE TITLE	L	T	P	C
22EC926	DESIGN OPTIMIZATION AND TIMING ANALYSIS	3	0	0	3

COURSE OBJECTIVES:

- Understand the basics of VLSI design optimization techniques.
- Analyze timing constraints and paths in digital circuits.
- Implement gate-level optimization methods to improve circuit performance.
- Apply sequential circuit optimization techniques for enhanced functionality.
- Explore advanced timing analysis techniques for complex designs.
- Develop skills in using industry-standard VLSI design tools for optimization andanalysis.

UNIT I	INTRODUCTION TO VLSI DESIGN OPTIMIZATION	9

Definition and importance of design optimization in VLSI. Evolution of optimization techniques in the semiconductor industry. Optimization Metrics and Goals Performance metrics: speed, power, area. Design goals: trade-offs between metrics. Optimization Algorithms- Simulated annealing, Genetic algorithms, Tabu search, Gradient descent methods. Optimization Tools- Introduction to industry-standard VLSI design tools, Overview of synthesis, place and route, and timing analysis tools.

UNIT II	TIMING ANALYSIS FUNDAMENTALS	9

Introduction to Timing Analysis- Definition and significance of timing analysis in VLSI, Timing constraints and design requirements, Setup and Hold Times, Clock Skew and Jitter, Critical Paths and Slack.

UNIT III	GATE LEVEL OPTIMIZATION TECHNIQUES	9

Introduction to Gate-Level Optimization- Importance of gate-level optimization in VLSI design & Basic optimization goals: area, speed & power, Logic Synthesis Basics- Overview of logic synthesis process, Boolean algebra and logic optimization techniques, Gate-Level Optimization Algorithms- Technology mapping algorithms & Logic restructuring techniques, Area vs. speed optimization strategies, Power OptimizationTechniques- Low-power design methodologies. Clock gating, power gating, and voltage scaling.

UNIT IV	SEQUENTIAL CIRCUIT OPTIMIZATION	9

Characteristics of sequential circuits, Challenges in optimizing sequential logic, Flip-Flops and Latches- Types of flip-flops: D, JK, T, etc. Setup and hold time considerations, State Machine Optimization- Finite state machines (FSMs) and their design, State minimization techniques, Advanced Sequential Optimization Techniques- Retiming and pipelining, Register balancing and clock domain crossing.

UNIT V	ADVANCED TIMING ANALYSIS AND OPTIMIZATION	9
Timing Closure in VLSI Design- Definition and importance of timing closure, Timing paths and constraints for high-performance designs, Advanced Timing Analysis Techniques- Path-based analysis: setup, hold, and recovery times, Skew and jitter analysis, Clock Domain Crossing (CDC)- Challenges in CDC and metastability, Synchronization techniques: synchronizers, FIFOs, dual-clock FIFOs, Timing Optimization Strategies- Timing-driven synthesis and place-and-route, Critical path optimization techniques.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will able to

CO1: Demonstrate proficiency in applying design optimization techniques to VLSIcircuits.

CO2: Evaluate and interpret timing requirements and constraints in digital designs.

CO3: Implement gate-level optimization algorithms to reduce area and power consumption.

CO4: Design and optimize sequential circuits for improved performance and functionality.

CO5: Perform comprehensive timing analysis on digital circuits using industry tools.

CO6: Communicate effectively and professionally about VLSI design optimization concepts and techniques.

TEXT BOOKS:

1. Gary D. Hachtel and Fabio Somenzi, VLSI Design Automation: A Practical Guide for Designing, Analyzing, and Optimizing Semiconductor Devices andSystems
2. Giovanni De Micheli, Synthesis and Optimization of Digital Circuits

REFERENCES:

1. Farhad Fallah, J. Bhasker, Timing Verification of Application-Specific Integrated Circuits (ASICs)
2. Bharat L. Bhuva and Narendra Shenoy, High-Performance VLSI Signal Processing Innovative Architectures and Algorithms

NPTEL LINK

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COURSE CODE	COURSE TITLE	L	T	P	C
22EC927	WIRELESS AD-HOC NETWORKS	3	0	0	3

COURSE OBJECTIVES:

The student should be made to:

- Learn Ad hoc network fundamentals
- Have an in-depth knowledge on adhoc network routing protocols
- Have an in-depth knowledge on MAC layer protocols
- Understand the security issues in Ad hoc network
- Investigating the existing adhoc network and improve its quality of service.

UNIT I	AD HOC NETWORKS – INTRODUCTION	9

Elements of Ad hoc Wireless Networks, Issues in Ad hoc wireless networks- Medium access scheme, Routing, Multicasting, Transport layer protocols, Medium access scheme ,Pricing scheme, Quality of service provisioning, Self-organization ,Security, Energy management, Addressing and service discovery, Scalability ,Deployment considerations Example commercial applications of Ad hoc networking- Military Applications, Collaborative and Distributed Computing ,Emergency Operations ,Wireless Mesh Networks -Ad hoc wireless Internet

UNIT II	ADHOC ROUTING PROTOCOLS-ISSUES AND CLASSIFICATIONS	9

Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks-Mobility, bandwidth constraint, Error-Prone Shared Broadcast Radio Channel, Hidden and Exposed Terminal Problems, resource Constraints-Characteristics of an Ideal Routing Protocol for Ad Hoc Wireless Networks Classifications of Routing Protocols, Table Driven Routing Protocols - DestinationSequenced Distance Vector (DSDV), On–Demand Routing protocols –Ad hoc On– Demand Distance Vector Routing (AODV).

UNIT III	MAC LAYER PROTOCOLS	~~9~~

MAC Layer Protocols for wireless ad hoc networks – Requirements, design constraints, Contention based protocols – with reservation, scheduling algorithms, protocols using directional antennas. – Energy efficient Routing protocols.

UNIT IV	ADHOC NETWORK SECURITY	9

Types of attacks in adhoc network--active and passive attacks-Network Layer Attacks Wormhole attack-Black hole attack-Byzantine attack-Information disclosure-Resource consumption attack-Routing attacks-Routing table overflow-Routing table poisoning- packet replication-Route cache poisoning – Key Distribution and Management – Intrusion Detection – Software based Anti-tamper techniques – Water marking techniques – Defense against routing attacks.

UNIT V	ADHOC NETWORKS MANAGEMENT TECHNIQUES	9
Energy management schemes-Battery management, transmission power management, system power management schemes. Quality of service solutions in ad hoc wireless networks.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Know the basics of Ad hoc networks.

CO2: Familiarize with the requirements, issues in routing protocols.

CO3: Apply this knowledge to identify the suitable routing algorithm based on the networkand user requirement

CO4: Apply the knowledge to identify appropriate MAC layer protocols.

CO5: Understand security issues possibilities in Ad hoc and sensor networks.

CO6: Evaluate the existing adhoc network and improve its quality of service

TEXT BOOKS:

1. C. Siva Ram Murthy and B. S. Manoj, "Ad Hoc Wireless Networks Architectures and Protocols", Prentice Hall, PTR, 2004
2. Ozan K. Tonguz and Gianguigi Ferrari: Ad-hoc Wireless Networks, John Wiley, 2007.

REFERENCES:

1. Feng Zhao, Leonidas Guibas, "Wireless Sensor Networks: an informationprocessing approach", Elsevier publication, 2004.
2. Charles E. Perkins, "Ad Hoc Networking", Addison Wesley, 2000.
3. Xiuzhen Cheng, Xiao Hung, Ding-Zhu Du: Ad-hoc Wireless Networking, Kluwer Academic Publishers, 2004.
4. C.K. Toh: Ad-hoc Mobile Wireless Networks- Protocols and Systems, Pearson Education, 2002

NPTEL LINK:

https://nptel.ac.in/courses/106105160

COURSE CODE	COURSE TITLE	L	T	P	C
22EC928	CYBER SECURITY	3	0	0	3

COURSE OBJECTIVES:

- To understand the field of digital security and concepts of access controlmechanisms.
- To introduce keywords and jargons involved in securing browser
- Understanding network basic and familiarize on security of network protocols
- Awareness and understanding on cyber-attacks and data privacy

UNIT I	BASICS OF DIGITAL SECURITY	9

Basics of digital security, protecting personal computers and devices, protecting devices from Virus and Malware, Identity, Authentication and Authorization, need for strong credentials.

UNIT II	CREDENTIAL SECURE PROTOCOL	9

In keeping credentials secure, protecting servers using physical and logical security, WorldWide Web (www), the Internet and the HTTP protocol, security of browser to web server interaction.

UNIT III	DESIGNING LARGE SCALE LANs	9

Networking basics (home network and large-scale business networks), Networking protocols, Security of protocols, sample application hosted on-premises.

UNIT IV	DATABASE SECURITY	9

Introduction to cyber-attacks, application security (design, development and testing), operations security, monitoring, identifying threats and remediating them, Principles of data security - Confidentiality, Integrity and Availability, Data Privacy, Data breaches, preventing attacks and breaches with security controls, Compliance standards, Computer Ethics.

UNIT V	SECURITY POLICY AND MANAGEMENT	9

Implementing operational security: evaluate security frameworks and guidelines and incorporate documentation, implement security strategies, manage data security processes, implement physical controls, Addressing security incidents: troubleshoot common security issues, respond to security incidents, investigate security incidents.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Apply a solid foundation in digital security and measures taken to protect device fromthreats.

CO2: Learning access control mechanism and understand how to protect servers

CO3: Understand the importance of a network basics and brief introduction on security of network protocols.

CO4: Comprehend cyber-attacks and learn data privacy issues and preventive measures.

CO5: Recognize cyber safety Identifying the Devices You Use, and Where You Use them.

CO6: Study the requirements, modelling, design testing and validation procedures that ensure security.

TEXT BOOKS:

1. Sammons, John, and Michael Cross. The basics of cyber safety: computer and mobile device safety made easy. Elsevier, 2016.

REFERENCES:

1. Charles P. Pfleeger, Shari Lawrence, Pfleeger Jonathan Margulies; Security in Computing, Pearson Education Inc . 5th Edition, 2015.
2. Brooks, Charles J., Christopher Grow, Philip Craig, and Donald Short, Cybersecurity essentials. John Wiley & Sons, 2018.

NPTEL LINK:

https://archive.nptel.ac.in/courses/112/105/112105249/

COURSE CODE	COURSE TITLE	L	T	P	C
22EC929	DATA ANALYTICS	3	0	0	3

COURSE OBJECTIVES:

- To explain the fundamentals of big data and data analytics
- To discuss the Hadoop framework
- To explain about exploratory data analysis.
- To discuss about data manipulation tools and use it for developing applications.
- To analyse and interpret streaming data
- To discuss various applications of data analytics

UNIT I	INTRODUCTION	9

Evolution of Big Data- Definition of Big Data-Challenges with Big Data- Traditional Business Intelligence (BI) versus Big Data- Introduction to big data analytics- Classification of Analytics- Analytics Tools- Importance of big data analytics.

UNIT II	HADOOP FRAMEWORK	9

Introducing Hadoop- RDBMS versus Hadoop- Hadoop Overview-HDFS (Hadoop Distributed File System)- Processing Data with Hadoop- Managing Resources and Applications with Hadoop YARN - Interacting with Hadoop Ecosystem.

UNIT III	EXPLORATORY DATA ANALYSIS	9

EDA fundamentals – Understanding data science – Significance of EDA – Making senseof data – Comparing EDA with classical and Bayesian analysis – Software tools for EDA – Data transformation techniques - Introduction to NoSQL – MongoDB: RDBMS Vs MongoDB – Data Types – Query Language – Hive – Hive Architecture – Data Types – File Formats - Hive Query Language (HQL) – RC File Implementation – User Defined Functions.

UNIT IV	MINING DATA STREAMS	9

The data stream model – stream queries-sampling data in a stream-general streaming problem filtering streams-analysis of filtering- dealing with infinite streams- Counting Distance Elements in a Stream – Estimating Moments – Counting Ones in Window – Decaying Windows.

UNIT V	APPLICATIONS	9

Application: Sales and Marketing – Industry Specific Data Mining – microRNA Data Analysis Case Study – Credit Scoring Case Study – Data Mining Non tabular Data.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Explain the fundamentals of big data and data analytics and illustrate it.

CO2: Discuss the Hadoop framework

CO3: Develop applications using exploratory data analysis.

CO4: Discuss about data manipulation tools.

CO5: Analyze and interpret streaming data.

CO6: Illustrate various applications of data analytics.

TEXT BOOKS:

1. Subhashini Chellappan, Seema Acharya, “Big Data and Analytics”, 2nd edition,Wiley Publications, 2019.
2. Suresh Kumar Mukhiya and Usman Ahmed, “Hands-on Exploratory Data Analysiswith Python”, Packet publishing, March 2020.

REFERENCES:

1. Nelli, F., Python Data Analytics: with Pandas, NumPy and Matplotlib, Apress,2018.
2. Bart Baesens," Analytics in a Big Data World: The Essential Guide to Data Scienceand its Applications", John Wiley & Sons, 2014.

NPTEL LINK:

https://onlinecourses.nptel.ac.in/noc21_cs45

COURSE CODE	COURSE TITLE	L	T	P	C
22EC930	SATELLITE COMMUNICATION	3	0	0	3

COURSE OBJECTIVES:

- To know about technology and evolution of Satellite networks.
- To gain knowledge on architecture and components of Space and Ground Segment.
- To analyse the uplink and downlink behaviour on satellite link budget.
- To understand access techniques of satellites and coding systems employed.
- To analyze and compare the characteristics and performance of various satellites.
- To familiarize and study the different arena in which satellite systems are applied.

UNIT I	INTRODUCTION	9

Kepler's Laws, Newton's law, orbital parameters, orbital perturbations, station keeping, geo-stationary and non-Geo-stationary orbits – Look Angle Determination- Limits of visibility – eclipse-Sub satellite point –Sun transit outage-Launching Procedures – launch vehicles and propulsion.

UNIT II	SPACE SEGMENT	9

Spacecraft Technology- Structure, Primary power, Attitude and Orbit control, Thermal control and Propulsion, communication Payload and supporting subsystems, Telemetry, Tracking and Command- Transponders-The Antenna Subsystem

UNIT III	SATELLITE LINK DESIGN	9

Basic link analysis, Interference analysis, Rain induced attenuation and interference, Ionospheric characteristics, Link Design with and without frequency reuse.

UNIT IV	SATELLITE ACCESS AND CODING SYSTEM	9

Modulation and Multiplexing: Voice, Data, Video, Analog – digital transmission system, Digital video Broadcast, multiple access: FDMA, TDMA, CDMA, DAMA Assignment Methods, compression – encryption, Coding Schemes

UNIT V	SATELLITE APPLICATION	9

INTELSAT Series, INSAT, VSAT, Mobile satellite services: GSM, GPS, INMARSAT, LEO, MEO, Satellite Navigational System. GPS Position Location Principles, Differential GPS, Direct Broadcast satellites (DBS/DTH), Satellite internet services.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Acquire knowledge of communication via satellite system.

CO2: Analyze the significance of various types of subsystems that make up a satellite system.

CO3: Design and analyze link budget.

CO4: Design compare and analyze access techniques.

CO5: Illustrate the advanced techniques and regulatory aspects of satellite communication.

CO6: Analyze the applications of satellite systems.

TEXT BOOKS:

1. Dennis Roddy, Satellite Communication, Fourth Edition, Mc Graw Hill International, 2016.
2. Timothy Pratt, Charles Bostian and Jeremy Allnutt, Satellite Communications, Wiley India, Third Edition, 2019

REFERENCES:

1. Wilbur L.Pritchard, Hendri G. Suyderhoud, Robert A. Nelson, Satellite Communication Systems Engineering, Prentice Hall/Pearson, 2007.
2. Bruce R. Elbert, The Satellite Communication Applications, Hand Book, Artech House Bostan London, 1997.
3. Tri T. Ha, Digital Satellite Communication, Second Edition, 1990.
4. Emanuel Fthenakis, Manual of Satellite Communications, Mc Graw Hill BookCo., 1984.
5. M.Richharia, Satellite Communication Systems-Design Principles, Macmillan 2003

NPTEL LINK:

https://nptel.ac.in/courses/117105131

MANAGEMENT ELECTIVES

COURSE CODE	COURSE TITLE	L	T	P	C
22EC981	PRINCIPLES OF MANAGEMENT	3	0	0	3

COURSE OBJECTIVES:

- Sketch the Evolution of Management.
- Extract the functions and principles of management.
- Learn the application of the principles in an organization.
- Study the various HR related activities.
- Analyze the position of self and company goals towards business

UNIT I	NATURE AND FUNCTIONS OF MANAGEMENT	9

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	PLANNING AND DECISION MAKING	9

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	ORGANIZING AND STAFFING	9

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	LEADING	9

Foundations of individual and group behavior– 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	CONTROL AND QUALITY MANAGEMENT	9

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 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Understand the management thoughts and various challenges of managerial activities in a global business environment.

CO2: Demonstrate the various strategies in Decision making at various levels management in the Organizations.

CO3: Discuss the various types of Organization structure.

CO4: Describe the steps in Staffing process and stages in Career development

CO5: Explain the elements in Direction

CO6: Summarize the various Controlling techniques to maintain standards in Organizations.

TEXT BOOKS:

1. Harold Koontz, Heinz Weihrich and Mark V. Cannice "Essentials of Management" 11th Edition McGraw Hill India 2020
2. Stephen P. Robbins and Mary Coulter, "Management", Prentice Hall (India)Pvt. Ltd., 10th Edition, 2009.

REFERENCES:

1. Robert Kreitner and Mamata Mohapatra, " Management", Biztantra, 2008.
2. Stephen A. Robbins and David A. Decenzo and Mary Coulter, "Fundamentals of Management", Pearson Education, 7th Edition, 2011.
3. Tripathy PC, Reddy PN and Ashish Bajpai, "Principles of Management", 7th Edition, Tata McGraw Hill, 2022.

NPTEL LINK:

https://onlinecourses.nptel.ac.in/noc23_mg33/preview

COURSE CODE	COURSE TITLE	L	T	P	C
22EC982	TOTAL QUALITY MANAGEMENT	3	0	0	3

COURSE OBJECTIVES:

- Understand the techniques for the implementation of quality management inmanufacturing and services processes.
- Explain the Quality Management principles and process.
- Discuss the importance of Quality in an organization.
- Understand the ISO Quality systems.
- Summarize the quality concepts adopted in industry scenario.

UNIT I	INTRODUCTION	9

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, and Customer retention

UNIT II	TQM PRINCIPLES	9

Leadership – Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S and case study, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating

UNIT III	TQM TOOLS & TECHNIQUES I	9

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process – FMEA and Applications in the Industry - Stages, Types.

UNIT IV	TQM TOOLS & TECHNIQUES II	9

Quality Circles, Cost of Quality, Quality Function Development (QFD) and case study- Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures

UNIT V	QUALITY SYSTEMS	9

Introduction - Benefits of ISO Registration - ISO 9000 Series of Standards - Sector-Specific Standards - AS 9100, TS16949 and TL 9000 - ISO 9001 Requirements – Implementation – Documentation - InternalAudits - Registration- Environmental Management System: Introduction - ISO 14000 Series Standards - Concepts of ISO 14001 - Requirements of ISO 14001 – Benefits of EMS.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Understand the quality philosophies and customer focused managerial system

CO2: Summarize the quality management principles.

CO3: Apply the six sigma concepts in manufacturing and service sector

CO4: Determine the tools and techniques for quality improvement.

CO5: Discuss the standards and auditing system on implementation of TQM

CO6: Analyze standards for the operation of EMS

TEXT BOOKS:

1. Dale H.Besterfiled, Carol B.Michna, Glen H. Besterfield, Mary B.Sacre, Hemant Urdhwareshe and Rashmi Urdhwareshe, Total Quality Management, Pearson Education Asia, Revised 3rd Edition, Indian Reprint, Sixth Impression, 2020

REFERENCES:

1. James R. Evans and William M. Lindsay, The Management and Control of Quality, 8thEdition, First Indian Edition, Cengage Learning, 2019.

2. Janakiraman. B and Gopal .R.K., Total Quality Management - Text and Cases, Prentice Hall(India) Pvt. Ltd., 2018.

3. Suganthi.L and Anand Samuel, Total Quality Management, Prentice Hall (India) Pvt. Ltd., 2020. ISO 9001-2015 standards

COURSE CODE	COURSE TITLE	L	T	P	C
22EC983	INTRODUCTION TO INNOVATION, IP MANAGEMENT & ENTREPRENEURSHIP	3	0	0	3

COURSE OBJECTIVES:

- Develop mindsets to pursue entrepreneurship.
- Understand the basics of Innovation and Entrepreneurship.
- Create, protect, assetize and commercialize intellectual property.
- Identify and discover market needs.
- Manage an innovation program.
- Understand Opportunities and challenges foe entrepreneurs through Startup Models

UNIT I	INNOVATION	9

Innovation Types of Innovation Incremental, disruptive, Lifecycle of Innovation (idea, literature survey, PoT, PoC, etc.), Challenges in Innovation (time, cost, data, infrastructure, etc.).

UNIT II	IPR	9

Types of IPR (patents, copyrights, trademarks, GI, etc.) Life cycle of IP (creation, protection, assetization, commercialization), Balancing IP Risks and Rewards (Right Access and Right Use of Open Source and 3rd party products, technology transfer and licensing).

UNIT III	ENTREPRENEURSHIP	9

Opportunity Identification in Technology Entrepreneurship (customer pain points, competitive context) Market Research, Segmentation and Sizing Product Positioning, Pricing, and Go-To-Market Strategy IP Valuation (methods, examples, limitations)..

UNIT IV	TYPES OF STARTUP BUSINESS MODEL	9

Startup Business Models (fund raising, market segments, channels, etc.) Co- innovation and Open Innovation (academia, startups, corporates) Technology Innovation: Two Case Studies.

UNIT V	PROCESSES IN STARTUP BUSINESS MODEL	9

Innovation, Incubation and Entrepreneurship in Corporate Context Technology-driven Social Innovation and Entrepreneurship Manage Innovation, IP and Entrepreneurship Programs – Processes, Governance and Tools.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Understand the basics of Innovation and Entrepreneurship

CO2: Manage an innovation program

CO3: Create, protect, assetize and commercialize intellectual property

CO4: Understand opportunities and challenges for entrepreneurs

CO5: Developing mindsets to pursue entrepreneurship.

CO6: Identify and discover market needs

TEXT BOOKS:

1. Jugaad Innovation: Think Frugal, Be Flexible, Generate Breakthrough Growth Navi Radjou, Jaideep Prabhu, Simone Ahuja , John Wiley & Sons, 2012.

REFERENCES:

1. Identifying Entrepreneurial Opportunities: Cognition and Categorization inNascent Entrepreneurs, Matthew J. Karlesky, University of Michigan, 2015.
2. http://www.businessdictionary.com/definition/entrepreneurship.
3. https://www.infoentrepreneurs.org/en/guides/use-innovation-to-grow-your- business/
4. http://sourcesofinsight.com/innovation-life-cycle/
5. https://www.investottawa.ca/
6. https://www.Lead-innovation.com

HONOR DEGREE IN IOT

COURSE CODE	COURSE TITLE	L	T	P	C
22EC941	INDUSTRIAL AND MEDICAL IOT	3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals of Industrial IoT and its applications,
- To gain conceptual understanding of communication protocols used in IIoT deployments.
- To learn about data management and analytics in Industrial IoT.
- To understand the fundamentals of Industrial IoT, its applications.
- To understand the different IoT platforms and cloud services.

UNIT I	IIoT SYSTEM INTEGRATION AND INTEROPERABILITY	9

IOT Vs IIOT, Integration of IIoT systems with existing industrial infrastructure - Interoperability challenges and solutions in IIoT - Standards and frameworks for IIoTsystem integration - Cyber-physical systems and digital twins in IIoT.

UNIT II	IIoT CONNECTIVITY AND COMMUNICATION PROTOCOL	9

IIoT communication requirements and challenges - Wired and wireless communication technologies for IIoT - Overview of common IIoT protocols: MQTT, OPC-UA, Modbus, Ethernet/IP, and more - Introduction to 5G and its role in IIoT – Network security and considerations in IIoT.

UNIT III	IIoT DATA MANAGEMENT AND ANALYTICS	9

Data acquisition, preprocessing, and storage in IIoT - Introduction to edge, fog, and cloud computing in IIoT - Data analytics techniques and tools for IIoT - Machine learning and AI for predictive maintenance and process optimization - Visualization of IIoT data and real-time monitoring.

UNIT IV	IoMT INTRODUCTION AND HEALTHCARE TECHNOLOGIES	9

Introduction to IoMT - Medical Sensors: ECG, blood pressure monitors, pulse oximeter, and glucose monitors. Communication Protocols in IoMT: Bluetooth, Wi-Fi, and Zigbee. Standards for IoMT - HIPAA, GDPR, and FDA regulations.

UNIT V	APPLICATION DESIGN & CASE STUDY	9

IoT Platforms and Cloud Services – Microsoft Azure, AWS. Application Design & Case Study: Wireless Patient Monitor system, Wearable Fitness & Activity Monitor, Design of IOT based pulse oximeter.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Develop conceptual design of Medical and Industrial IoT architecture.

CO2: Apply sensors and various protocols for industry standard solutions.

CO3: Articulate privacy and security measures for industry standard solutions.

CO4: Study about Internet of Medical Things (IoMT) and its applications in healthcare industry.

CO5: Design various applications using IoT in Healthcare Technologies.

CO6: Demonstrate and build the project successfully by hardware/sensor requirements, coding, emulating and testing.

TEXT BOOKS:

1. Veneri, Giacomo, and Antonio Capasso. Hands-on Industrial Internet of Things: Create a Powerful Industrial IoT Infrastructure Using Industry 4.0, 1st edition, Packt Publishing Ltd, 2018.
2. Reis, Catarina I., and Marisa da Silva Maximiano, eds. Internet of Things and advanced application in healthcare, 1st edition, IGI Global, 2016.

REFERENCES:

1. Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things, 1st Edition, Apress, 2017
2. Aboul Ella Hassanien, Nilanjan Dey and Sureaka Boara, Medical Big Data and Internet of Medical Things: Advances, Challenges and Applications, 1st edition, CRC Press, 2019.
3. Hamed Farhadi, Rezaul Begg, and Joarder Kamruzzaman, Internet of Medical Things (IoMT) and Analytics Handbook for Connected Healthcare, Elsevier, 2020.
4. Martin Gillet, Industrial Internet of Things: A Guide to Deploying IoT in Industrial and Manufacturing Environments, Apress,2017.
5. Arvind Kumar Bansal and Valentina E. Balas, Internet of Things for Healthcare Technologies: From Sensor to Cloud Based Systems, Springer, 2020.

NPTEL LINK:

https://archive.nptel.ac.in/courses/106/105/106105195/

COURSE CODE	COURSE TITLE	L	T	P	C
22EC942	PROGRAMMING AND WEB TECHNOLOGIES FOR IOT	3	0	0	3

COURSE OBJECTIVES:

- To comprehend and analyze the basic concepts of web programmingand internet Protocols.
- To describe how the client-server model of Internet programming works.
- To design and develop IoT applications using web technologies such as HTML, CSS, and JavaScript.
- To learn how to integrate IoT devices with web services.
- To gain hands-on experience in programming and developing web technologies for IoT.

UNIT I	INTRODUCTION TO INTERNET	9

Internet Overview- Networks – WWW –Web Protocols — Web Organization and Addressing – Internet Service Providers, DNS Servers, Connection Types, Internet Addresses - Web Browsers and Web Servers -Security and Vulnerability-Web System Architecture – URL - Domain Name.

UNIT II	CLIENT SIDE SCRIPTING	9

HTML5 – Text tags; Graphics, Form elements, HTML 5 Input types, semantic tags, CSS3 - Selectors, Box Model, Backgrounds and Borders, Text Effects, Animations, Cascading and inheritance of style properties - Normal Flow Box Layout-Beyond the Normal Flow – Introduction to responsive design – bootstrap. JavaScript -Variables and Data Types - Statements – Operators- Literals- Functions Objects- Arrays- Built-in Objects, DOM – BOM - Regular Expression Exceptions, Event handling, Validation – Jquery.

UNIT III	DEVELOPING INTERACTIVE WEB APPLICATIONS	9

AJAX –AJAX calls - XML http – request – response – AJAX with PHP - Data Formats - AJAX with Database – Processing Server Response - AJAX Security.

UNIT IV	SERVER-SIDE SCRIPTING	9

Introduction to Node.js- NPM - Events, Timers, and Callbacks in Node.js – file upload – email – Express framework – request –response –routing - templates- view engines. Introduction to Mongo DB- creating DB, collection – CRUD operations – Accessing MongoDB from Node.js. – Accessing online Mongo DB from Node JS.

UNIT V	REACT WEB FRAMEWORK	9

Introduction – Environment setup – JSX – React DOM – React Elements - Components – react

state – Props – Hooks – Component life cycle. Introduction – Environment setup – JSX – React DOM – React Elements - Components – react state – Props – Hooks – Component life cycle.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Know the different web protocols and web architecture.

CO2: Apply HTML and CSS effectively to create dynamic websites.

CO3: Create event responsive webpages using AJAX and JQuery.

CO4: Implement server-side programming

CO5: Learn web data storage and transfer technologies using Angular.

CO6: Develop web applications using advanced technologies such as Node JS.

TEXT BOOKS:

1. Paul J. Deitel, Harvey Deitel, Internet and World Wide Web How To Program, 6th Edition, Pearson, 2020.
2. Vasan Subramanian, Pro MERN Stack - Full stack web app development, 2nd Edition, 2019.

REFERENCES:

1. Jessica Minnick, Responsive Web Design with HTML 5 & CSS, Cengage Learning, 2020.
2. Frank Zammetti, Modern Full-Stack Development: TypeScript, React, Node.js, 1st Edition, Apress, 2020.
3. Jennifer Niederst Robbins, Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics, O'Reilly Media, 2018.
4. Jon Duckett, JavaScript and JQuery: Interactive Front-End Web Development, Wiley, 2014.
5. Jon Duckett, Web Design with HTML, CSS, JavaScript and jQuery Set, Wiley, 2014.

NPTEL LINK:

https://archive.nptel.ac.in/courses/106/106/106106156/

COURSE CODE	COURSE TITLE	L	T	P	C
22EC943	DEEP LEARNING AND ITS APPLICATIONS	3	0	0	3

COURSE OBJECTIVES:

- To introduce the theory and techniques of deep learning, including deep neural networks, convolutional neural networks (CNNs), and recurrent neural networks RNNs.
- To design and develop an application using specific deep learning models.
- To provide the practical knowledge in handling and analysing real world applications.
- To learn how to implement and train deep learning models using popular frameworks such as TensorFlow, Keras, and PyTorch.
- To explore ways to improve model performance and interpretability.

UNIT I	DEEP LEARNING ARCHITECTURES	9

Machine Learning and Deep Learning, Representation Learning, Width and Depth of Neural Networks, Activation Functions: RELU, LRELU, ERELU, Unsupervised Training of Neural Networks, Restricted Boltzmann Machines, Auto Encoders, Deep learning frameworks: TensorFlow, Keras, and PyTorch.

UNIT II	CONVOLUTIONAL NEURAL NETWORKS AND TRANSFER LEARNING	9

Architectural Overview, Motivation, Layers, Filters, Parameter sharing, Regularization, Popular CNN Architectures: ResNet, AlexNet – Applications. Transfer learning Techniques, Variants of CNN: DenseNet, PixelNet.

UNIT III	SEQUENCE MODELLING – RECURRENT AND RECURSIVE NETS	9

Recurrent Neural Networks, Bidirectional RNNs, Encoder-decoder sequence to sequence architectures - BPTT for training RNN, Long Short Term Memory Networks.

UNIT IV	AUTO ENCODERS AND DEEP GENERATIVE MODELS	9

Under complete Auto encoder, Regularized Auto encoder, stochastic Encoders and Decoders, Contractive Encoders. Deep Belief networks, Boltzmann Machines, Deep Boltzmann Machine, Generative Adversial Networks.

UNIT V	DEEP LEARNING WITH IOT APPLICATIONS	9

Real-time processing and optimization for camera-based applications - Developing an object detection model for IoT devices - Face detection and recognition using a pre-trained CNN model - Activity recognition using a pre-trained LSTM model - Real-time object detection using a Raspberry Pi.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Recognize the characteristics of deep learning models that are useful to solve real- world problems.

CO2: Understand different methodologies to create application using deep nets.

CO3: Identify and apply appropriate deep learning algorithms for analyzing the data for variety of problems.

CO4: Implement different deep learning algorithms.

CO5: Design the test procedures to assess the efficacy of the developed model.

CO6: Combine several models in to gain better results

TEXT BOOKS:

1. Ian Goodfellow, YoshuaBengio and Aaron Courville, Deep Learning, MIT Press, 2017.
2. Josh Patterson, Adam Gibson, Deep Learning: A Practitioner's Approach, O'Reilly Media, 2017.

REFERENCES:

1. Kevin P. Murphy, Machine Learning: A Probabilistic Perspective, The MIT Press, 2012.
2. EthemAlpaydin, Introduction to Machine Learning, MIT Press, Prentice Hall of India, Third Edition 2014.
3. Giancarlo Zaccone, Md. RezaulKarim, Ahmed Menshawy, Deep Learning with TensorFlow: Explore neural networks with Python, Packt Publisher, 2017.
4. Antonio Gulli, Sujit Pal, Deep Learning with Keras, Packt Publishers, 2017.
5. Francois Chollet, Deep Learning with Python, Manning Publications, 2017.

NPTEL LINK:

https://archive.nptel.ac.in/courses/106/106/106106224/

COURSE CODE	COURSE TITLE	L	T	P	C
22EC944	DESIGN OF SMART CITIES	3	0	0	3

COURSE OBJECTIVES:

- To understand the concept of smart city and associated challenges.
- To understand smart infrastructure development used in smart cities.
- To understand process of planning and drafting a plan for smart city.
- To understand the importance of project management in smart cities.
- To understand the application of technologies in smart cities.

UNIT I	INTRODUCTION TO SMART CITY AND URBAN PLANNING	9

Introduction, Smart City, Complexities of Smart Cities, Urban Network, Sensor Network, Role of Urban Networks, Trends in Urban Development, Community Resource Sensing. Urban Planning, Databases, Principles of Urban Planning, Data Organization, Role of Planning in Smart Cities, Case Studies.

UNIT II	SMART PHYSICAL INFRASTRUCTURE	9

Infrastructure development in Smart Cities - Physical Infrastructure, Land Use - Compact/mixed-use development, Transit oriented development (TOD); Smart City Management-Transportation Unified governance structure (UMTA). Smart public transportation, Smart parking, Intelligent traffic management, Detour management; Low emission vehicles, Electric Mobility - Environmental projects etc.

UNIT III	SUSTAINABILITY AND SMART PLANNING	9

Relationship Between Sustainability and Smart planning - Place making project guidelines-Surveillance, Smart Street Lighting, Intelligent Emergency Services, Intelligent Disaster Forecasting and Management, GIS-based Spatial Decision Support Systems, Smart Communication Services.

UNIT IV	PROJECT MANAGEMENT IN SMART CITIES	9

Philosophy and project management, Phases and Stages of Project, Work Breakdown Structure, Project Organization Structure, Planning, Scheduling, Case studies on project management of smart cities – web application and mobile based implementation

UNIT V	APPLICATION OF TECHNOLOGIES IN SMART CITIES	9

Role of Technologies in Smart Cities - Integrated Command and Control Center (ICCC), Data Analytics, Data driven strategies implementation in smart cities

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Acquaint knowledge on smart cities planning and development.

CO2: Gain knowledge on implementation of smart physical infrastructure.

CO3: Understand the role of smart planning for sustainable development.

CO4: Understand energy efficient and safety measures related to smart cities.

CO5: Develop work break down structure, scheduling and project management of smart cities.

CO6: Comprehend the knowledge of Technologies in Smart City planning.

TEXT BOOKS:

1. Prasanna K.Mohanty "Cities and Public Policy: An Urban Agenda for India" Sage Publications, 2014
2. Dr. Sameer Sharma, "Smart Cities Unbundled: Ideas and Practice of Smart Cities in India", Bloomsbury India, 2018.

REFERENCES:

1. Urban and Regional Development Plans Formulation and Implementation Guidelines: Volume I and II, Town and Country Planning Organisation, Ministry of Housing and Urban Affairs, Government of India.
2. S. K. Kulshrestha, "Urban Renewal in India: Theory, Initiatives and Spatial Planning Strategies" SAGE Publications, 2018
3. Massimo Bertoncini and Alessandra De Paola, The Internet of Things and Smart Cities: Technologies, Applications and Challenges, Springer 2018.
4. Poonam Sharma and Swati Rajput, "Sustainable Smart cities in India: Challenges and Future Perspectives" Springer Nature, 2017
5. Tan Yigitcanlar, Nikos Komninos and Mark Deakin, "Smart Cities" Elsevier, 2017

NPTEL LINK:

http://www.nitttrc.edu.in/nptel/courses/video/124107007/L43.html

COURSE CODE	COURSE TITLE	L	T	P	C
22EC979	CAPSTONE PROJECT	0	0	12	6

COURSE OBJECTIVES:

- To provide students with a comprehensive understanding of IoT technologies, including sensors, actuators, and image and video analytics, and how they can be integrated into practical solutions.
- To enable students to design and develop IoT systems using the Robot Operating System (ROS), a widely used open-source robotics middleware platform.
- To give students hands-on experience with IoT technologies through the development of a Capstone project that addresses a real-world problem or meets a specific need in the industry, healthcare, agriculture, or smart homes.
- To foster teamwork, creativity, and communication skills by working collaboratively on a Capstone project that involves industry partners, stakeholders, or end-users.
- To prepare students for a successful career in the rapidly growing field of IoT by enhancing their problem-solving skills, critical thinking, and adaptability to new technologies and challenges.

STRATEGY:

- A student or a group of students (maximum 4) has to identify a topic of interest in consultation with faculty supervisor.
- They review the literature and gather information pertaining to the chosen topic and state the objectives and develop a methodology to achieve the objectives.
- Based on the topic, experimental investigation/ software analysis/ analytical modelling will be carried out.
- The results will be analyzed with a concluding remark to correlate the objectives.
- A comprehensive report will be prepared after completing the project.
- Evaluation will be done based on the performance in the periodic reviews, project report and viva voce examination.

TOTAL: 180 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Demonstrate a comprehensive understanding of IoT technologies, including sensors, actuators, and image and video analytics, and their applications in practical solutions.

CO2: Analyze and evaluate IoT solutions using a systematic approach, including the use of appropriate sensors, actuators, and analytics algorithms.

CO3: Collaborate effectively with industry partners, stakeholders, or end-users to develop a Capstone project that addresses a real-world problem or meets a specific need in the industry, healthcare, agriculture, or smart homes.

CO4:Communicate and present complex technical information effectively to both technical and non-technical audiences.

CO5: Continuously adapt to new technologies and challenges in the rapidly evolving field of IoT and demonstrate the ability to learn and apply new skills to real-world problems.

HONOR DEGREE IN VLSI					
COURSE CODE	**COURSE TITLE**	**L**	**T**	**P**	**C**
22EC947	**SEMICONDUCTOR DEVICES AND FABRICATION PROCESSES**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

- To acquire fundamental knowledge of MOS capacitors.
- To understand the semiconductor device modelling aspects
- To understand the short channel effects of MOSFET.
- To analyze the miniaturization of CMOS Device.
- To gain knowledge on CMOS fabrication processes.

UNIT I	**MOS CAPACITORS**	**9**

Surface Potential: Accumulation, Depletion, and Inversion, Electrostatic Potential and Charge Distribution in Silicon, Capacitances in an MOS Structure, Polysilicon-Gate Work Function and Depletion Effects, MOS under Non equilibrium and Gated Diodes, Charge in Silicon Dioxide and at the Silicon–Oxide Interface,Effect of Interface Traps and Oxide Charge on Device Characteristics.

UNIT II	**MOSFET DEVICES**	**9**

Long-Channel MOSFETs, Drain-Current Model, MOSFET I–V Characteristics, Subthreshold Characteristics, Substrate Bias and Temperature ependence of Threshold Voltage, MOSFET Channel Mobility, MOSFET Capacitances and Inversion-Layer Capacitance Effect.

UNIT III	**ANALYSIS OF SHORT CHANNEL EFFECTS**	**9**

Short-Channel MOSFETs, Short-Channel Effect, Velocity Saturation and High-Field Transport Channel Length Modulation, Source–Drain Series Resistance, MOSFET Degradation and Breakdown at High Fields.

UNIT IV	**CMOS DEVICE SCALING**	**9**

CMOS Scaling, Constant-Field Scaling, Generalized Scaling, Non scaling Effects, Threshold Voltage, Threshold-Voltage Requirement, Channel Profile Design, Non Uniform Doping, Quantum Effect on Threshold Voltage, Discrete Dopant Effects on Threshold Voltage, MOSFET Channel Length, Various Definitions of Channel Length, Extraction of the Effective Channel Length, Physical Meaning of Effective Channel Length, Extraction of Channel Length by C–V Measurements.

UNIT V	**VLSI FABRICATION PROCESSES**	**9**

Overview of nMOS fabrication process, CMOS Fabrication-p Well process, n well process,

Twin well process, SOI wafer fabrication technologies: an overview, SOI volume-fabrication process

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Explore the properties of MOS capacitors

CO2: Analyze the various characteristics of MOSFET devices.

CO3: Understand the short channel effects of MOSFET.

CO4: Understand the effects of scaling of CMOS devices.

CO5: Explain the impact of design parameters on the performance of the device

CO6: Understand the concept of CMOS fabrication process

TEXT BOOKS:

1. Yuan Taur and Tak H.Ning, Fundamentals of Modern VLSI Devices, Cambridge University Press,2016
2. Douglas A. Pucknell, Kamran Eshraghian, Basic VLSI Design, PHI learning India Private Limited, III Edition,2011

REFERENCES:

1. A.B. Bhattacharyya, Compact MOSFET Models for VLSI Design, John Wiley & Sons Ltd, 2009.
2. B. G. Streetman and S. Banerjee, Solid State Electronic Devices, 6th Edition, PHI Private Limited,2011.
3. Behzad Razavi, Fundamentals of Microelectronics, Wiley Student Edition, 2nd Edition, 2014.
4. S.M.Sze, Kwok.K. NG, Physics of Semiconductor devices, Springer, 2006.
5. M. Lundstrom,Fundamentals of Carrier Transport, Cambridge University Press, 2000.

NPTEL LINK:

http://nptel.ac.in/courses/117106033

COURSE CODE	COURSE TITLE	L	T	P	C
22EC948	RFIC DESIGN	3	0	0	3

COURSE OBJECTIVES:

- To study the various impedance matching techniques used in RF circuit design.
- To study amplifier design
- To analyze oscillators performance.
- To understand the functional design aspects of LNAs, Mixers, PLLs and VCOs.
- To understand frequency synthesis.

UNIT I	IMPEDANCE MATCHING IN AMPLIFIERS	9

Characteristics of passive IC components at RF frequencies – Definition of 'Q', Series Parallel Transformations of Lossy Circuits, Impedance Matching Using 'L', 'Pi' and T Networks, Integrated Inductors, Resistors, Capacitors, Tunable Inductors, Transformers.

UNIT II	HIGH FREQUENCY AMPLIFIER DESIGN	9

High frequency amplifier design – zeros as bandwidth enhancers, shunt-series amplifier, fTdoublers, Low noise amplifier design – LNA topologies, impedance matching, power constrained noise optimization, linearity and large signal performance.

UNIT III	ANALYSIS OF SHORT CHANNEL EFFECTS	9

Mixers – fundamentals of mixers, multiplier-based mixers, sub sampling mixers, diode-ring mixers.

UNIT IV	OSCILLATORS	9

Oscillators– Feedback View of Oscillators, Colpitts oscillator, Hartley oscillator, describing functions, tuned oscillators, negative resistance oscillators.

UNIT V	PLL AND FREQUENCY SYNTHESIZERS	9

Phase Detector/Charge Pump, Analog Phase Detectors, Digital Phase Detectors, Frequency Dividers, Loop Filter Design, Phase Locked Loops, Phase Noise in PLL, Loop Bandwidth, Basic Integer-N Frequency Synthesizer, Basic Fractional-N Frequency Synthesizer

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: To understand the principles of operation of an RF receiver front end

CO2: To design and apply constraints for LNAs, Mixers and frequency synthesizers.CO3: To analyze and design mixers.

CO4: To design different types of oscillators and perform noise analysisCO5: To design PLL and frequency synthesizer

CO6: To understand passive components at RF frequencies and required circuit theory

TEXT BOOKS:

1. Thomas H. Lee, Cambridge, The Design of CMOS Radio-Frequency Integrated Circuits, UK: Cambridge University Press, 2004
2. Phillip E. Allen and Douglas R. Holberg- CMOS Analog Circuit Design Oxford University Press -3rd Ed., -2011

REFERENCES:

1. Behzad Razavi, RF Microelectronics, Prentice Hall, 1998.
2. Ludwig, Rf Circuit Design, 2nd Ed., Pearson,2011.
3. Bosco H Leung VLSI for Wireless Communication, Pearson Education, 2002
4. Behzad Razavi, Design of Analog CMOS Integrated Circuits, Mcgraw-Hill, 1999
5. Jia-Sheng Hong, Microstrip Filters for RF/Microwave Applications, Wiley, 2001

NPTEL LINK:

https://nptel.ac.in/courses/117102012

COURSE CODE	COURSETITLE	L	T	P	C
22EC949	VLSI ALGORITHMS AND ARCHITECTURES	3	0	0	3

COURSE OBJECTIVES:

- To discuss the algorithms for logic synthesis and verification.
- To discuss the design tradeoff in various partitioning algorithms, placement, floor planning and pin assignment of VLSI design automation.
- To analyze the different global routing algorithms.
- To describe the basics of 7series FPGA Architecture.
- To discuss the various implementation strategies with FPGA.

UNIT I	LOGIC SYNTHESIS & VERIFICATION	9

Introduction to combinational logic synthesis, Binary Decision Diagram, Hardware models for High-level synthesis, Introduction to Circuit Simulation-Co–Simulation.

UNIT II	PARTITIONING, PLACEMENT, FLOOR PLANNING &PIN ASSIGNMENT	9

Problem formulation, classification of partitioning algorithms, Group migration algorithms, simulated annealing & evolution, other partitioning algorithms, simulation base placement algorithms, other placement algorithms, constraint-based floor planning, floor planning algorithms for mixed block & cell design. General & channel pin assignment.

UNIT III	GLOBAL ROUTING	9

Problemformulation, classification of global routing algorithms, Mazerouting algorithm, lineprobe algorithm, Steiner Tree based algorithms, ILP based approaches Detailed Routing: problem formulation, classification of routing algorithms, single layer routing algorithms, two-layer channel routing algorithms, three-layer channel routing algorithms, and switch box routing algorithms Over the Cell Routing & Via Minimization: two layers over the cell routers, constrained & unconstrained via minimization.

UNIT IV	INTRODUCTION TO FPGA ARCHITECTURES	9

Logic blocks, routing architecture, Design flow–Strengths and Weaknesses of FPGA, Application andcomputationalCharacteristicsandPerformanceinXilinxVirtex-7, Spartan-7FPGAs

UNIT V	IMPLEMENTING APPLICATION SWITH FPGA	9

General Implementation Strategies for FPGA-based Systems - Configure - once Run time Reconfiguration Design Flow–. Implementing Arithmetic-Fixed-point, Floating-point, Block Floating Point Number Representation - CORDIC Architectures for FPGA Computing.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Analyze the algorithms needed for synthesis.

CO2 : Explore the partitioning, placement and floor planning

CO3: Describe the various global routing algorithm.

CO4: Analyze the classification of channel routing algorithm.

CO5: Describe the routing architecture of FPGA.

CO6: Implement application with FPGA

TEXT BOOKS:

1. Naveed Shervani, Algorithms for VLSI physical design Automation, KluwerAcademic Publisher, Third Edition,2017.
2. P.K.Chan & S.Mourad, Digital Design Using Field Programmable Gate Array,Prentice Hall (Pte), 1994.

REFERENCES:

1. Trimburger,Introduction to CAD for VLSI, Kluwer Academic publisher,2002.
2. SabihH.Gerez,Algorithms for VLSI Design Automation, John Wiley & Sons,2007.
3. J.OldField,R.Dorf,Field Programmable Gate Arrays,John Wiley & Sons,NewYork, 1995.
4. Christophn Meinel & Thorsten Theobold, Algorithm and Data Structures for VLSI Design, Kluwer Academic publisher, 2002.
5. 7 series FPGA's Data sheetsofArtix-7,Kintex-7,Virtex-7-xilinx-2020.

NPTEL LINK:

https://nptel.ac.in/courses/108105118

COURSE CODE	COURSE TITLE	L	T	P	C
22EC952	RECONFIGURABLE ARCHITECTURES	3	0	0	3

COURSE OBJECTIVES:

- To develop an overview and deeper insight into the research and development that is underway to meet future needs of flexible processors
- To learn the concepts of implementation, synthesis and placement of modules in reconfigurable architectures
- To understand the communication techniques and System on Programmable Chip for reconfigurable architectures
- To learn the process of reconfiguration management
- To familiarize the applications of reconfigurable architectures

UNIT I	INTRODUCTION	9

General purpose computing – domain specific processors – Application Specific Processors – reconfigurable computing – fields of application – evolution of reconfigurable systems – Simple Programmable Logic Devices – Complex Programmable Logic Devices – Field Programmable Gate Arrays – coarse grained reconfigurable devices.

UNIT II	IMPLEMENTATION, SYNTHESIS AND PLACEMENT	9

Integration – FPGA design flow – logic synthesis – LUT based technology mapping – modeling –temporal partitioning algorithms – offline and online temporal placement – managing device's free and occupied spaces.

UNIT III	COMMUNICATION AND SOPC	9

Direct communication – communication over third party – bus based communication – circuit switching – Network on Chip – dynamic Network on Chip – System on a Programmable Chip –adaptive multi-processing on chip.

UNIT IV	RECONFIGURATION MANAGEMENT	9

Reconfiguration – configuration architectures – managing the reconfiguration process – reducing configuration transfer time – configuration security.

UNIT V	APPLICATIONS	9

FPGA based parallel pattern matching - low power FPGA based architecture for microphone arrays in Wireless Sensor Networks - exploiting partial reconfiguration on a dynamic coarse grained reconfigurable architecture – parallel pipelined OFDM baseband modulator with dynamic frequency scaling for 5G systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Analyze the different architecture principles relevant to reconfigurable computing systems

CO2: Compare the tradeoffs that are necessary to meet the area, power and timing criteria of reconfigurable systems

CO3: Analyze the algorithms related to placement and partitioning

CO4: Analyze the communication techniques and system on programmable chip for reconfigurable architectures.

CO5: Analyze the principles of Network and System on a Programmable Chip

TEXT BOOKS:

1. Christophe Bobda, "Introduction to Reconfigurable Computing: Architectures, Algorithms and Applications", Springer 2007.
2. Scott Hauck and Andre Dehon, "Reconfigurable Computing: The Theory and Practice of FPGA Based Computation", Elsevier 2008.

REFERENCES:

1. M. Gokhale and P. Graham, "Reconfigurable Computing: Accelerating Computation with Field-Programmable Gate Arrays", Springer, 2005.
2. Nikoloas Voros Et Al. "Applied Reconfigurable Computing: Architectures, Tools andApplications" Springer, 2018.
3. Koen Bertels, João M.P. Cardoso, Stamatis Vassiliadis,"Reconfigurable Computing: Architectures and Applications", Springer 2006

NPTEL LINK:

https://nptel.ac.in/courses/117108040

COURSE CODE	COURSE TITLE	L	T	P	C
22EC979	CAPSTONE PROJECT	0	0	12	6

COURSE OBJECTIVES:

- To provide students with a comprehensive understanding of IoT technologies, including sensors, actuators, and image and video analytics, and how they can be integrated into practical solutions.
- To enable students to design and develop IoT systems using the Robot Operating System (ROS), a widely used open-source robotics middleware platform.
- To give students hands-on experience with IoT technologies through the development of a Capstone project that addresses a real-world problem or meets a specific need in the industry, healthcare, agriculture, or smart homes.
- To foster teamwork, creativity, and communication skills by working collaboratively on a Capstone project that involves industry partners, stakeholders, or end-users.
- To prepare students for a successful career in the rapidly growing field of IoT by enhancing their problem-solving skills, critical thinking, and adaptability to new technologies and challenges.

STRATEGY:

- A student or a group of students (maximum 4) has to identify a topic of interest in consultation with faculty supervisor.
- They review the literature and gather information pertaining to the chosen topic and state the objectives and develop a methodology to achieve the objectives.
- Based on the topic, experimental investigation/ software analysis/ analytical modelling will be carried out.
- The results will be analyzed with a concluding remark to correlate the objectives.
- A comprehensive report will be prepared after completing the project.
- Evaluation will be done based on the performance in the periodic reviews, project report and viva voce examination.

TOTAL: 180 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Demonstrate a comprehensive understanding of IoT technologies, including sensors, actuators, and image and video analytics, and their applications in practical solutions.

CO2: Analyze and evaluate IoT solutions using a systematic approach, including the use of appropriate sensors, actuators, and analytics algorithms.

CO3: Collaborate effectively with industry partners, stakeholders, or end-users to develop a Capstone project that addresses a real-world problem or meets a specific need in the industry, healthcare, agriculture, or smart homes.

CO4: Communicate and present complex technical information effectively to both technical and non-technical audiences.

CO5: Continuously adapt to new technologies and challenges in the rapidly evolving field of IoT and demonstrate the ability to learn and apply new skills to real-world problems.

HONOR DEGREE IN HIGH-SPEED COMMUNICATION

COURSE CODE	COURSE TITLE	L	T	P	C
22EC953	ADVANCED WIRELESS COMMUNICATION	3	0	0	3

COURSE OBJECTIVES:

- To learn the concepts of wireless communication.
- To know about the various propagation methods, Channel models, capacity calculations multiple antennas and multiple user techniques used in the mobile communication.

UNIT I	WIRELESS CHANNEL PROPAGATION AND MODEL	9

Propagation of EM signals in wireless channel – Reflection, diffraction and Scattering-freespace, two ray. Small scale fading- channel classification- channel models – COST -231 Hata model, NLOS Multipath Fading Models: Rayleigh, Rician, Nakagami, 5G Channel model requirements and Measurements, propagation scenarios, METIS channel models, Map-based model, stochastic model.

UNIT II	CAPACITY OF WIRELESS CHANNELS	9

Capacity in AWGN, capacity of flat fading channel, capacity of frequency selective fading channels. Capacity of MISO, SIMO systems.

UNIT III	DIVERSITY	9

Realization of independent fading paths, Receiver Diversity: Selection combining, Threshold Combining, Maximum-ratio Combining, Equal gain Combining. Transmitter Diversity: Channel known at transmitter, Channel unknown at the transmitter.

UNIT IV	MIMO COMMUNICATIONS	9

Narrowband MIMO model, Parallel decomposition of the MIMO channel, MIMO channel capacity, MIMO Diversity Gain: Beam forming, Diversity-Multiplexing trade-offs, Spacetime Modulation and coding: STBC, STTC, Spatial Multiplexing and BLAST Architectures.

UNIT V	MULTI USER SYSTEMS	9

Introduction to MUD, Linear decorrelator, MMSE MUD, Adaptive MUD, MIMO-MUD Application of convex optimization to wireless design.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Analyse the wireless channel characteristics and identify appropriate channel Models.

CO2: Understand the mathematics behind the capacity calculation under different channel Conditions.

CO3: Understand the implication of diversity combining methods and the knowledge of Channel.

CO4: Understand the concepts in MIMO Communications.

CO5: Understand different access techniques

CO6: Understand use of access techniques in different multi-user scenarios

TEXT BOOKS:

1. David Tse and Pramod Viswanath, Fundamentals of wireless communications,Cambridge University Press, First Edition, 2012
2. Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2007.

REFERENCES:

1. Harry R. Anderson, "Fixed Broadband Wireless System Design", John Wiley,India, 2003.
2. Andreas.F. Molisch, "Wireless Communications", John Wiley, India, 2006.
3. Simon Haykin & Michael Moher, "Modern Wireless Communications", Pearson Education, 2007.
4. Rappaport. T.S., "Wireless communications", Pearson Education, 2003.
5. Gordon L. Stuber, "Principles of Mobile Communication", Springer International Ltd., 2001.

NPTEL LINK:

https://onlinecourses.nptel.ac.in/noc24_ee10/preview

COURSE CODE	COURSE TITLE	L	T	P	C
22EC954	ADVANCED WIRELESS NETWORKS	3	0	0	3

COURSE OBJECTIVES:

- To gain knowledge about the digital cellular systems
- To build an understanding of the concepts and performance of IEEE 802.16 standard.
- To build knowledge on LTE specific signalling protocols and procedures.
- To understand Wireless local and personal area network setup & its security
- To comprehend the concepts of cognitive radio technologies

UNIT I	3G MOBILE CELLULAR TECHNOLOGIES	9

CDMA2000-Operational Advantages, General Architecture, Airlink Design, Data Throughput, Forward Link Scheduling, Reverse Link, CDMA2000 1xEV Signaling, Handoffs, CDMA2000 1xEV-DO, CDMA2000 1xEV-DV. WCDMA-ETSI UMTS versus ARIB WCDMA, UMTS Cell and Network Structure, UMTS Radio Interface, UMTS, UTRA Channels, UTRA Multiplexing and Frame Structure, Spreading and Carrier Modulations, Packet Data, Power Control Handovers.

UNIT II	WiMAX	9

Background on IEEE 802.16 and WiMAX, Salient Features of WiMAX, WiMAX Physical Layer, MAC-Layer Overview, Advanced Features for Performance Enhancements, Reference Network Architecture, Performance Characterization

UNIT III	LTE AND LTE-ADVANCED NETWORKS	9

Overview of LTE Networks, The Radio Protocol Architecture, The Interfaces, Support for Home eNBs (Femtocells), Air Interface, Frame Structure, UE States and State Transitions, Quality of Service and Bandwidth Reservation, Mobility Management, Security, Frame Structure in LTE, Frame Structure in LTE-Advanced, LTE Identification, Naming and Addressing.

UNIT IV	WIRELESS DATA NETWORKS	9

IEEE 802.11 Standards for Wireless Networks, IEEE 802.11a Supplement to 802.11 Standards, IEEE 802.11 Security, IEEE 802.15 WPAN Standards, ETSI HIPERLAN and ETSI HIPERLAN/2 Standards, Bluetooth Technologies.

UNIT V	COGNITIVE RADIO TECHNOLOGY & 5G	9

Definitions of Cognitive Radio, Basic Cognitive Algorithms, Conceptual Classifications of Cognitive Radios, Cognitive Radio for WPANs, Cognitive Radio for WLANs, Cognitive Radio for WMANs, Cognitive Radio for WWANs, Cognitive Radio for WRANs: IEEE 802.22, Challenges to Implement Cognitive Radio.5G system concept, Concept overview, Extreme mobile broadband, Massive machine type communication, Ultra-reliable machine-type communication-The 5G architecture-NFV and SD Basics about RAN architecture, D2D standardization: 4G LTE D2D, New relaying Techniques for 5G.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1 : Apply Digital cellular concepts in the design of Cellular networks

CO2: Build and Design the wireless networks based on the IEEE 802.16 standard

CO3: Explain the LTE related components and its functions

CO4: Demonstrate advanced knowledge of networking and performance of data networks and define performance metrics

CO5: Explain the concepts behind the cognitive wireless networks and next generation Networks

CO6: Explain the concept of new relaying techniques for 5G

TEXT BOOKS:

1. William Stallings; Foundations of Modern Networking, 1st Ed.; Pearson Education India,2016 .
2. Hsiao-Hwa Chen and Mohsen Guizani, Next Generation Wireless Systems and Networks, John Wiley & Sons Ltd, 2006.

REFERENCES:

1. Abd-Elhamid M Taha, Hossam S Hassanein and Najah Abu Ali, LTE, LTE-Advanced and WiMAX towards IMT-Advanced Networks, John Wiley & Sons, Ltd, 2012.
2. Jeffrey G Andrews, Arunabha Ghosha and Rias Muhamed, Fundamentals of WiMAX
3. Fazel K and Kaiser S, Multi-Carrier and Spread Spectrum Systems-From OFDM and MC-CDMA to LTE and WiMAX, John Wiley & Sons, Second Edition, 2008.
4. Steve Rackley, Wireless Networking Technology from Principles to Successful Implementation, Elsevier, 2007.
5. Paul Goransson, Chuck Black, Software Defined Networks: A Comprehensive Approach,1st Edition, 2006

NPTEL LINK:

https://nptel.ac.in/courses/112107289

COURSE CODE	COURSE TITLE	L	T	P	C
22EC955	SOFTWARE DEFINED NETWORKS	3	0	0	3

COURSE OBJECTIVES:

- To learn the fundamentals of software defined networks
- To understand the separation of the data plane and the control plane.
- To study about the data center concepts in SDN
- To understand the programming in SDN and network function virtualization concept
- To build an SDN framework and understand the concept of data center orchestration.

UNIT I	INTRODUCTION TO SDN	9

History of Software Defined Networking (SDN) – Modern Data Center – Traditional Switch Architecture – Why SDN – Evolution of SDN – How SDN Works – Centralized and Distributed Control and Date Planes

UNIT II	OPEN FLOW AND SDN CONTROLLERS	9

Open Flow Specification – Drawbacks of Open SDN, SDN via APIs, SDN via Hypervisor-Based Overlays – SDN via Opening up the Device – SDN Controllers – General Concept

UNIT III	DATA CENTER CONCEPTS	9

Multitenant and Virtualized Multitenant Data Center – SDN Solutions for the Data Center Network – VLANs – EVPN – VxLAN – NVGRE

UNIT IV	NETWORK FUNCTION VIRTUALIZATION	9

Programming SDNs: Northbound Application Programming Interface, Current Languages and Tools, Composition of SDNs – Network Functions Virtualization (NFV) and Software Defined Networks: Concepts, Implementation and Applications

UNIT V	BUILDING AN SDN FRAMEWORK	9

Juniper SDN Framework – IETF SDN Framework – Open Daylight Controller – Floodlight Controller – Bandwidth Calendaring – Data Center Orchestration

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Analyze the evolution of software defined networks

CO2: Express the various components of SDN and their uses

CO3: Explain the use of SDN in the current networking scenario

CO4: Design and develop various applications of SDN

CO5: Apply the concept in building SDN framework

CO6: Discuss the use cases.

TEXT BOOKS:

1. Paul Goransson and Chuck Black, Software Defined Networks: A Comprehensive Approach, First Edition, Morgan Kaufmann, 2014.
2. Thomas D. Nadeau, Ken Gray, SDN: Software Defined Networks, O'Reilly Media, 2013.

REFERENCES:

1. Oswald Coker, Siamak Azodolmolky, Software-Defined Networking with OpenFlow, 2nd Edition,O'Reilly Media, 2017
2. Vivek Tiwari, SDN and Open Flow for Beginners, Amazon Digital Services, Inc., 2013.
3. William Stallings, Foundations of Modern Networking: SDN, NFV, QoE, IoT and Cloud, Pearson Education, 1st Edition, 2015
4. Fei Hu, Network Innovation through OpenFlow and SDN: Principles and Design, 1st Edition,CRC Press, 2014
5. Ken Gray, Thomas D. Nadeau, Network Function Virtualization, Morgan Kauffman, 2016.

NPTEL LINK:

https://nptel.ac.in/courses/106105077

COURSE CODE	COURSE TITLE	L	T	P	C
22EC956	SATELLITE COMMUNICATION & NAVIGATION SYSTEMS	3	0	0	3

COURSE OBJECTIVES:

- To learn the basic parameters in satellite communication.
- Learn M2M developments and satellite applications.
- Understand Satellite Communication in IPv6 Environment.
- Learn the concepts of GPS Working and its application.
- Understand the concepts of Deep Space Networks and Inter Planetary Mission.

UNIT I	OVERVIEW OF SATELLITE COMMUNICATION	9

Overview of satellite communication and orbital mechanics Link budget Parameters, Link budget calculations, Auxiliary Equations, Performance Calculations.

UNIT II	M2M DEVELOPMENTS AND SATELLITE APPLICATIONS	9

Overview of the Internet of Things and M2M- M2M Applications Examples and Satellite Support- Satellite Roles Context and Applications- Antennas for Satellite M2MApplications- M2M Market Opportunities for Satellite Operators

UNIT III	SATELLITE COMMUNICATION IN IPV6 ENVIRONMENT	9

Overview of IPv6 and its benefits for Satellite Networks - Migration and Coexistence- Implementation scenarios and support- Preparations for IPv6 in Satellite communication- Satellite specific Protocol issues in IPv6 – Impact of IPv6 on Satellite Network architecture and services.

UNIT IV	SATELLITE NAVIGATION AND GLOBAL POSITIONING SYSTEM	9

Overview of Radio and Satellite Navigation, GPS Principles, Signal model and Codes, Satellite Signal Acquisition, Mathematical model of GPS observables, Methods of processing GPS data, GPS Receiver Operation and Differential GPS.

UNIT V	DEEP SPACE NETWORKS AND INTER PLANETARY MISSION	9

Introduction – Functional description - Design procedure and performance criterion-Mars exploration Rover- Mission and spacecraft summary-Telecommunication subsystem overview- Ground Subsystem-Telecom subsystem and Link performance Telecom subsystem Hardware and software Chandrayaan-1 Mission - Mission and spacecraft summary-Telecommunication subsystem overview-Ground Subsystem-Telecom subsystem and Link performance.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Discuss Satellite navigation and global positioning system

CO2: Understand deep space networks and inter planetary missions

CO3: Demonstrate an understanding of the different interferences and attenuation mechanisms affecting the satellite link design.

CO4: Demonstrate an understanding of the different communication, sensing and navigational applications of satellite

CO5: Familiar with the implementation aspects of existing satellite-based systems.

CO6: Understand the CHANDRAYAN mission and its working

TEXT BOOKS:

1. Anil K. Maini, Varsha Agrawal, 'Satellite Technology: Principles and Applications', Third Edition, Wiley, 2014.
2. Daniel Minoli, Satellite Systems Engineering in an IPv6 Environment, CRC Press, First Edition, 2009.

REFERENCES:

1. Daniel Minoli' Innovations in Satellite Communication and Satellite Technology Wiley,2015
2. Hofmann-Wellenhof B., Lichtenegger H., and Elmar Wasle, Global Navigational Satellite Systems Springer-Verlag, 2008.
3. Adimurthy.V, Concept design and planning of India's first interplanetary mission Current Science, VOL. 109, NO. 6, 1054 25 SEPTEMBER 2015.
4. Jim Taylor,Deep Space Communications John Wiley & Sons, 2016
5. Louis J. Ippolito, Jr. Satellite Communications Systems Engineering: Atmospheric Effects, Satellite Link Design and System Performance, Second Edition, 2017

NPTEL LINK:

https://archive.nptel.ac.in/courses/117/105/117105131/

COURSE CODE	COURSE TITLE	L	T	P	C
22EC979	CAPSTONE PROJECT	0	0	12	6

COURSE OBJECTIVES:

- To provide students with a comprehensive understanding of IoT technologies, including sensors, actuators, and image and video analytics, and how they can be integrated into practical solutions.
- To enable students to design and develop IoT systems using the Robot Operating System (ROS), a widely used open-source robotics middleware platform.
- To give students hands-on experience with IoT technologies through the development of a Capstone project that addresses a real-world problem or meets a specific need in the industry, healthcare, agriculture, or smart homes.
- To foster teamwork, creativity, and communication skills by working collaboratively on a Capstone project that involves industry partners, stakeholders, or end-users.
- To prepare students for a successful career in the rapidly growing field of IoT by enhancing their problem-solving skills, critical thinking, and adaptability to new technologies and challenges.

STRATEGY:

- A student or a group of students (maximum 4) has to identify a topic of interest in consultation with faculty supervisor.
- They review the literature and gather information pertaining to the chosen topic and state the objectives and develop a methodology to achieve the objectives.
- Based on the topic, experimental investigation/ software analysis/ analytical modelling will be carried out.
- The results will be analyzed with a concluding remark to correlate the objectives.
- A comprehensive report will be prepared after completing the project.
- Evaluation will be done based on the performance in the periodic reviews, project report and viva voce examination.

TOTAL: 180 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Demonstrate a comprehensive understanding of IoT technologies, including sensors, actuators, and image and video analytics, and their applications in practical solutions.

CO2: Analyze and evaluate IoT solutions using a systematic approach, including the use of appropriate sensors, actuators, and analytics algorithms.

CO3: Collaborate effectively with industry partners, stakeholders, or end-users to develop a Capstone project that addresses a real-world problem or meets a specific need in the industry, healthcare, agriculture, or smart homes.

CO4: Communicate and present complex technical information effectively to both technical and non-technical audiences.

CO5: Continuously adapt to new technologies and challenges in the rapidly evolving field of IoT and demonstrate the ability to learn and apply new skills to real-world problems.

HONOR DEGREE IN BIO MEDICAL TECHNOLOGY

COURSE CODE	COURSE TITLE	L	T	P	C
22EC959	BIOMETRIC SYSTEMS	3	0	0	3

COURSE OBJECTIVES:

- Demonstrate the knowledge of engineering principles underlying biometric systems
- Apply algorithms to model finger print.
- Classify different face recognition and hand geometry pattern
- Analyse the design and performance of biometrics.
- Explain various computation of authentication methods.

UNIT I	INTRODUCTION TO BIOMETRICS	9

Introduction and back ground – biometric technologies – passive biometrics – activebiometrics - Biometric systems – Enrolment – templates – algorithm – verification – Biometric applications – biometric characteristics- Authentication technologies –Need for strong authentication - Protecting privacy and biometrics and policy – Biometric applications – biometric characteristics.

UNIT II	FINGERPRINT TECHNOLOGY	9

History of fingerprint pattern recognition - General description of fingerprints - Finger print feature processing techniques - fingerprint sensors using RF imaging techniques – fingerprint quality assessment – computer enhancement and modelling of fingerprint images – fingerprint enhancement – Feature extraction – fingerprint classification – and matching.

UNIT III	FACE RECOGNITION AND HAND GEOMETRY	9

Introduction to face recognition, Neural networks for face recognition – face recognition from correspondence maps – Hand geometry – scanning – Feature Extraction - Adaptive Classifiers - Visual-Based Feature Extraction and Pattern Classification - feature extraction – types of algorithm – Biometric fusion.

UNIT IV	MULTIMODAL BIOMETRICS AND PERFORMANCE EVALUATION	9

Voice Scan – physiological biometrics –Behavioral Biometrics - Introduction to multimodal biometric system – Integration strategies – Architecture – level of fusion – combination strategy – training and adaptability – examples of multimodal biometric systems – Performance evaluation-Statistical Measures of Biometrics – FAR – FRR – FTE – EER – Memory requirement and allocation.

UNIT V	BIOMETRIC AUTHENTICATION	9

Introduction - Biometric Authentication Methods - Biometric Authentication Systems – Biometric authentication by fingerprint -Biometric Authentication by Face Recognition. Expectation-Maximization theory - Support Vector Machines. Biometric authentication by fingerprint – biometric authentication by hand geometry- Securing and trusting a biometric transaction – matching location – local host - authentication server – match on card (MOC) – Multibiometrics and Two-Factor Authentication.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Describe the concepts, algorithm and application of biometrics.

CO2: Explain the description and processing technique in fingerprint technology.

CO3: Illustrate the concept of face recognition and geometry.

CO4: Know various multi modal Biometric and performance evaluation.

CO5: Understand various Biometric authentication.

CO6: Analyze various security involved in Biometric System.

TEXT BOOKS:

1. James Wayman, Anil Jain, Davide Maltoni, Dario Maio, "Biometric Systems, Technology Design and Performance Evaluation",Springer,2005 (Units I,II,III&IV)
2. S.Y. Kung, S.H. Lin, M.W.Mak, "Biometric Authentication: A Machine Learning Approach" PrenticeHall,2005(Unit V)

REFERENCES:

1. Paul Reid, "Biometrics for Network Security", Pearson Education, 2004.
2. Nalini K Ratha, Ruud Bolle, "Automatic finger print Recognition System",Springer,2003.
3. Handbook of Biometrics" edited by Anil K. Jain, Patrick Flynn, and Arun A. Rosswas the second edition, published in 2007.
4. Biometric Recognition: Challenges and Opportunities" edited by Joseph P.Campbell, Simon J. Godsill, and Anthony N. K. Yezzi Jr, first edition 2010
5. Biometrics" by John D. Woodward, Nicholas M. Orlans, and Peter T. Higgins, first edition 2010

NPTEL LINK:

https://nptel.ac.in/courses/106104119

COURSE CODE	COURSE TITLE	L	T	P	C
22EC960	BIO-SIGNAL PROCESSING	3	0	0	3

COURSE OBJECTIVES:

- To describe the characteristics of different bio signals
- To discuss linear and non-linear filtering techniques to extract desired information
- To demonstrate the significance of wavelet detection applied in bio signal processing.
- To extract the features from the bio signal
- To summarize techniques for automated classification and decision making to aid diagnosis

UNIT I	SIGNAL, SYSTEM AND SPECTRUM	9

Characteristics of some dynamic biomedical signals, Noises- random, structured and physiological noises. Filters- IIR and FIR filters. Spectrum – power spectral density function, cross-spectral density and coherence function, cepstrum and homomorphic filtering. Estimation of mean of finite time signals.

UNIT II	TIME SERIES ANALYSIS AND SPECTRAL ESTIMATION	9

Time series analysis – linear prediction models, process order estimation, non-stationary process, fixed segmentation, adaptive segmentation, application in EEG, PCG and HRV signals, model-based ECG simulator. Spectral estimation – Blackman Tukey method, periodogram and model-based estimation. Application in Heart rate variability, PCG signals

UNIT III	ADAPTIVE FILTERING AND WAVELET DETECTION	9

Filtering – LMS adaptive filter, adaptive noise cancelling in ECG, improved adaptive filtering in FECG, EEG and other applications in Bio signals, Wavelet detection in ECG – structural features, matched filtering, adaptive wavelet detection, detection of overlapping wavelets.

UNIT IV	ANALYSIS OF BIOSIGNAL	9

Removal of artifact – ECG, Event detection –ECG, P Wave, QRS complex, T wave, Correlation analysis of ECG signals, Average of Signals-PCG, ECG and EMG.

UNIT V	BIOSIGNAL CLASSIFICATION AND RECOGNITION	9

Statistical signal classification, linear discriminate function, direct feature selection and ordering, Back propagation neural network-based classification.

Case study: 1. Various methods used to extract features from EEG signal

Case Study 2: Diagnosis and monitoring of sleep apnea

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Analyse the different types of signals & systems

CO2: Analyse signals in time series domain & estimate the spectrum

CO3: Apply wavelet detection in biosignal processing

CO4: Extract the features from biosignal .

CO5: Discuss methods of the classification of biosignals.

CO6: Develop systems for monitoring of biosignals

TEXT BOOKS:

1. Willis J.Tompkins, Biomedical Digital Signal Processing, Prentice Hall of India,New Delhi, 2006.
2. Rangaraj M. Rangayyan, 2nd edition "Biomedical Signal Analysis-A case study approach", Wiley- Interscience /IEEE Press, 2015

REFERENCES:

1. Raghuveer M. Rao and Ajith S.Bopardikar, Wavelets transform – Introduction to theory and its applications, Pearson Education, India 2000
2. Emmanuel C. Ifeachor, Barrie W.Jervis, second edition, "Digital Signal processing-Practical Approach" Pearson education Ltd., 2002
3. Arnon Cohen, "Bio-Medical Signal Processing Vol I and Vol II", CRC Press Inc.,Boca Rato, Florida, 1999.
4. D.C.Reddy, "Biomedical Signal Processing – Principles and Techniques"", Tata McGraw-Hill Publishing Co. Ltd, 2005.
5. Gari D. Clifford, Francisco Azuaje and Patrick E.McSharry, "Advanced Methods and Tech for ECG Data Analysis", ARTECH House, Boston, 1st Edition, 2006.

NPTEL LINK:

https://onlinecourses.nptel.ac.in/noc20_ee41/preview

COURSE CODE	COURSE TITLE	L	T	P	C
22EC963	BRAIN COMPUTER INTERFACE AND APPLICATIONS	3	0	0	3

COURSE OBJECTIVES:

- Understand the basic concepts of brain computer interface
- Study the various signal acquisition methods
- Learn about the signal processing methods used in BCI
- Understand the various machine learning methods of BCI.
- Learn the various applications of BCI

UNIT I	INTRODUCTION TO BCI	9

Introduction - Brain structure and function, Brain Computer Interface Types – Synchronous and Asynchronous -Invasive BCI -Partially Invasive BCI - Non Invasive BCI, Structure of BCI System, BCI Monitoring Hardware, EEG, ECoG, MEG, fMRI

UNIT II	BRAIN ACTIVATION	9

Brain activation patterns - Spikes, Oscillatory potential and ERD, Slow cortical potentials, Movement related potentials-Mu rhythms, motor imagery, Stimulus related potentials - Visual Evoked Potentials – P300 and Auditory Evoked Potentials, Potentials related to cognitive tasks.

UNIT III	FEATURE EXTRACTION METHODS	9

Data Processing – Spike sorting, Frequency domain analysis, Wavelet analysis, Time domain analysis, Spatial filtering -Principal Component Analysis (PCA), Independent Component Analysis (ICA), Artefacts reduction, Feature Extraction - Phase synchronization and coherence

UNIT IV	MACHINE LEARNING METHODS FOR BCI	9

Classification techniques –Binary classification, Ensemble classification, Multiclass Classification, Evaluation of classification performance, Regression - Linear, Polynomial, RBF's, Perceptron's, Multilayer neural networks, Support vector machine, Graph theoretical functional connectivity analysis

UNIT V	APPLICATIONS OF BCI	9

Case Studies - Invasive BCIs: decoding and tracking arm (hand) position, controlling prosthetic devices such as orthotic hands, Cursor and robotic control using multi electrode array implant, Cortical control of muscles via functional electrical stimulation. Noninvasive BCIs:P300 Mind Speller, Visual cognitive BCI, Emotion detection. Ethics of Brain Computer Interfacing.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Comprehend and appreciate the significance and role of this course in the present

contemporary world.

CO2: Evaluate concept of BCI.

CO3: Assign functions appropriately to the human and to the machine.

CO4: Select appropriate feature extraction methods.

CO5: Apply machine learning algorithms for translation.

CO6: Interpret the applications of BCI.

TEXT BOOKS:

1. Rajesh.P.N.Rao, "Brain-Computer Interfacing: An Introduction", Cambridge University Press, First edition, 2013.
2. Jonathan Wolpaw, Elizabeth Winter Wolpaw, "Brain Computer Interfaces: Principles and practice", Oxford University Press, USA, Edition 1, January 2012.

REFERENCES:

1. Ella Hassianien, A &Azar.A.T (Editors), "Brain-Computer Interfaces Current Trends and Applications", Springer, 2015.
2. Bernhard Graimann, Brendan Allison, GertPfurtscheller, "Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction", Springer, 2010
3. Ali Bashashati, MehrdadFatourechi, Rabab K Ward, Gary E Birch," A survey of signal Processing algorithms in brain–computer interfaces based on electrical brain signals" Journal of Neural Engineering, Vol.4, 2007, PP.32-57
4. Arnon Kohen, "Biomedical Signal Processing", Vol I and II, CRC Press Inc, Boca Rato, Florida.
5. Bishop C.M., "Neural networks for Pattern Recognition", Oxford, Clarendon Press, 1995.

NPTEL LINK:

https://nptel.ac.in/courses/108108167

COURSE CODE	COURSE TITLE	L	T	P	C
22EC962	MEDICAL IMAGING TECHNIQUES	3	0	0	3

COURSE OBJECTIVES:

- To understand the generation of X-ray and its uses in medical imaging
- To describe the principle of Computed Tomography.
- To know the techniques used for visualizing various sections of the body
- To learn the principles of different radio diagnostic equipment in Imaging.
- To discuss the radiation therapy techniques and radiation safety.

UNIT I	UNIT 1 X RAYS	9

Nature of X-rays- X-Ray absorption – Tissue contrast. X- Ray Equipment (Block Diagram) – X-Ray Tube, the collimator, Bucky Grid, power supply, Digital Radiography - discrete digital detectors, storage phosphor and film scanning, X-ray Image Intensifier tubes – Fluoroscopy – Digital Fluoroscopy. Angiography, cine Angiography. Digital subtraction Angiography. Mammography.

UNIT II	COMPUTED TOMOGRAPHY	9

Principles of tomography, CT Generations, X- Ray sources- collimation- X- Ray detectors – Viewing systems – spiral CT scanning – Ultra fast CT scanners. Image reconstruction techniques – back projection and iterative method.

UNIT III	MAGNETIC RESONANCE IMAGING	9

Fundamentals of magnetic resonance- properties of electromagnetic waves : speed ,amplitude, phase, orientation and waves in matter - Interaction of Nuclei with static magnetic field and Radio frequency wave- rotation and precession – Induction of magneticresonance signals – bulk magnetization – Relaxation processes T1 and T2. Block Diagram approach of MRI system – system magnet (Permanent, Electromagnet and Superconductors), generations of gradient magnetic fields, Radio Frequency coils (sendingand receiving), shim coil.

UNIT IV	NUCLEAR IMAGING	9

Radioisotopes- alpha, beta, and gamma radiations. Radio Pharmaceuticals. Radiation detectors – gas filled, ionization chambers, proportional counter, GM counter and scintillation Detectors, Gamma camera– Principle of operation, collimator, photomultiplier tube, X-Y positioning circuit, pulse height analyzer. Principles of SPECTand PET

UNIT V	RADIATION THERAPY AND RADIATION SAFETY	9
Radiation therapy – linear accelerator, Telegamma Machine. SRS – SRT – Recent Techniques in radiation therapy – 3D CRT – IMRT – IGRT and Cyber knife – radiation measuring instruments Dosimeter, film badges, Thermo Luminescent dosimeters – electronic dosimeter – Radiation protection in medicine – radiation protection principles		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Describe the working principle of the X-ray machine and its application.

CO2: Illustrate the principle computed tomography.

CO3: Interpret the technique used for visualizing various sections of the body using Magnetic Resonance Imaging.

CO4: Demonstrate the applications of radionuclide imaging.

CO5: Analyze different imaging techniques and choose appropriate imaging equipmentfor better diagnosis and outline the methods of radiation safety.

CO6: Discover the advancements of IoT in various sectors

TEXT BOOKS:

1. Isaac Bankman, I. N. Bankman , Handbook Of Medical Imaging: Processing and Analysis(Biomedical Engineering),Academic Press,2000
2. Jacob Beutel (Editor), M. Sonka (Editor), Handbook of Medical Imaging, Volume Medical Image Processing and Analysis , SPIE Press 2000

REFERENCES:

1. Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw – Hill,New Delhi, 2003.
2. Dougherty, Geoff (Ed.), “Medical Image Processing - Techniques and Applications Springer-Verlag New York, 2011.
3. https://www.asia.elsevierhealth.com/medical-imaging-e-book-9780702052019.html.

NPTEL LINK:

https://onlinecourses.nptel.ac.in/noc22_bt34/preview

COURSE CODE	COURSE TITLE	L	T	P	C
22EC979	CAPSTONE PROJECT	0	0	12	6

COURSE OBJECTIVES:

- To provide students with a comprehensive understanding of IoT technologies, including sensors, actuators, and image and video analytics, and how they can be integrated into practical solutions.
- To enable students to design and develop IoT systems using the Robot Operating System (ROS), a widely used open-source robotics middleware platform.
- To give students hands-on experience with IoT technologies through the development of a Capstone project that addresses a real-world problem or meets a specific need in the industry, healthcare, agriculture, or smart homes.
- To foster teamwork, creativity, and communication skills by working collaboratively on a Capstone project that involves industry partners, stakeholders, or end-users.
- To prepare students for a successful career in the rapidly growing field of IoT by enhancing their problem-solving skills, critical thinking, and adaptability to new technologies and challenges.

STRATEGY:

- A student or a group of students (maximum 4) has to identify a topic of interest in consultation with faculty supervisor.
- They review the literature and gather information pertaining to the chosen topic and state the objectives and develop a methodology to achieve the objectives.
- Based on the topic, experimental investigation/ software analysis/ analytical modelling will be carried out.
- The results will be analyzed with a concluding remark to correlate the objectives.
- A comprehensive report will be prepared after completing the project.
- Evaluation will be done based on the performance in the periodic reviews, project report and viva voce examination.

TOTAL: 180 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Demonstrate a comprehensive understanding of IoT technologies, including sensors, actuators, and image and video analytics, and their applications in practical solutions.

CO2: Analyze and evaluate IoT solutions using a systematic approach, including the use of appropriate sensors, actuators, and analytics algorithms.

CO3: Collaborate effectively with industry partners, stakeholders, or end-users to develop a Capstone project that addresses a real-world problem or meets a specific need in the industry, healthcare, agriculture, or smart homes.

CO4: Communicate and present complex technical information effectively to both technical and non-technical audiences.

CO5: Continuously adapt to new technologies and challenges in the rapidly evolving field of IoT and demonstrate the ability to learn and apply new skills to real-world problems.

HONORS DEGREE IN SIGNAL & IMAGE PROCESSING

COURSE CODE	COURSE TITLE	L	T	P	C
22EC965	COMPUTER VISION	3	0	0	3

COURSE OBJECTIVES:

- To develop algorithms and techniques to analyze and interpret the visible world around us.
- To Understand the fundamental concepts related to multi-dimensional signal processing, feature extraction, pattern analysis visual geometric modeling, stochasticoptimization etc.
- To explore and contribute to research and further developments in the field of computer vision.
- To understand various applications, range from Biometrics, Medical diagnosis, document processing, mining of visual content, to surveillance, advanced renderingetc.
- To understand the image segmentation concepts.
- To learn about pattern and motion analysis.

UNIT I	DIGITAL IMAGE FORMATION AND LOW-LEVEL PROCESSING	9

Overview and State-of-the-art, Fundamentals of Image Formation, Algorithmic Architecture for Transformation: Orthogonal, Euclidean, Affine, Projective, etc., Fourier Transform, Convolution and Filtering, Image Enhancement, Restoration, Histogram Processing.

UNIT II	DEPTH ESTIMATION AND MULTI-CAMERA VIEWS	9

Perspective, Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework; Auto-calibration.

UNIT III	FEATURE EXTRACTION	9

Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale-Space Analysis-
Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT.

UNIT IV	IMAGE SEGMENTATION	9

Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation; Object detection

UNIT V	PATTERN AND MOTION ANALYSIS	9

Clustering: K-Means, K-Medoids, Mixture of Gaussians, Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised; Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA; Non-parametric methods.

Background Subtraction and Modeling, Optical Flow, KLT, Spatio-Temporal Analysis, Dynamic Stereo; Motion parameter estimation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Understand fundamentals of Digital Image Formation

CO2: Analyze the Binocular Stereopsis for Depth Estimation and Multi-Camera Views

CO3: Illustrate the concepts of line decoder and detectors.

CO4: Illustrate the concept of image segmentation

CO5: Demonstrate the classifications of K-Means clustering.

CO6: Analyze feature extraction using filters.

TEXT BOOKS:

1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2011.
2. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, 2003.

REFERENCES:

1. Richard Hartley and Andrew Zisserman, Multiple View Geometry in ComputerVision, Second Edition, Cambridge University Press, March 2004.
2. Christopher M. Bishop; Pattern Recognition and Machine Learning, Springer,2006
3. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Addison- Wesley,1992.
4. K. Fukunaga; Introduction to Statistical Pattern Recognition, Second Edition, Academic Press, Morgan Kaufmann, 1990.
5. Bishop C.M., "Neural networks for Pattern Recognition", Oxford, ClarendonPress, 1995.

NPTEL LINK:

https://nptel.ac.in/courses/108108167

COURSE CODE	COURSE TITLE	L	T	P	C
22EC966	BIG DATA ANALYTICS	3	0	0	3

COURSE OBJECTIVES:

- To understand the basics of big data analytics.
- To learn the Hadoop tools.
- To know about the architecture of NoSQL.
- To understand the concept of MapReduce and MongoDB
- To understand the structure and applications OF big data analytics.

UNIT I	INTRODUCTION TO BIG DATA ANALYTICS	9

Big Data, Scalability and Parallel Processing, Designing Data Architecture, Data Sources, Quality, Pre-Processing and Storing, Data Storage and Analysis, Big Data Analytics Applications and Case Studies.

UNIT II	INTRODUCTION TO HADOOP	9

Introduction, Hadoop and its Ecosystem, Hadoop Distributed File System, MapReduce Framework and Programming Model, Hadoop Yarn, Hadoop Ecosystem Tools.

UNIT III	NQSQL, BIG DATA MANAGEMENT, MONGODB AND CASSANDRA	9

Introduction, NoSQL Data Store, NoSQL Data Architecture Patterns, NoSQL to Manage Big Data, Shared-Nothing Architecture for Big Data Tasks, MongoDB, Databases, Cassandra Databases.

UNIT IV	MAPREDUCE, HIVE AND PIG	9

Introduction, MapReduce Map Tasks, Reduce Tasks and MapReduce Execution,Composing MapReduce for Calculations and Algorithms, Hive, HiveQL, Pig.

UNIT V	MACHINE LEARNING ALGORITHMS FOR BIG DATA ANALYTICS	9

Introduction, Estimating the relationships, Outliers, Variances, Probability Distributions, and Correlations, Regression analysis, Finding Similar Items, Similarity of Sets and Collaborative Filtering, Frequent Itemsets and Association Rule Mining. Text, Web Content,Link, and Social Network Analytics: Introduction, Text mining, Web Mining, Web Content and Web Usage Analytics, Page Rank, Structure of Web and analyzing a Web Graph, SocialNetwork as Graphs and Social Network Analytics.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Understand fundamentals of Big Data analytics.

CO2: Investigate Hadoop framework and Hadoop Distributed File system.

CO3: Illustrate the concepts of NoSQL using MongoDB and Cassandra for Big Data.

CO4: Demonstrate the MapReduce programming model to process the big data along with Hadoop tools.

CO5: Use Machine Learning algorithms for real world big data.

CO6: Analyze web contents and Social Networks to provide analytics with relevant visualization tools.

TEXT BOOKS:

1. Raj Kamal and Preeti Saxena, "Big Data Analytics Introduction to Hadoop, Spark, and Machine-Learning", McGraw Hill Education, 2018.

2. Douglas Eadline, "Hadoop 2 Quick-Start Guide: Learn the Essentials of Big Data Computing in the Apache Hadoop 2 Ecosystem", 1 stEdition, Pearson Education, 2016.

REFERENCES:

1. Tom White, "Hadoop: The Definitive Guide", 4 th Edition, O"Reilly Media, 2015.
2. Boris Lublinsky, Kevin T Smith, Alexey Yakubovich, "Professional Hadoop Solutions", 1 stEdition, Wrox Press, 2014.
3. Eric Sammer, "Hadoop Operations: A Guide for Developers and Administrators",1st Edition, O'Reilly Media, 2012.
4. Arshdeep Bahga, Vijay Madisetti, "Big Data Analytics: A Hands-On Approach", 1st Edition, VPT Publications, 2018. Bishop C.M., "Neural networks for Pattern Recognition", Oxford, Clarendon Press, 1995.

NPTEL LINK:

https://onlinecourses.swayam2.ac.in/cec24_ma20/preview

COURSE CODE	COURSE TITLE	L	T	P	C
22EC967	IMAGE PROCESSING WITH PYTHON	3	0	0	3

COURSE OBJECTIVES:

- To introduce various Python Libraries for Image Processing.
- Students can gain knowledge on smoothing and Sharpening Techniques.
- To introduce various deep learning image classification.
- To impart knowledge about Tensor flow and 3D Image Processing.
- To introduce and gain knowledge on filtering and segmentation.
- To impart knowledge about the hidden & Extracting data.

UNIT I	INTRODUCTION TO PYTHON LIBRARIES	9

Introduction to Python libraries for image processing, Basic image manipulation and enhancement techniques. Advanced image manipulation and enhancement techniques, Geometric transformations, understanding image color spaces, Applying color manipulation techniques.

UNIT II	IMAGE RESTORATION TECHNIQUES	9

Understanding image histograms, applying image smoothing and sharpening techniques, understanding and applying basic and advanced image filtering techniques. Image restoration techniques, Edge detection techniques, Feature extraction techniques.

UNIT III	SEGMENTATION METHOD	9

Image segmentation, Thresholding techniques, Watershed segmentation. Object detection and recognition, template matching, deep learning for image classification and recognition.

UNIT IV	ADVANCED DEEP LEARNING MODELS	9

Image classification model with Tensor Flow, Advanced deep learning models for medical image processing. Preprocessing, Segmentation and Registration of medical images. Understanding 3D image processing, image visualization and manipulation, filtering and segmentation.

UNIT V	IMAGE COMPRESSION TECHNIQUES USING PYTHON	9

Introduction to Image compression technique, JPEG and Wavelet-based compression technique. Introduction to image steganography, hiding data and Extracting hidden data from images using Python.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Explain all important components of python libraries

CO2: Discussion on basic and advanced image filtering techniques

CO3: Outline the major design flows for various Thresholding techniques

CO4: Discuss the image visualization and manipulation

CO5: Explain all important concepts of hiding and Extracting hidden data.

CO6: Discussion on various types of compression techniques.

TEXT BOOKS:

1. Python Crash Course – A Hands-on, Project based introduction to Programming (2nd Edition)
2. Python Programming – An Introduction to Computer Science (3rd EDITION)

REFERENCES:

1. Digital Image Processing-3rd edition by Gonzalez and Wintz.
2. Digital Image Processing -2nd edition by Sridhar.
3. Digital Image Procession Using Python by Dr.Kannan Shanmugam.
4. Alasdair McAndrew, ―Introduction to Digital Image Processing with Matlab, Cengage Learning 2011,India.
5. Anil J Jain, ―Fundamentals of Digital Image Processing‖, PHI, 2006.

NPTEL LINK:

https://onlinecourses.swayam2.ac.in/nou23_cs15/preview

COURSE CODE	COURSE TITLE	L	T	P	C
22EC970	PATTERN RECOGNITION	3	0	0	3

COURSE OBJECTIVES:

- To learn various classification and pattern classifier algorithms.
- To learn various unsupervised algorithms for pattern recognition.
- To study grammar and its applications.
- To analyze feature selection and feature generation strategies.
- To use neural networks and genetic algorithms for pattern recognition

UNIT I	CLASSIFICATION & PATTERN CLASSIFIER	9

Overview of pattern recognition-Discriminant functions - Supervised learning - Parametric estimation - Maximum likelihood estimation. Bayesian parameter estimation-perceptron algorithm LMSE algorithm-problems with Bayes approach-Pattern classification by distance functions Minimum distance pattern classifier.

UNIT II	UNSUPERVISED CLASSIFICATION	9

Clustering for unsupervised learning and classification-Clustering concept - C-means algorithm - Hierarchical clustering procedures - Graph theoretic approach to pattern clustering - Validity of clustering solution.

UNIT III	STRUCTURAL PATTERN RECOGNITION	9

Elements of formal grammars-String generation as pattern description - Recognition of Syntactic description - Parsing-Stochastic grammars and applications – Graph structural based representation.

UNIT IV	FEATURE SELECTION & FEATURE GENERATION	9

Pre-processing, Feature Selection Based on Statistical Hypothesis Testing, The Receiver Operating Characteristics (ROC) Curve, Class Separability Measures, Feature Subset selection, Optimal Feature Generation, Neural Networks and Feature Generation / Selection, The Bayesian Information Criterion. Linear Transforms, Regional Features, Features for Shape and Size Characterization, Typical Features for Speech and Audio Classification Template Matching: Introduction, Similarity Measures Based on Optimal Path Searching Techniques, Measures Based on Correlations, Deformable Template Models.

UNIT V	NEURAL NETWORKS AND GENETIC ALGORITHM FOR PATTERN CLASSIFICATION	9

Neural network structures for pattern recognition-Neural network -based pattern associators– Self organizing networks. Pattern Classification and Optimization using Genetic Algorithm – Recent Trends.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Understand various classification and pattern classifier algorithms.

CO2: Elaborate various unsupervised algorithms for pattern recognition.

CO3: Discuss the grammar and its applications.

CO4: Analyse Feature selection and Feature generation techniques.

CO5: Use neural networks algorithms and genetic algorithms for pattern recognition.

TEXT BOOKS:

1. Trevor H, Robert T,Jerome Friedman, The Elements of Statistical Learning, SpringerSeries,2017.
2. Christopher M Bishop, Pattern Recognition and Machine Learning. Springer. 2011.,

REFERENCES:

1. Morton Nadier and Eric Smith P., Pattern Recognition Engineering, John Wiley & Sons, NewYork, 1993.
2. S.Theodoridis and K.Koutroumbas, Pattern Recognition, 4th Ed., Academic Press, 2009.
3. S. Theodoridis and K. Koutroumbas, Pattern Recognition, Academic Press, 2009
4. E. Alpaydin, Introduction to Machine Learning, Prentice-Hall of India, 2010
5. G. James, D. Witten, T. Hastie and R. Tibshirani, Introduction to Statistical Learning, Springer, 2013

NPTEL LINK:

https://onlinecourses.nptel.ac.in/noc19_ee56/preview

COURSE CODE	COURSE TITLE	L	T	P	C
22EC979	CAPSTONE PROJECT	0	0	12	6

COURSE OBJECTIVES:

- To provide students with a comprehensive understanding of IoT technologies, including sensors, actuators, and image and video analytics, and how they can be integrated into practical solutions.
- To enable students to design and develop IoT systems using the Robot Operating System (ROS), a widely used open-source robotics middleware platform.
- To give students hands-on experience with IoT technologies through the development of a Capstone project that addresses a real-world problem or meets a specific need in the industry, healthcare, agriculture, or smart homes.
- To foster teamwork, creativity, and communication skills by working collaboratively on a Capstone project that involves industry partners, stakeholders, or end-users.
- To prepare students for a successful career in the rapidly growing field of IoT by enhancing their problem-solving skills, critical thinking, and adaptability to new technologies and challenges.

STRATEGY:

- A student or a group of students (maximum 4) has to identify a topic of interest in consultation with faculty supervisor.
- They review the literature and gather information pertaining to the chosen topic and state the objectives and develop a methodology to achieve the objectives.
- Based on the topic, experimental investigation/ software analysis/ analytical modelling will be carried out.
- The results will be analyzed with a concluding remark to correlate the objectives.
- A comprehensive report will be prepared after completing the project.
- Evaluation will be done based on the performance in the periodic reviews, project report and viva voce examination.

TOTAL: 180 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Demonstrate a comprehensive understanding of IoT technologies, including sensors, actuators, and image and video analytics, and their applications in practical solutions.

CO2: Analyze and evaluate IoT solutions using a systematic approach, including the use of appropriate sensors, actuators, and analytics algorithms.

CO3: Collaborate effectively with industry partners, stakeholders, or end-users to develop a Capstone project that addresses a real-world problem or meets a specific need in the industry, healthcare, agriculture, or smart homes.

CO4: Communicate and present complex technical information effectively to both technical and non-technical audiences.

CO5: Continuously adapt to new technologies and challenges in the rapidly evolving field of IoT and demonstrate the ability to learn and apply new skills to real-world problems.

HONORS DEGREE IN ROBOTICS &AUTOMATION

COURSE CODE	COURSE TITLE	L	T	P	C
22EC971	CONCEPTS IN MOBILE ROBOTICS	3	0	0	3

COURSE OBJECTIVES:

- To know locomotion of Robots and underwater Vehicles.
- To analyse kinematic model for different Trajectory Planning.
- To characterize the different perception in sensors.
- To analyse various localization and mapping techniques
- To understand various planning and navigation techniques and collaboration in Robotics.

UNIT I	INTRODUCTION TO MOBILE ROBOTICS	9

Introduction – Locomotion of the Robots – Key Issues on Locomotion – Legged Mobile Roots -Configurations and Stability – Wheeled Mobile Robots – Design Space and Mobility Issues -Unmanned Aerial and Underwater Vehicles.

UNIT II	KINEMATIC MODELS	9

Position Analysis – Matrix representation – Forward and Inverse kinematics equations (Position, Orientation) – Denavit-Hatenberg (DH) Representation of Forward Kinematic Equations – General solutions of inverse kinematic equations - Trajectory Planning – path vs Trajectory – Join Space trajectory planning – Cartesian Space Trajectories

UNIT III	PERCEPTION	9

Sensor for Mobile Robots – Classification and Performance Characterization – heel/Motor Sensors – Heading Sensors – Ground-Based Beacons – Active Ranging – Motion/Speed Sensors – Camera – Visual Appearance based Feature Extraction.

UNIT IV	LOCALIZATION	9

Localization Based Navigation Versus Programmed Solutions – Map Representation – Continuous Representations – Decomposition Strategies – Probabilistic Map-Based Localization – Landmark Based Navigation – Globally Unique Localization – Positioning Beacon Systems – Route-Based Localization – Autonomous Map Building – Simultaneous Localization and Mapping (SLAM).

UNIT V	PLANNING, NAVIGATION AND COLLABORATIVE ROBOTS	9

Planning, navigation and collaborative robots - Introduction – Competences for Navigation: Planning and Reacting – Path Planning – Obstacle Avoidance – Navigation Architectures – Control Localization – Techniques for Decomposition -Case Studies – Collaborative Robots – Swarm Robots.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Evaluate the appropriate mobile robots for the desired application.
CO2: Create the kinematics for given wheeled and legged robot.
CO3: Analyse the sensors for the intelligence of mobile robotics.
CO4: Create the localization strategies and mapping technique for mobile robot.
CO5: Create the collaborative mobile robotics for planning, navigation and intelligence for desired applications.

TEXT BOOKS:

1. Create the collaborative mobile robotics for planning, navigation and intelligence for desired applications.
2. Introduction to Robotics Analysis, Systems and Applications by Saeed B.Niku, 3rd edition – Wiley publications – 2019

REFERENCES:

1. Dragomir N. Nenchev, Atsushi Konno, TeppeiTsujita, "Humanoid Robots:Modelling and Control", Butterworth-Heinemann, 2018
2. MohantaJagadish Chandra, "Introduction to Mobile Robots Navigation", LAP Lambert Academic Publishing, 2015.
3. Industrial Robotics Technology, Programming and Applications by Mikell P. Groover, 3rd edition - McGraw Hill Publications - 2008

NPTEL LINK:

https://onlinecourses.nptel.ac.in/noc24_me23/preview

COURSE CODE	COURSE TITLE	L	T	P	C
22EC972	SENSORS AND ACTUATORS FOR ROBOTICS	3	0	0	3

COURSE OBJECTIVES:

- To Understand the operation of sensors
- To learn the various sensors for robotics.
- To learn the various sensors for pressure and temperature measurements.
- To study different electrical actuators.
- To analyze the different actuators for robotics

UNIT I	INTRODUCTION	9

Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types. Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer – GPS, Bluetooth.

UNIT II	RANGING, FORCE AND MAGNETIC SENSORS	9

Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR). Strain Gage, Load Cell, Magnetic Sensors –types, principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor, Heading Sensors – Compass, Gyroscope, Inclinometers.

UNIT III	OPTICAL, PRESSURE AND TEMPERATURE SENSORS	9

Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement, Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors.

UNIT IV	ELECTRIC ACTUATORS	9

Direct current motor, Permanent magnet stepper motor, Servo Control DC motors, Linear and latching linear actuators, Rotatory actuators, Piezo electric actuators, Actuator parameters and characteristics, Stepper motors, Specifications and characteristics of Stepper motors Servomotors.

UNIT V	PNEUMATIC AND HYDRAULIC ACTUATORS	9

Hydraulic and pneumatic power actuation devices Hydraulic Actuators, selection of linear actuating cylinders, Hydraulic Motors, Pneumatic actuators, design considerations and selection, pneumatic cylinders , pneumatic drive system, Linear & rotary actuators, Advanced actuators – Piezoelectric actuators, elastomer actuators, soft actuators, shape memory alloy based actuators, under actuated robotic hand

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Explain the fundamental principle of working of sensors in robotics

CO2: Analyze sensory systems in robotics.

CO3: Select the sensor for robotic application and design the system.

CO4: Analyze actuators and configuring the parameters of Actuators

CO5: Analyze and select the appropriate actuators for robotics application

TEXT BOOKS:

1. Doebelin's Measurement Systems: 7th Edition (SIE), Ernest O. Doebelin Dhanesh N. Manik McGraw Hill Publishers, 2019.
2. Clarence W. de Silva, Sensors and Actuators: Control System Instrumentation, CRC Press, 2007, ISBN-13: 978-142004483

REFERENCES:

1. Robert Brandy, "Automotive Electronics and Computer System", Prentice Hall,2001
2. D. Patranabis, "Sensors and Transducers", PHI Learning Private Limited.
3. James D Halderman, "Automotive Electrical and Electronics" , Prentice Hall, USA, 2013
4. Tom Denton, "Automotive Electrical and Electronics Systems," Third Edition, 2004, SAE International.
5. Piezoelectric Actuators (Electrical Engineering Developments), 2012, by Joshua E. Segel

NPTEL LINK:

https://onlinecourses.nptel.ac.in/noc21_ee32/preview

COURSE CODE	COURSE TITLE	L	T	P	C
22EC973	MICROCONTROLLERS FOR ROBOTICS	3	0	0	3

COURSE OBJECTIVES:

- To introduce the basic features, programming methods and applications of Micro controllers
- To study about programming in microcontroller
- Discuss different applications in microcontroller
- To know about the design of systems using PLC is introduced in detail.
- To know about the application PLC in Robotics.

UNIT I	INTRODUCTION TO MICROCONTROLLER	9

8051 Architecture: – Memory map - Addressing modes, I/O Ports –Counters and Timers – Serial data - I/O – Interrupts –Instruction set, Data transfer instructions, Arithmetic and Logical Instructions, Jump and Call Instructions, Assembly Language Programming tools.

UNIT II	MICROCONTROLLER PROGRAMMING	9

8051 Assembly Language Programming- Block transfer, arithmetic operations, Code conversion, Time delay generation, Interrupt programming, Lookup table techniques

UNIT III	MICROCONTROLLER APPLICATIONS	9

Interfacing of Keyboards – Interfacing of Display Devices – Pulse measurement – Analog to Digital and Digital to Analog Converter – Interfacing Hardware Circuit – Serial Data Communication – Network Configuration.

UNIT IV	PROGRAMMABLE LOGIC CONTROLLERS	9

Introduction — Principles of operation – PLC Architecture and specifications – PLC hardware components Analog & digital I/O modules, CPU & memory module – Programming devices – PLC ladder diagram, Converting simple relay ladder diagram in to PLC relay ladder diagram. PLC programming Simple instructions – Manually operated switches – Mechanically operated a Proximity switches - Latching relay

UNIT V	APPLICATIONS OF PROGRAMMABLE LOGIC CONTROLLERS	9

Timer instructions - On delay, Off delay, Cyclic and Retentive timers, Up /Down Counters, control instructions – Data manipulating instructions, math instructions; Applications of PLC – Simple materials handling applications, Automatic control of warehouse door, Automatic lubrication of supplier Conveyor belt, motor control, Automatic car washing machine, Bottle label detection and process control application.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Summarize the features and peripherals of 8051 microcontrollers.

CO2: Apply programming techniques in developing the assembly language program for microcontroller application.

CO3: Recognize the different applications of microcontroller.

CO4: Summarize the architectural features and specifications of Programmable Logic Controllers.

CO5: Apply Programmable Logic Controllers concept for robotics design.

CO6: Classify different applications of Programmable Logic Controllers.

TEXT BOOKS:

1. Muhammad Ali Mazdi, J.G.Mazdi & R.D.McKinlay "The 8051 Microcontroller& Embedded systems Using assembly & C" 2nd Edition Pearson Education , Inc ,2006
2. Udayasankara.v & Mallikarjunaswamy.M. S,'8051 Microcontroller, Hardware, Software & Applications, Tata McGraw Hill Education Pvt Limited. New Delhi ,2009.
3. Gary Dunning, 'Introduction to Programmable Logic Controllers '' Thomson Learning, 2001.

REFERENCES:

1. Singh. B.P., "Microprocessors and Microcontrollers", Galcotia Publications (P) Ltd, First edition, New Delhi, 1997.
2. Parr, "Programmable Controllers: An Engineers Guide", 3rd Edition, Elsevier, Indian Reprint, 2013
3. Valdes-Perez, Microcontrollers: Fundamentals and Applications with PIC, Taylor & Francis, Indian Reprint, 2013.
4. Bolton, "Programmable Logic Controllers" 5th Edition Newness, ,2009

NPTEL LINK:

https://nptel.ac.in/domains/discipline/115?course=115_9

COURSE CODE	COURSE TITLE	L	T	P	C
22EC974	PROCESS CONTROL AUTOMATION	3	0	0	3

COURSE OBJECTIVES:

- To Understand the Process Control terms and modes.
- To document the process and give the symbolic representation of the process
- To learn the concepts involved in process automation
- To perform PLC programming in the Industrial automation process

UNIT I	PROCESS CONTROL	9

Introduction to process control, Basic Terms, Control Modes – ON/OFF Action, Differential action, Proportional action, Derivative action, Integral action, PID action, Implementation of Control loops – ON/OFF action pneumatic controller, ON/OFF action electrical controller, PID action pneumatic controller, PID action control circuits, PID electronic Controller, Digital Controllers.

UNIT II	DOCUMENTATIONS & SYMBOLS IN PROCESS CONTROL	9

System Documentation – Alarm and Trip Systems, Alarm and Trip documentation, PLC documentation, Pipe and Identification Diagrams - Standardization, Interconnections, Instrument symbols, Instrument identification, Functional Symbols – Actuators, Primary elements, Regulators, Math functions, P and ID diagrams.

UNIT III	AUTOMATION IN PROCESS CONTROL	9

Introduction to automation, Types of process – Natural Process, Self-regulated Process, Industrial Process, Basic elements of an Automated system, Types of Automation system – Fixed, programmable and Flexible Automation, Automation pyramid.

UNIT IV	PLANT AUTOMATION	9

Aims of Automation, Approaches – Partial plant automation, complete plant automation, benefits of plant automation, Factors contributed to development of modern automation, levels of automation, classic approaches and modern methods of plant automation, computer-based plant automation concepts - approaches, Automation functions in system level.

UNIT V	MANUFACTURING AUTOMATION & PLC	9

Hierarchy of manufacturing automation – Data Acquisition system, Distributed Control Systems (DCS), advantages and disadvantages of DCS, Direct Digital Control (DDC), advantages and disadvantages of DDC, Programmable Logic Controller, Standardization in PLC Communication, Modernization of Protocols for PLC, Advantages and disadvantages of using PLC, PLC Block diagram, functional structure of the PLC system, PLC Programming Languages- PLC application with example.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Understand process control basics

CO2: Apply the symbols used in the process control

CO3: Recognize the importance of automation in process control

CO4: Comprehend plant automation process in system level

CO5: Categorize the different types of process used in industrial automation.

CO6: Study the Programing Logic Controller and its Programming

TEXT BOOKS:

1. Fundamentals of Industrial Instrumentation and Process Control by William C. Dunn,McGraw-Hill Company, 2005.
2. Process Control Instrumentation technology by Curtis D. Johnson, 8th Edition, Pearson New International Edition, 2014.

REFERENCES:

1. https://bmsce.ac.in/Content/IT/APC_2021_Part_1.pdf

2. Introduction to the Principles of Automation and Control by Ilesanmi Afolabi Daniyan, DOI: 10.2174/978981508092612301000 6.

3. Concepts of Automation and Control by Ilesanmi Afolabi Daniyan*, Lanre Daniyan, Adefemi Adeodu and Khumbulani Mpofu, DOI: 10.2174/978981508092612301000 7

NPTEL LINK:

https://nptel.ac.in/courses/103105064

COURSE CODE	COURSE TITLE	L	T	P	C
22EC979	CAPSTONE PROJECT	0	0	12	6

COURSE OBJECTIVES:

- To provide students with a comprehensive understanding of IoT technologies, including sensors, actuators, and image and video analytics, and how they can be integrated into practical solutions.
- To enable students to design and develop IoT systems using the Robot Operating System (ROS), a widely used open-source robotics middleware platform.
- To give students hands-on experience with IoT technologies through the development of a Capstone project that addresses a real-world problem or meets a specific need in the industry, healthcare, agriculture, or smart homes.
- To foster teamwork, creativity, and communication skills by working collaboratively on a Capstone project that involves industry partners, stakeholders, or end-users.
- To prepare students for a successful career in the rapidly growing field of IoT by enhancing their problem-solving skills, critical thinking, and adaptability to new technologies and challenges.

STRATEGY:

- A student or a group of students (maximum 4) has to identify a topic of interest in consultation with faculty supervisor.
- They review the literature and gather information pertaining to the chosen topic and state the objectives and develop a methodology to achieve the objectives.
- Based on the topic, experimental investigation/ software analysis/ analytical modelling will be carried out.
- The results will be analyzed with a concluding remark to correlate the objectives.
- A comprehensive report will be prepared after completing the project.
- Evaluation will be done based on the performance in the periodic reviews, project report and viva voce examination.

TOTAL: 180 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Demonstrate a comprehensive understanding of IoT technologies, including sensors, actuators, and image and video analytics, and their applications in practical solutions.

CO2: Analyze and evaluate IoT solutions using a systematic approach, including the use of appropriate sensors, actuators, and analytics algorithms.

CO3: Collaborate effectively with industry partners, stakeholders, or end-users to develop a Capstone project that addresses a real-world problem or meets a specific need in the industry, healthcare, agriculture, or smart homes.

CO4: Communicate and present complex technical information effectively to both technical and non-technical audiences.

CO5: Continuously adapt to new technologies and challenges in the rapidly evolving field of IoT and demonstrate the ability to learn and apply new skills to real-world problems.

MINOR DEGREE IN INTERNET OF THINGS					
COURSE CODE	**COURSE TITLE**	**L**	**T**	**P**	**C**
22EC901	**INTRODUCTION TO INTERNET OF THINGS**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the fundamentals of Internet of Things
- To learn about the IoT architecture
- To familiarize various IoT Protocols
- To build a small low cost embedded system using Raspberry Pi.
- To apply the concept of Internet of Things in the real-world scenario.

UNIT I	**INTRODUCTION TO IoT**	**9**

Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates - Domain Specific IoTs - IoT and M2M.

UNIT II	**IoT ARCHITECTURE**	**9**

M2M high-level ETSI architecture - IETF architecture for IoT - OGC architecture - IoT reference model - Domain model - information model - functional model - communication model - IoT reference architecture.

UNIT III	**IoT PROTOCOLS**	**9**

Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus – Zigbee Architecture – 6LowPAN – CoAP.

UNIT IV	**BUILDING IoT WITH RASPBERRY PI & ARDUINO**	**9**

Building IOT with RASPERRY PI- IoT Systems - Logical Design using Python – IoT Physical Devices & Endpoints - IoT Device -Building blocks -Raspberry Pi -Board - Linux on Raspberry Pi - Raspberry Pi Interfaces -Programming Raspberry Pi with Python - Other IoT Platforms - Arduino.

UNIT V	**CASE STUDIES AND REAL-WORLD APPLICATIONS**	**9**

Real world design constraints – Applications - Industrial automation, smart grid, Commercial building automation - Data Analytics for IoT – Software & Management Tools for IoT Cloud Storage Models & Communication APIs - Cloud for IoT - Amazon Web Services for IoT.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Identify IoT enabling technologies.

CO2: Discover different IoT Architecture.

CO3: Understand communication, network and security protocols.

CO4: Develop IoT based applications with Raspberry Pi.
CO5: Infer the applications of IoT in Real-world scenario.
CO6: Discover the advancements of IoT in various sectors.

TEXT BOOKS:

1. Arshdeep Bahga, Vijay Madisetti, ―Internet of Things – A hands-on approach‖, Universities Press, 2015
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), ―Architecting the Internet of Things, Springer, 2011.

REFERENCES:

1. Honbo Zhou, ―The Internet of Things in the Cloud: A Middleware Perspective‖, CRC Press, 2012..
2. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle, - From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence, Elsevier, 2014
3. Olivier Hersent, David Boswarthick, Omar Elloumi, ―The Internet of Things – Key applications and Protocols‖, Wiley, 2012.
4. David E. Goldberg, - IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, Cisco Press, 2017.
5. Maciej Kranz - Building the Internet of Things: Implement New Business Models, Disrupt Competitors, Transform Your Industry, John Wiley & Son, 2016

NPTEL LINK:

https://archive.nptel.ac.in/courses/106/105/106105166/

COURSE CODE	COURSE TITLE	L	T	P	C
22EC907	SENSORS AND ACTUATOR DEVICES	3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamental principles and operating mechanisms of sensors and actuator devices.
- To familiarize the basic electronic circuits and systems used to interface sensors and actuator devices.
- To acquire the skills to create, construct, and validate basic sensor and actuator devices.
- To analyse, troubleshoot, and debug sensor and actuator systems.
- To develop real-time IoT based applications with sensors and actuators.
- To understand the fundamental principles and operating mechanisms of sensors and actuator devices.

UNIT I	SENSORS AND ACTUATORS	9

Introduction to Sensors and Actuator- Sensor and Actuator Characteristics- Types of sensors and actuators - Calibration, accuracy, and precision of sensors - Signal conditioning and amplification of sensor signals.

UNIT II	SEVEN GENERATIONS OF IOT SENSORS	9

Introduction to IoT Sensors - First-generation sensors: temperature, light, and motion sensors - Second-generation sensors: proximity sensors, pressure sensors, and gas sensors - Third-generation sensors: biosensors, chemical sensors, and magnetic sensors - Fourth-generation sensors: intelligent sensors, microelectromechanical systems (MEMS) - Fifth-generation sensors: nanosensors, biometric sensors - Sixth-generation sensors: printed sensors, flexible sensors - Seventh-generation sensors: quantum sensors, carbon nanotube sensors, and neural sensors.

UNIT III	ACTUATORS AND ADVANCED SENSING TECHNIQUES	9

Electromechanical and electrothermal actuators: differences, characteristics, and use cases - Types of actuators: motors, solenoids, relays, and others - Control of actuator devices: DC, AC, and stepper motor control - H-bridge motor driver circuits.

UNIT IV	SENSORS FOR AUTOMOTIVE AND SMART CITIES	9

Introduction to automotive sensors and their applications - Types of automotive sensors: temperature, pressure, speed, position - Sensor requirements for automotive applications: reliability, durability, and accuracy. Introduction to sensors for smart city applications - Types of smart city sensors: air quality, noise, traffic, weather, and others - Sensor requirements for smart city applications: energy efficiency, data accuracy, and real-time monitoring.

UNIT V	DEVELOPING AN IOT BASED APPLICATIONS	9
Smart Energy Monitor Based on IoT, Develop a Face Recognizing Robot, Build an IoT based Smart Home System, IoT Based Air Quality Index Monitoring, IoT Based Contactless Body Temperature Monitor.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Build schematic for IoT solutions with sensors.

CO2: Design and develop IoT based sensor systems.

CO3: Select the appropriate sensors for various industrial applications

CO4: Evaluate the wireless sensor technologies for IoT.

CO5: Design and develop an IoT Prototype project

CO6: Identify the IoT networking components with respect to sensors

TEXT BOOKS:

1. D. Patranabis, Sensors and Transducers, 1st edition, PHI Learning Private Limited, 2013.
2. Maggie Lin and Qiang Lin., Internet of Things Ecosystem: 2nd Edition, 2021.

REFERENCES:

1. Timothy Chou, - Precision: Principles, Practices and Solutions for the Internet of Things, Cloudbook Inc., USA, 2020
2. Ravindra P. Singh and Narayan C. Kar, Smart Sensors and MEMS: Intelligent Devices and Microsystems for Industrial Applications, CRC Press, 2014.
3. A.J. Siti Shafrah, R. Badlishah Ahmad, and I.A. Halim, Sensors and Actuators: Control SystemInstrumentation, Penerbit UTM Press, 2018
4. Sanjay Sharma, Sensors and Actuators: Engineering System Instrumentation, Second Edition, CRC Press, 2015.
5. Clarence W. de Silva, Intelligent Autonomous Systems 13: Proceedings of the 13th International Conference IAS-13, Springer, 2014.

NPTEL LINK:

https://archive.nptel.ac.in/courses/108/108/108108147/

COURSE CODE	COURSE TITLE	L	T	P	C
22EC977	IMAGE AND VIDEO ANALYTICS	3	0	0	3

COURSE OBJECTIVES:

- To impart knowledge on the basic principles and concepts in digital image and video processing.
- To explore and demonstrate real time image and video analytics in solving practical problems of commercial and scientific interests.
- To develop algorithms and techniques to analyse and interpret the visible world around us.
- To Understand the fundamental concepts related to feature extraction, pattern analysis visual geometric modelling etc.

To explore and contribute to research and further developments in the field of Image and Video Analytics.

UNIT I	IMAGE PROCESSING	9

Basic steps of Image Processing System. Image Segmentation - Color-Based Image Segmentation. Transformation: Orthogonal, Euclidean, Projective. Fourier Transform, Convolution and Filtering, Image Enhancement, Restoration, Histogram Processing.

UNIT II	FEATURE EXTRACTION AND TEXTURE ANALYSIS	9

Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF - Scale-Space Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT.

UNIT III	OBJECT RECOGNITION AND IMAGE RETRIEVAL	9

Basics of object recognition and image search, Object Recognition - Patterns and pattern class, Bayes' Parametric classification, Feature Selection and Boosting, Template- Matching. Content Based Image Retrieval - Feature based image retrieval, Object Based Retrieval.

UNIT IV	IMAGE ANALYSIS USING MACHINE LEARNING	9

Convolutional image processing; Basic architecture of a convolutional neural network for machine vision applications. Introduction to PyTorch. Training, activation, normalization, ensembles, data augmentation for Detection and segmentation in images. Processing video for motion estimation, and human action recognition.

UNIT V	VIDEO PROCESSING	9

Digital Video, Sampling of video signal, Video Enhancement and Noise Reduction- Rate control and buffering, MPEG, H.264, Inter frame Filtering Techniques, Fundamentals of Motion Estimation and Motion Compensation. Change Detection, Background modelling, Motion Segmentation, Motion Tracking.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Understand the requirements of image processing

CO2: Illustrate the principles and techniques of digital image in applications related to digital Imaging system.

CO3: Demonstrate the image recognition and motion recognition.

CO4: Understand the fundamentals of digital video processing.

CO5: Illustrate the motion estimation, segmentation and modelling.

TEXT BOOKS:

1. Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, Third Ed., Prentice-Hall, 2008.
2. A. Murat Tekalp, Digital Video Processing, Second Edition, Prentice Hall, 2015.

REFERENCES:

1. Jessica Minnick, Responsive Web Design with HTML 5 & CSS, Cengage Learning, 2020.
2. Frank Zammetti, Modern Full-Stack Development: TypeScript, React, Node.js, 1st Edition, Apress, 2020.
3. Jennifer Niederst Robbins, Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics, O'Reilly Media, 2018.
4. Jon Duckett, JavaScript and JQuery: Interactive Front-End Web Development, Wiley, 2014.
5. Jon Duckett, Web Design with HTML, CSS, JavaScript and jQuery Set, Wiley, 2014.

NPTEL LINK:

https://nptel.ac.in/courses/108103174

COURSE CODE	COURSE TITLE	L	T	P	C
22EC978	ROBOT OPERATING SYSTEMS	3	0	0	3

COURSE OBJECTIVES:

- To introduce the fundamentals of robotic programming
- To summarize and analyze the different types of robot sensors and actuators.
- To introduce students the criteria for selecting a sensor and actuator for a particularapplication
- To understand the Robot Operating System (ROS) fundamentals.
- To introduce students the criteria for selecting a sensor and actuator for a particular ROS robotic application.

UNIT I	ROBOTICS OPERATING SYSTEM (ROS)	9

Robot Introduction- Seven Criteria of Defining a Robot, Robot Controllers-Major Components, History of ROS, Sensors and Robots Supporting ROS, ROS Architecture and Concepts, ROS Filesystem Level.

UNIT II	ROS FUNDAMENTAL	9

Ubuntu Linux for Robotics-Ubuntu Graphical User Interface, Shell Commands, C++ and Python for Robotic Programming- Basic Concepts with Examples.

UNIT III	ROS PROGRAMMING	9

Creating ROS Workspace and Package, Using ROS Client Libraries, ROS Nodes and Topics – ROS command line tools – rosnode, rostopic.

UNIT IV	ROBOTIC PROJECTS USING ROS	9

Introduction to Wheeled Robots, Building Robot Hardware-Block Diagram and Assembling Robot Hardware, Programming Robot Firmware.

UNIT V	ROS NAVIGATION	9

Localizing the robot in a map, ROS Navigation Stack-hardware requirement-navigation packages, path planning, motion planning of robot.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Understand the robotics design and implementation.

CO2: Comprehend, classify and analyze the behavior of different types of sensors and actuators.

CO3: Understand the ROS fundamentals

CO4: Gain the knowledge about the types of actuators: electrical, pneumatic, and hydraulic, performance criteria and selection.

CO5: Design robotic applications using ROS.

CO6: Design Robots with Localization.

TEXT BOOKS:

1. Lentin Joseph, Robot Operating System (ROS) for Absolute Beginners: Robotics ProgrammingMade Easy, 1st Edition, APress, 2018.
2. Jonathan Cacace; Lentin Joseph, Mastering ROS for Robotics Programming: Design, build, and simulate complex robots using the Robot Operating System, 2nd Edition, Packt Publishing, 2018.

REFERENCES:

1. Hughes, C. and Hughes, T., Robot programming: a guide to controlling autonomous robots. QuePublishing, 2016.
2. Quigley, M., Gerkey, B. and Smart, W.D., Programming Robots with ROS: a practicalintroduction to the Robot Operating System, O'Reilly Media, 2015.
3. Anil Mahtani, Luis Sanchez, Enrique Fernandez, Aaron Martinez, Lentin Joseph. ROSProgramming: Building Powerful Robots. Packt Publishing, 2018.
4. Jonathan Cacace; Lentin Joseph, Mastering ROS for Robotics Programming: Design, build, and
5. simulate complex robots using the Robot Operating System, 2nd Edition, Packt Publishing, 2018.

NPTEL LINK:

https://archive.nptel.ac.in/courses/112/105/112105249/

COURSE CODE	COURSE TITLE	L	T	P	C
22EC979	CAPSTONE PROJECT	0	0	12	6

COURSE OBJECTIVES:

- To provide students with a comprehensive understanding of IoT technologies, including sensors, actuators, and image and video analytics, and how they can be integrated into practical solutions.
- To enable students to design and develop IoT systems using the Robot Operating System (ROS), a widely used open-source robotics middleware platform.
- To give students hands-on experience with IoT technologies through the development of a Capstone project that addresses a real-world problem or meets a specific need in the industry, healthcare, agriculture, or smart homes.
- To foster teamwork, creativity, and communication skills by working collaboratively on a Capstone project that involves industry partners, stakeholders, or end-users.
- To prepare students for a successful career in the rapidly growing field of IoT by enhancing their problem-solving skills, critical thinking, and adaptability to new technologies and challenges.

STRATEGY:

- A student or a group of students (maximum 4) has to identify a topic of interest in consultation with faculty supervisor.
- They review the literature and gather information pertaining to the chosen topic and state the objectives and develop a methodology to achieve the objectives.
- Based on the topic, experimental investigation/ software analysis/ analytical modelling will be carried out.
- The results will be analyzed with a concluding remark to correlate the objectives.
- A comprehensive report will be prepared after completing the project.
- Evaluation will be done based on the performance in the periodic reviews, project report and viva voce examination.

TOTAL: 180 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Demonstrate a comprehensive understanding of IoT technologies, including sensors, actuators, and image and video analytics, and their applications in practical solutions.

CO2: Analyze and evaluate IoT solutions using a systematic approach, including the use of appropriate sensors, actuators, and analytics algorithms.

CO3: Collaborate effectively with industry partners, stakeholders, or end-users to develop a Capstone project that addresses a real-world problem or meets a specific need in the industry, healthcare, agriculture, or smart homes.

CO4: Communicate and present complex technical information effectively to both technical and non-technical audiences.

CO5: Continuously adapt to new technologies and challenges in the rapidly evolving field of IoT and demonstrate the ability to learn and apply new skills to real-world problems.

OPEN ELECTIVES

COURSE CODE	COURSE TITLE	L	T	P	C
22EC001	PCB DESIGN	3	0	0	3

COURSE OBJECTIVES:

- To explore the concept of PCB design and electronic components.
- To examine the rules for designing Analog and Digital Circuits.
- To apply advance techniques, skills and modern tools for designing and fabrication of PCBs.
- To understand the PCB production techniques.

UNIT I	INTRODUCTION TO PRINTED CIRCUIT BOARD	9

Fundamental of electronic components – passive electronic components – Resistors, Thermistors, Capacitors, Inductors; active electronic components - Diode, Transistor, MOSFET, LED, IC's. PCB advantages, basic electronic circuits, Basics of printed circuit board designing: Layout planning, general rules and parameters, ground conductor considerations, thermal issues, check and inspection of art work.

UNIT II	DESIGN RULES FOR PCB	9

PCB layout design, Prototype Designing, PCB Making, Assembly of components, PCB Layers: Electrical Layers, Mechanical, Documentation Layers; Heat sinks and Package Density, Footprint, pad stack, Vias, Track. Design rules for Digital circuit PCBs, Analog circuit PCBs, High frequency and fast pulse applications, Power electronic applications, Microwave applications

UNIT III	INTRODUCTION TO ELECTRONIC DESIGN AUTOMATION (EDA) TOOLS FOR PCB DESIGNING	9

Brief Introduction of various simulators, SPICE and PSPICE Environment, Selecting the Components Footprints as per design, Making New Footprints, Assigning Footprint to components, Net listing, PCB Layout Designing, Auto routing and manual routing. Assigning specific text to design, creating report of design, Creating manufacturing data (GERBER) for design.

UNIT IV	PRINTED CIRCUIT BOARD PRODUCTION TECHNIQUES	9

Photo printing, film master production, reprographic camera, basic process for double sided PCBs photo resists, Screen printing process, plating, Relative performance and quality control, Etching machines, Solders alloys,fluxes, soldering techniques, Mechanical operations.

UNIT V	PCB TECHNOLOGY TRENDS AND DESIGN FOR EMI/EMC	9

Multilayer PCBs, Multiwire PCB, Flexible PCBs, Surface mount PCBs, Reflow soldering, Introduction to High-Density Interconnection (HDI) Technology. Subsystem/PCB Placement in an enclosure, Filtering circuit placement, decoupling and bypassing, Electronic discharge protection, Electronic waste; Printed circuit boards Recycling techniques, Introduction to Integrated Circuit Packaging and footprints, NEMA and IPC standards.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Identify the various types of electronic components for PCB design

CO2: Apply the appropriate design rules for designing application-based PCB circuits

CO3: Design and Develop a PCB layout using modern tools

CO4: Identify and select the appropriate PCB manufacturing technology

TEXT BOOKS:

1. R.S Khandpur, Printed Circuit Boards - Design, Fabrication, Assembly and Testing,1st Edition, TMH, 2017
2. Xing Chang Wei, Modeling and Design of Electromagnetic Compatibility for High

REFERENCES:

1. Kraig Mitzner, Complete PCB Design Using OrCAD Capture and PCB Editor, 2nd Edition, Academic Press, 2019.

2. Clyde F. Coombs, Jr, Happy T., Printed Circuits Handbook, Sixth Edition, Holden Publisher McGraw-Hill Education, 2016

3. Mark I. Montrose, Printed Circuit Board Design Techniques for EMC Compliance: A handbook for designers, 2nd ed., Wiley, 2015.

4. Bruce R. Archambeault, James Drewniak, PCB Design for Real-World EMI Control, Volume 696 of The Springer International Series in Engineering and Computer Science, Springer Science & Business Media, 2013.

5. Kraig Mitzner, Complete PCB Design Using OrCAD Capture and PCB Editor, Newnes / Elsevier, 2009

NPTEL LINK:

https://nptel.ac.in/courses/112105267

COURSE CODE	COURSE TITLE	L	T	P	C
22EC002	EMBEDDED SYSTEMS	3	0	0	3

COURSE OBJECTIVES:

- To describe the build process of Embedded System and the components of embedded systems.
- To discuss various Embedded Development Strategies.
- To outline different bus communication in processors and I/O interfacing.
- To impart knowledge in RTOS and various scheduling algorithms.

UNIT I	INTRODUCTION TO EMBEDDED SYSTEMS	9

Introduction to Embedded Systems – The build process for embedded systems- Structural units in Embedded processor, Selection of processor & memory devices- DMA – Memory management methods- Timer and Counting devices, Watchdog Timer, Real Time Clock, In circuit emulator, Target Hardware Debugging.

UNIT II	EMBEDDED FIRMWARE DEVELOPMENT ENVIRONMENT	9

Embedded Product Development Life Cycle- objectives, different phases of EDLC, Modelling of EDLC; issues in Hardware-software Co-design, Data Flow Graph, State machine model, Sequential Program Model, Concurrent Model, Object oriented Model.

UNIT III	EMBEDDED NETWORKING	9

Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus communication protocols – RS232 standard – RS422 – RS485 – CAN Bus -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) – Need for device drivers.

UNIT IV	RTOS BASED EMBEDDED SYSTEMS	9

Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Task communication shared memory, message passing, Inter process Communication — Synchronization between processes - Semaphores, mailbox, pipes, priority inversion, priority inversion.

UNIT V	EMBEDDED SYSTEM APPLICATION AND DEVELOPMENT	9

Case Study of Washing Machine – Automotive Application – Smart card system Application – ATM machine – Digital Camera.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Elaborate the build process of embedded systems.

CO2: Summarize the concepts of embedded system development life cycle.

CO3: Interpret the various embedded networking protocols and I/O interfacing.

CO4: Describe RTOS, multiprocessing and multitasking.

CO5: Illustrate the different scheduling algorithms used for embedded systems.

CO6: Implement embedded system design methods to a specific application.

TEXT BOOKS:

1. Rajkamal, Embedded System-Architecture, Programming, Design, Mc Graw Hill Third edition 2017.
2. Peckol, Embedded systems A contemporary design tool, Wiley, 2014.

REFERENCES:

1. LylaB. Das, Embedded Systems: An Integrated Approach Pearson Education, 2013.
2. Tammy Noergaard, Embedded Systems Architecture, Elsevier,2nd Edition,2017.
3. Rajib Mall ,Real-Time systems Theory and Practice,Pearson Education,1st Edition,2006.
4. Sriram V Iyer, Pankaj Gupta, Embedded Real Time Systems Programming, Tata McGraw Hill, 2017.
5. JonathanW.V alvano, Embedded Microcomputer Systems Real Time Interfacing, Second Edition Cengage Learning,2012

NPTEL LINK:

https://onlinecourses.nptel.ac.in/noc21_cs08/

COURSE CODE	COURSE TITLE	L	T	P	C
22EC003	PRINCIPLES OF ANALOG AND DIGITAL COMMUNICATION	3	0	0	3

COURSE OBJECTIVES:

- To discuss the concepts of various Amplitude Modulation schemes and compare their performance.
- To describe the concept of Angle Modulation and demodulation.
- To explain the transmitter and receiver blocks of variouswaveform coding techniques.
- To describe the various digital modulation schemes.
- To familiarize the fundamentals of Source coding Techniques.

UNIT I	AMPLITUDE MODULATION	9

Need for Modulation - Amplitude modulation, Frequency spectrum of AM, Representation of AM, Amplitude Modulation Index, Power relations in AM, Generation of AM, Collector Modulator-Theory of Double-sideband suppressed carrier (DSBSC) - Single sideband (SSB) modulation techniques – AM Demodulation, Envelope Detector-VSB - Comparison of AM, DSBSC, SSB and VSB modulation - Superheterodyne receiver.

UNIT II	ANGLE MODULATION	9

Principles of Angle Modulation - Definition of Frequency Modulation, Mathematical representation of FM - Narrowband and Wideband FM-Generation of FM, Varactor diode modulator and Armstrong Modulator - PLL FM Demodulator-Phase Modulation, Definition of PM, Relationship between FM and PM, Comparison of AM, FM and PM.

UNIT III	PULSE MODULATION SYSTEMS	9

Block Diagram of Digital communication system, Sampling – Quantization – Pulse Code Modulation (PCM) - Differential pulse code modulation-Delta modulation and Adaptive Delta Modulation (Block Diagram and Explanation).

UNIT IV	DIGITAL MODULATION TECHNIQUES	9

Design Features of Digital Modulation, BASK, BFSK, BPSK, QPSK and comparison of all digital Modulation Techniques.

UNIT V	INFORMATION THEORY AND SOURCE CODING	9

Definition of - Discrete Memoryless source, Information, Entropy - Source coding theorem - Shannon Fano & Huffman codes.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Describe the concepts of various Amplitude Modulation Techniques.

CO2: Summarize the concepts of Angle Modulation Systems.

CO3: Explain the performance of various Pulse code modulation Techniques.

CO4: Illustrate the different digital modulation schemes.

CO5: Compare the analog and digital modulation techniques.

CO6: Illustrate the different source coding schemes.

TEXT BOOKS:

1. George Kennedy, Bernard Davis, Electronic Communication Systems, 2009, Mc Graw Hill.
2. Wayne Tomasi, Advanced Electronic Communications Systems, 2014, 6th Edition, Pearson New International Edition, Noida, India.

REFERENCES:

1. Herbert Taub and Donald Schilling, Principles of Communication Systems, ,Mc Graw Hill, 4th edition, 2017
2. T L Singal, Analog and Digital Communications, McGRaw-Hill, 2012.
3. Sanjay Sharma, Communication Systems (Analog and digital), , S.K. Kataria & Sons Reprint edition, 2016
4. Roddy and Coolen, Electronic Communication, Pearson Education, Noida, India, 4th Edition, 2014.
5. B. P. Lathi , Zhi Ding Modern Digital and Analog Communication Systems,

NPTEL LINK:

https://nptel.ac.in/courses/108104091

COURSE CODE	COURSE TITLE	L	T	P	C
22EC004	SENSORS AND INSTRUMENTATION	3	0	0	3

COURSE OBJECTIVES:

- To categorize the sensors according to their needs.
- To analyze different type of bio inspired and life inspired sensors.
- To examine the sensors used in robotic system.
- To interpret the data acquired by the sensing system.
- To illustrate the working of detectors for human occupancy.

UNIT I	INTRODUCTION TO SENSORS	9

Basic Sensor Classification, Basic Sensor Types- Mechanical Sensors, Thermal Sensors, Electrical Sensors, Magnetic Sensors, Radiant Sensors, Chemical Sensors, Signal Processing and Decision Making, Sensor Fusion, Sensors in Manufacturing – Introduction, Signal Processing and Conversion.

UNIT II	BIO-INSPIRED AND LIFE - INSPIRED SENSORS	9

Introduction, Bio-inspired Systems, Life-inspired Systems, Semiconductor Sensors, Biomedical and Biological Sensors, Advanced Biosensors, Biomimetic Sensors, Signal Processing, Bio-inspired Sensors in industry.

UNIT III	ROBOTICS AND SENSORS - ENVIRONMENTAL APPLICATIONS	9

Introduction, Sensors for General Robotic Systems, Sensors for a Humanoid Robot, Anthropomorphic Robotic Arm for plant health monitoring using RGB Color Sensor, Sensors for Mobile Robotic Platforms in Environmental applications, Biomimetic Sensor design.

UNIT IV	DATA ACQUISITION SYSTEMS	9

Introduction, Signals, Plug-in DAQ Boards, Types of ADCs, Analog input architecture, Data Acquisition software, Scanning, Factors influencing the accuracy of measurements.

UNIT V	HUMAN OCCUPANCY DETECTORS	9

Introduction, Ultrasonic Detectors, Microwave Motion Detectors, Capacitive Occupancy Detectors, Triboelectric Detectors, Optoelectronic Motion Detectors, Optical Presence Sensors, Pressure-Gradient Sensors.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Identify the sensor according to the specific requirement.

CO2: Summarize the sensors that are bio inspired.

CO3: Use the sensors in robotic system.

CO4: Acquire the data obtained by the sensors.

TEXT BOOKS:

1. John G. Webster, Halit Eren, Measurement, Instrumentation, and Sensors Handbook, 2nd Edition, Taylor & Francis, 2014.
2. H.K. Tönshoff, I. Inasaki, Sensors in Manufacturing, Wiley, 2001.

REFERENCES:

1. Princeton Brown, Sensors and Actuators: Technology and Applications, Library Press, 2017.
2. Ian R. Sinclair, Sensors and Transducers, 3rd Edition, Newnes, 2001.
3. Sawney A K and Puneet Sawney, A Course in Mechanical Measurements and Instrumentation and Control, 12th edition Dhanpat Rai & Co, 2013.
4. Patranabis D, Sensors and Transducers, 2nd Edition, PHI, New Delhi, 2011.
5. DVS Murthy, Transducers and Instrumentation, 2nd Edition, PHI, 2013

NPTEL LINK:

https://nptel.ac.in/courses/108108147

COURSE CODE	COURSE TITLE	L	T	P	C
22EC005	AUTOMOTIVE ELECTRONICS	3	0	0	3

COURSE OBJECTIVES:

- To learn about automotive electronics trends and its evolution.
- To understand the basic principles and fundamentals of ignition and injection systems.
- To describe about various actuators used in automobiles.
- To impart knowledge on the diagnostic systems used in Modern Automobiles.
- To interpret the basics of Chassis and safety control Systems

UNIT I	INTRODUCTION	9

Evolution of electronics in automobiles – emission laws – introduction to Euro I, Euro II, Euro III, Euro IV, Euro V standards – Equivalent Bharat Standards. Charging systems: Working and design of charging circuit diagram – Alternators – Requirements of starting system – Starter motors and starter circuits.

UNIT II	IGNITION AND INJECTION SYSTEMS	9

Ignition systems: Ignition fundamentals - Electronic ignition systems - Programmed Ignition –Distribution less ignition - Direct ignition – Spark Plugs. Electronic fuel Control: Basics of combustion – Engine fuelling and exhaust emissions – Electronic control of carburetion – Petrol fuel injection – Diesel fuel injection.

UNIT III	SENSORS AND ACTUATORS	9

Working principle and characteristics of Airflow rate, Engine crankshaft angular position, Hall effect, Throttle angle, temperature, exhaust gas oxygen sensors – study of fuel injector, exhaust gas recirculation actuators, stepper motor actuator, vacuum operated actuator.

UNIT IV	ENGINE CONTROL SYSTEMS	9

Control modes for fuel control-engine control subsystems – ignition control methodologies –different ECU's used in the engine management – block diagram of the engine management system. In vehicle networks: CAN standard, format of CAN standard – diagnostics systems in modern automobiles.

UNIT V	CHASSIS AND SAFETY SYSTEMS	9

Traction control system – Cruise control system – electronic control of automatic transmission –antilock braking system – electronic suspension system – working of airbag and role of MEMS in airbag systems – centralized door locking system – climate control of cars.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Describe the concept of automotive electronics trends and its evolution.

CO2: Interpret the basic principles and fundamentals of ignition and injection systems

CO3: List out the different types of sensors and define its working principle.

CO4: Classify and demonstrate various types of actuators used in automobiles

TEXT BOOKS:

1. William B. Ribbens, Understanding Automotive Electronics, 6th Edition, Publishing.2002.
2. Robert Bosch Gmbh (Ed.) Bosch Automotive Electrics and Automotive Electronics Systems Elsevier and Components, Networking and Hybrid Drive, 5th edition, John Wiley& Sons Inc., 2007.

REFERENCES:

1. Tom Denton, Automobile Electrical and Electronics Systems, Edward Arnold Publishers, 2000.

2. William B. Ribbens, Understanding Automotive Electronics, 5th edition, Newnes Publishing, 2000.

3. Barry Hollembeak, Automotive Electricity, Electronics & Computer Controls, Delmar Publishers, 2001.

4. Richard K. Dupuy ,Alan Ahlstrand , Kalton C. Lahue ,Fuel System and Emission controls, Check Chart Publication, 2000.

NPTEL LINK:

https://nptel.ac.in/courses/112107289

COURSE CODE	COURSE TITLE	L	T	P	C
22EC006	ROBOTICS SYSTEMS	3	0	0	3

COURSE OBJECTIVES:

- To understand the functions of the basic components of a Robot.
- To study the use of various types of End of Effectors and Sensors
- To familiarize students with the concepts of Robot Kinematics
- To impart Knowledge in Robot Programming
- To learn Robot safety issues and economics.

UNIT I	FUNDAMENTALS OF ROBOT	9

Robot - Definition - Robot Anatomy - Coordinate Systems, Work Envelope Types and Classification- Specifications-Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load-Robot Parts and their Functions-Need for Robots - Different Applications.

UNIT II	ROBOT DRIVE SYSTEMS AND END EFFECTORS	9

Pneumatic Drives - Hydraulic Drives-Mechanical Drives-Electrical Drives-D.C. Servo Motors, Stepper Motors, A.C. Servo Motors-Salient Features, Applications and Comparison of all these Drives, End Effectors – Grippers - Mechanical Grippers, Pneumatic and Hydraulic - Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations.

UNIT III	SENSORS AND MACHINE VISION	9

Requirements of a sensor, Principles and Applications of the following types of sensors- Position sensors - Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, pneumatic Position Sensors, Range Sensors Triangulations Principles, Structured, Lighting Approach, Time of Flight, Range Finders, Laser Range Meters, Touch Sensors ,binary Sensors, Analog Sensors, Wrist Sensors, Compliance Sensors, Slip Sensors, Camera, Frame Grabber, Sensing and Digitizing Image Data- Signal Conversion, Image Storage, Lighting Techniques, Image Processing and Analysis - Data Reduction, Segmentation, Feature Extraction, Object Recognition, Other Algorithms, Applications - Inspection, Identification, Visual Serving and Navigation.

UNIT IV	ROBOT KINEMATICS AND ROBOT PROGRAMMING	9

Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), Four Degrees of freedom (in 3 Dimension) Jacobians, Velocity and Forces - Manipulator Dynamics, Trajectory Generator, Manipulator Mechanism Design - Derivations and problems. Lead

through Programming, Robot programming Languages - VAL Programming - Motion Commands, Sensor Commands, End Effector commands and simple Programs.

UNIT V	IMPLEMENTATION AND ROBOT ECONOMICS	9

RGV, AGV- Implementation of Robots in Industries - Various Steps - Safety Considerations for Robot Operations - Economic Analysis of Robots.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Understand the basic concepts of a Robot

CO2: Explain the use of various types of End of Effectors

CO3: Explain the use of Various types of Sensors

CO4: Explain the Concepts of Robot Kinematics

CO5: Demonstrate the Robot Programming

CO6: Understand the Robot safety issues and economics

TEXT BOOKS:

1. Klafter R.D., Chmielewski T.A and Negin M, Robotic Engineering - An Integrated Approach, Prentice Hall, 2003.
2. Groover M.P., Industrial Robotics -Technology Programming and Applications, McGraw Hill, 2001.

REFERENCES:

1. Craig J.J., Introduction to Robotics Mechanics and Control, Pearson Education, 2008
2. Mikell P. Groover, Industrial Robotics Technology, Programming and Applications McGraw Hill Publications -3rd edition 2008
3. S.R. Deb, Robotics Technology and flexible automation, Tata McGraw-Hill Education., 2009.
4. Richard D. Klafter, Thomas .A, ChriElewski, Michael Negin, Robotics Engineering an Integrated Approach, PHI Learning., 2009.
5. Saeed B.Niku ,Introduction to Robotics Analysis, Systems and Applications ,3rd edition – Wiley publications – 2019.

NPTEL LINK:

https://nptel.ac.in/courses/112107289

COURSE CODE	COURSE TITLE	L	T	P	C
22EC007	CONSUMER ELECTRONICS	3	0	0	3

COURSE OBJECTIVES:

- To understand working principles of various audio systems.
- To identify the working principles of various video systems anddisplay operations.
- To study the various technical specifications and facilities of the domestic & consumer appliances used on day to day basis.
- To learn how to maintain the products by using preventive powersupplies
- To understand how to select the product by comparing commercially available products on the basis of electrical safety

UNIT I	AUDIO SYSTEMS	9

Audio System: Microphones, loudspeakers baffle and enclosure, Acoustics, mono, stereo, Quad, Amplifying System, Equalizers and Mixers Synthesizers, Commercial Sound, Theater Sound System.

UNIT II	VIDEO SYSTEMS AND TELEVISON	9

Video Systems and Displays: Monochrome, Color TV standards, TFT, Plasma, HDTV,LCD, LED TV, Direct-To- Home (DTH- Set Top Box), Video Telephone and Video Conferencing.

UNIT III	DOMESTIC & CONSUMER APPLIANCES	9

Domestic & Consumer Appliances: Washing machines, Microwave ovens, Air-conditioners and Refrigerators, Computers office System, Telephone & Mobile Radio System

UNIT IV	POWER SUPPLIES AND OTHER SYSTEMS	9

Power Supplies SMPS/UPS and Preventive Maintenance and others systems such as Remote controls, Bar codes, RFID, Scanners, Printers, Photocopier

UNIT V	PRODUCT COMPLIANCE AND PRODUCT SAFETY	9

Product Compliance: Product safety and liability issues; standards related to electrical safety and fire hazards, EMI/EMC requirements, design techniques for ESD, RF interference and Immunity, line current harmonics and mains voltage surge.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Understand electronics engineering concepts used in consumer electronics systems.

CO2: Identify the need of preventive maintenance in various electronic appliances.

CO3: Use different product safety, compliance standards and techniques associated with electronic products.

CO4: Evaluate and analyze different electronic products and systems based on specifications

CO5: Manage multi-faceted and multi-disciplinary projects with significant technical considerations using a broad systems perspective

CO6: Foster a desire to continue life-long learning.

TEXT BOOKS:

1. R.P.Bali, Consumer Electronics, Pearson Education ,2008
2. R.G.Gupta, Audio and video System, Tata McGraw Hill,2008

REFERENCES:

1. Douglas Kinney ,A Beginners Guide to Consumer Electronics Repair: Hand Book and Tutorial , iUniverse Publishers ,2006
2. Dr J S Chitode, Consumer Electronics - A Conceptual Approach by, Technical Publications Pune,2008.
3. H Davidson,Troubleshooting Consumer Electronics Audio Circuits , Prompt publications,2001
4. Gulati.R.R,Modern Television Practice:Transmission,reception,Applications,New Age International,2015
5. Dhake A.M,Television and Video Engineering, Tata McGraw Hill,2006

NPTEL LINK:

https://archive.nptel.ac.in/courses/108/106/108106138/

COURSE CODE	COURSE TITLE	L	T	P	C
22EC008	HEALTH CARE ELECTRONICS	3	0	0	3

COURSE OBJECTIVES:

- To familiarize the essentials of Telemedicine.
- To explain the technologies and Communication infrastructure in telemedicine.
- To describe the concepts of real time telemedicine standards
- To disseminate the concepts of picture archiving and communication System
- To discuss m-health and its applications

UNIT I	TELEMEDICINE AND HEALTH	9

History and Evolution of telemedicine, Functional diagram of telemedicine system, Tele-consultation, Tele health, Organs of Telemedicine, Global and Indian scenario, international regulations in e-health and telemedicine, Ethical and legal aspects of Telemedicine - Confidentiality, Social and legal issues, Safety and regulatory issues, Cyber laws related to telemedicine - Patient Rights

UNIT II	TELEMEDICAL TECHNOLOGY	9

Principles of Multimedia: Text, Audio, Video, data - Data communications and networks, Internet, Body centric wireless communication: Wireless Body Area Networks (WBAN), Wireless Sensor Networks (WSN) and Wireless Personal Area Networks (WPAN) and their design concepts Antenna design considerations for in-body and on-body electronics - Communication infrastructure for Telemedicine - Telemedicine through world wide web

UNIT III	TELEMEDICAL STANDARDS	9

Real-time Telemedicine integrating doctors / Hospitals, Access to health care services – Health education and self-care, Telesurgery, Teleradiology, Telecardiology, Teleoncology, Telemedicine in neurosciences, Telepathology, Interactive videoconferencing consults, Store and forward consults, Remote monitoring and home care, Home Telehealth Protocols and Procedure

UNIT IV	PICTURE ARCHIVING AND COMMUNCIATION SYSTEM	9

Types of image formats, DICOM standard, PACS system: Block diagram, Storing & retrieving images, Algorithm for retrieving images, Compressions and its significance, Lossless data Storage and in-house communication, Computer aided diagnosis (CAD), Hospital information system - Doctors, paramedics, facilities available. Pharmaceutical information system

UNIT V	M HEALTH	9

Mobile Devices : Smart phones, Tablet PCs, iPads, PDAs, Wearable computers – mHealth technology and communication infrastructure - Healthcare Apps – m-Health applications: Education and awareness, Remote data collection, Remote monitoring, Communication and training for healthcare workers, Disease and epidemic outbreak tracking, Diagnostic and treatment support – m-Health and the Transformation of Clinical Trials - Harnessing data, advanced analytics, and the Internet of Things to optimize digitized clinical trials

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Describe the key principles for telemedicine and health.

CO2: Discuss the technologies and Communication infrastructure in telemedicine applications.

CO3: Develop real time telemedicine systems.

CO4: Describe the concepts of picture archiving and communication system.

CO5: Discuss recent trends in m-Health.

TEXT BOOKS:

1. Norris, A.C. Essentials of Telemedicine and Tele care, Wiley, 2002
2. Wootton R., Craig, J., Patterson, V. (Eds.), Introduction to Telemedicine,Royal Society of Medicine Press Ltd (ISBN 1853156779), 2006

REFERENCES:

1. David Dagan Feng, Biomedical Information Technology, Academic Press Series in Biomedical Engineering, Elsevier Inc, USA, 2008
2. Ilias G. Maglogiannis, Kostas Karpouzis and Manolis Wallace, Image and Signal Processing for Networked E-Health Applications, Morgan & Claypool Publishers series, USA, 2006
3. Simpson, W. Video over IP. A practical guide to technology and applications. Focal PressElsevier,2006.
4. Bemmel, J.H. van, Musen, M.A. (Eds.) Handbook of Medical Informatics. Heidelberg, Germany:Springer,1997
5. Mohan Bansal Medical Informatics, Tata McGraw-Hill, 2004.

Apress, 2020.

NPTEL LINK:

https://onlinecourses.nptel.ac.in/noc23_hs67/preview

COURSE CODE	COURSE TITLE	L	T	P	C
22EC009	SEMICONDUCTOR PHYSICS	3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals of basic semiconductor physics which includes the electronic materials, Semiconductors
- To understand the carrier transport and properties of semiconductors
- To be familiar with light semiconductor
- To provide problem solving experience and learning of concepts through it in Semiconductor Physics.
- To deliver complex problem solving through electrical measurements and nanomaterials.

UNIT I	ELECTRONIC MATERIALS	9

Classical Free Electron Theory- Energy Bands in solids - Kronig Penny model - Direct & Indirect Band gaps -Brillouin Zone - Energy band structure in Semiconductors - Concept of Effective mass - Classification of Electronic materials - Fermi level - Probability of Occupation - Influence of donor sand acceptors in semiconductors - Non equilibrium properties of carriers.

UNIT II	CARRIER TRANSPORT AND SEMICONDUCTORS	9

Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature (equilibrium carrier statistics), Carrier generation and recombination, Carrier transport: diffusion and drift, p-n junction, Metal semiconductor junction (Ohmic and Schottky), Semiconductor materials of interest for opto electronic devices.

UNIT III	LIGHT-SEMICONDUCTOR INTERACTION	9

Optical transitions in bulk semiconductors: absorption, spontaneous emission, and stimulated emission; Density of states for photons, Transition rates (Fermi's golden rule), Optical loss and gain; Photovoltaic effect, Exciton, Drude model. Laser, Amplification of light by population inversion, different types of lasers: gas laser (He-Ne, CO2), Solid state laser (Ruby, Neodymium), Dye laser, Applications of laser in science and medicines.

UNIT IV	ELECTRICAL MEASUREMENTS	9

Electrical Measurements – Two-point probe technique- Four-point probe technique-Linear method - Four-point probe technique- Vander Paw method - Significance of carrier density, Resistivity & hall mobility - Hot point probe measurements - Extraction of parameters in a diode - I-V characteristics of a diode - Deep level transient spectroscopy - (DLTS)

UNIT V	NANOMATERIALS	9

Density of states in 2D - Density of states in 1D & 0D - Introduction to low dimensional systems, Quantum well, Quantum wire & do - CNT – Properties & synthesis CVD – Fabrication Technique PVD- Characterization techniques for low dimensional system- XRD powder method - Principle of electron microscopy –SEM - AFM - Hetero junctions – Band diagram of hetero junctions

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Understand fundamentals of energy band theory in semiconducting materials.

CO2: Understand the basic of Intrinsic and Extrinsic Semiconductors.

CO3: Understand the concepts of light interaction with matter and its applications.

CO4: Analyze and apply the elementary understanding of the measurement techniques for semiconductor.

CO5: Summarize the concepts of hetero junctions with band diagram

CO6: Analyze the fabrication techniques involved in semiconductors

TEXT BOOKS:

1. J. Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw-Hill Inc.,1995.
2. B. E. A. Saleh and M. C. Teich, Fundamentals of Photonics, John Wiley & Sons, Inc.,2007.

REFERENCES:

1. Mishra, Umesh K. and Singh, Jaspreet, Semiconductor Device Physics and Design, Springer, 2008.
2. Pierret, R.F., Semiconductor Device Fundamentals, Pearson Education Inc., 2006.

NPTEL LINK:

https://nptel.ac.in/courses/108108122

COURSE CODE	COURSE TITLE	L	T	P	C
22EC010	BIOMEDICAL INSTRUMENTATION	3	0	0	3

COURSE OBJECTIVES:

- To study about the different bio potentials and its propagation
- To understand the different types of electrodes and their placement forvarious recordings
- To study the design of bio amplifier for various physiologicalrecording
- To learn the different measurement techniques for non-physiologicalparameters.
- To be familiar with chemical measurement techniques.

UNIT I	BIO POTENTIAL GENERATION AND ELECTRODES TYPES	9

Origin of bio potential and its propagation. Types of electrodes - surface, needle and micro electrodes and their equivalent circuits. Recording problems - measurement with two electrodes

UNIT II	BIOSIGNAL CHARACTERISTICS AND ELECTRODE CONFIGURATIONS	9

Bio signals characteristics – frequency and amplitude ranges. ECG – Einthoven's triangle, standard 12 lead system. EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode.

UNIT III	SIGNAL CONDITIONING CIRCUITS	9

Need for bio-amplifier - differential bio-amplifier, Impedance matching circuit, isolation amplifiers, Power line interference, Right leg driven ECG amplifier, Band pass filtering.

UNIT IV	MEASUREMENT OF NON-ELECTRICAL PARAMETERS	9

Temperature, respiration rate and pulse rate measurements. Blood Pressure: indirect methods - Auscultatory method, direct methods: electronic manometer, Systolic, diastolic pressure, Blood flow and cardiac output measurement: Indicator dilution, and dye dilution method, ultrasound blood flow measurement.

UNIT V	BIO-CHEMICAL MEASUREMENT	9

Blood gas analyzers and Non-Invasive monitoring, colorimeter, Sodium Potassium Analyzer, Spectrophotometer, blood cell counter, auto analyzer (simplified schematic description).

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Understand the different bio potential and its propagation.

CO2: Summarize the bio signal characteristics

CO3: Summarize the different electrode placement for various physiological recording

CO4: Design bio amplifier for various physiological recording

CO5: Understand various technique non electrical physiological measurements

CO6: Understand the different biochemical measurements

TEXT BOOKS:

1. Leslie Cromwell, Biomedical Instrumentation and measurement, Prentice hall of India, New Delhi, 2007.
2. John G. Webster, Medical Instrumentation Application and Design, John Wiley and sons, New York, 2004.

REFERENCES:

1. Myer Kutz, Standard Handbook of Biomedical Engineering and Design, McGraw Hill Publisher, 2003.
2. Khandpur R.S, Handbook of Biomedical Instrumentation, Tata McGraw-Hill, New Delhi, 2003.
3. Joseph J. Carr and John M. Brown, Introduction to Biomedical Equipment Technology, Pearson Education, 2004.
4. Ed. Joseph D. Bronzino, The Biomedical Engineering Hand Book, Third Edition, Boca Raton, CRC Press LLC, 2006.
5. M. Arumugam, Bio-Medical Instrumentation, Anuradha Agencies, 2003.

NPTEL LINK:

https://onlinecourses.nptel.ac.in/noc22_bt56/preview

COURSE CODE	COURSE TITLE	L	T	P	C
22EC011	MATLAB PROGRAMMING	3	0	0	3

COURSE OBJECTIVES:

- To learn features of MATLAB for program solving.
- To promote new teaching model that will help to develop programming skills and technique to solve mathematical problems
- To understand MATLAB graphic feature and its applications
- To develop programs in MATLAB language for engineeringapplications.
- To use MATLAB as a simulation tool

UNIT I	INTRODUCTION	9

The MATLAB Environment - MATLAB Basics – Variables , Numbers, Operators , Expressions, Input and output - Vectors, Arrays – Matrices

UNIT II	SAMPLE CONTENT	9

Built-in Functions - User defined Functions – Function Creation – Argument Definitions – Scope variables and Generate Names – Error handling

UNIT III	GRAPHICS WITH MATLAB	9

Files and File Management – Import/Export - Basic 2D, 3D plots - Graphic handling - Formatting and Annotation – Printing and Saving – Graphics Objects – Graphics Performance

UNIT IV	PROGRAMMING WITH MATLAB	9

Conditional Statements, Loops - MATLAB Programs – Programming and Debugging - Applications of MATLAB Programming

UNIT V	MATHEMATICAL COMPUTING WITH MATLAB	9

Algebraic equations - Basic Symbolic Calculus and Differential equations - Numerical Techniques and Transforms

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Learn features of MATLAB as a programming tool.

CO2: Promote new teaching model that will help to develop programming skills and technique to solve mathematical problems.

CO3: Understand MATLAB graphic feature and its applications

CO4: Use MATLAB as a simulation tool
CO5: Learn the MATLAB Library

TEXT BOOKS:

1. Brian R. Hunt, Ronald L. Lipsman, Jonathan M. Rosenberg, A Guide to MATLAB for Beginners and Experienced Users, 2nd Ed., Cambridge University Press, 2006
2. Stephen J. Chapman, Cengage Learning,Essentials of MATLAB Programming, 2nd Ed. 2009.

REFERENCES:

1. David McMahon,MATLAB Demystified,The McGraw-Hill Companies, 2007.
2. Holly Moore,MATLAB® for Engineers,3rd Ed, Pearson Education, Inc.,2012.
3. David M. Smith,Engineering computation with MATLAB, 2nd Ed., Pearson Education, Inc.2010
4. Brian Hahn and Daniel T. Valentine,Essential MATLAB for Engineers and Scientists,7th Edition, Apress, 2018.
5. Michael Paluszek, Stephanie Thomas,Practical MATLAB Deep Learning: A Project-
6. Based Approach, Apress,4th Edition, 2016

NPTEL LINK:

https://nptel.ac.in/courses/103/106/103106118/

COURSE CODE	COURSE TITLE	L	T	P	C
22EC012	INDUSTRIAL IoT APPLICATIONS	3	0	0	3

COURSE OBJECTIVES:

- To introduce how IoT has become a game changer in the new economy where the customers are looking for integrated value.
- To get insights over the architecture and protocols of IIoT
- To know the various sensors and interfacing used in IIoT.
- To bring the IoT perspective in thinking and building solutions.
- To understand the different IoT platforms and cloud services

UNIT I	INTRODUCTION	9

Introduction to IOT, what is IIOT? IOT Vs. IIOT, History of IIOT, Components of IIOT - Sensors, Interface, Networks, People Process, Hype cycle, IOT Market, Trends, future Real life examples, Key terms – IOT Platform, Interfaces, API, clouds, Data Management Analytics, Mining Manipulation, Thinking about Prototyping – Costs versus ease of prototyping, prototyping and Production, open source versus Closed Source, Role of IIOT in Manufacturing Processes, Use of IIOT in plant maintenance practices, Sustainability through Business excellence tools Challenges, Benefits in implementing IIOT

UNIT II	ARCHITECTURE AND PROTOCOLS	9

Overview of IOT components; Various Architectures of IOT and IIOT, Advantages & disadvantages, Industrial Internet - Reference Architecture; IIOT System components: Sensors, Gateways, Routers, Modem, Cloud brokers, servers and its integration, WSN, WSN network design for IOT; Need for protocols, Wi-Fi, Zigbee, Bacnet, IIOT protocols –COAP, MQTT, 6LoWPAN, LWM2M, AMPQ

UNIT III	SENSORS AND INTERFACING	9

Introduction to sensors, Transducers, Classification, Roles of sensors in IIOT, Various types of sensors , Design of sensors, sensor architecture, special requirements for IIOT sensors, Role of actuators, types of actuators. Hardwire the sensors with different protocols such as HART, MODBUS-Serial,Parallel, Ethernet, BACNet , Current, M2M, Prototyping online Components – Getting Started with an API, Writing a New API, Real Time Reactions.

UNIT IV	CLOUD, SECURITY AND GOVERNANCE	9

IIOT cloud platforms: Overview of cots cloud platforms, predix, thingworks, azure, Data analytics, cloud services, Business models: Saas, Paas, Iaas; Introduction to web security, Conventional web technology and relationship with IIOT, Vulnerabilities of IoT, IoT security

tomography and layered attacker model, Identity establishment, Access control, Message integrity; Management aspects of cyber security.

UNIT V	IOT ANALYTICS AND APPLICATIONS	9

IOT Analytics: Role of Analytics in IOT, Data visualization Techniques, Statistical Methods; IOT Applications: Smart Metering, e-Health Body Area Networks, City Automation, Automotive Applications, Plant Automation, Real life examples of IIOT in Manufacturing Sector.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Describe IOT, IIOT

CO2: Understand various IoT Layers and their relative importance

CO3: Interpret the requirements of IIOT sensors and understand the role of actuators.

CO4: Study various IoT platforms and Security

CO5: Realize the importance of Data Analytics in IoT

CO6: Design various applications using IIoT in manufacturing sector.

TEXT BOOKS:

1. Daniel Minoli, Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications,1st Edition, Wiley Publications, 2013
2. Dieter Uckelmann , Mark Harrison, Florian Michahelles, Architecting the Internet of Things, Springer-Verlag Berlin Heidelberg 2011 Industry 4.0: The Industrial Internet of Things
3.

REFERENCES:

1. Hakima Chaouchi,The Internet of Things Connecting Objects to the Web Willy Publications.
2. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key Applications and Protocols, 2nd Edition,Wiley Publications
3. Internet of Things - From Research and Innovation to Market Deployment; by OvidiuVermesan & Peter Friess; River Publishers Series,2014
4. How Protocol Conversion Addresses IIoT Challenges:White Paper By RedLion.
5. Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things,First edition,Kindle edition

NPTEL LINK:

https://onlinecourses.nptel.ac.in/noc20_cs69/preview