R.M.K. ENGINEERING COLLEGE

(An Autonomous Institution, Affiliated to Anna University, Chennai)

RSM NAGAR, KAVARAIPETTAI – 601 206

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Curriculum 2020

Bachelor of Engineering

Electronics & Communication Engineering

R.M.K. ENGINEERING COLLEGE

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RSM NAGAR, KAVARAIPETTAI – 601 206

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

REGULATIONS-2020

Vision and Mission of the Department

Vision

- To be one of the most sought after Centre of Excellence in the field of Electronics and Communication Engineering by providing High Quality Education.
- To mould the students to compete Internationally and to become Excellent Researchers and Innovators who can provide solution to societal issues.

Mission

- To provide the needed resources and infrastructure and to establish a Conducive Ambience for the Teaching-Learning and Research Processes and to meet with the technological developments.
- To create High Quality Professionals and Entrepreneurs in the field of Electronics and Communication Engineering with the right attitude to serve the society with ethical values.
- To Modernize the Laboratories on par with industry standards and to collaborate with them to improve the skill set of the students for providing Innovative Solutions to the Industry.
- To provide a good ambience which encourages the students to Pursue Higher Education.

Mapping of Programme Educational Objectives with Department Mission

Mission	PEO1	PEO2	PEO3	PEO4	PEO5
To provide the needed resources and infrastructure and to establish a Conducive Ambience for the Teaching-Learning and Research Processes and to meet with the technological developments.	3	2	2	1	2
To create High Quality Professionals and Entrepreneurs in the field of Electronics and Communication Engineering with the right attitude to serve the society with ethical values.	2	3	2	2	2
To Modernize the Laboratories on par with industry standards and to collaborate with them to improve the skill set of the students for providing Innovative Solutions to the Industry.	1	2	2	1	1
To provide a good ambience which encourages the students to Pursue Higher Education.	2	1	3	3	3

Contribution 1: Reasonable 2: Significant 3: Strong

PROGRAMME EDUCATIONAL OBJECTIVES

PEO1: Graduates will develop the ability to Identify, Formulate and Solve Challenging Problems in the field of Electronics and Communication Engineering.

PEO2: Graduates will acquire the Professional Skills that make them ready for Immediate Employment or to Pursue Higher Studies in the related disciplines.

PEO3: Graduates will be moulded with a Strong Educational Foundation that prepares them for Leadership Roles.

PEO4: Graduates will show the understanding of Impact of Engineering Solutions in the Society and also will be aware of Contemporary Issues.

PEO5: Graduates will develop Confidence to Communicate their Ideas effectively to Industry and Society.

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. Apply the principles of Semiconductor Devices, Digital Systems, Microprocessor and Signal Processing in the fields of Consumer Electronics, Medical, Defence and Spacecraft Electronics industry.

2. Design a variety of Computer-based Components and Systems for applications including Communications, Networking and Control Systems.

3. Develop Indigenous Components and methods for producing High Quality, Compact, Energy Efficient and Eco-Friendly consumer goods at an affordable price.

4. Apply acquired knowledge in information and communication technologies to the benefit of society.

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
4	2	2	2	2	2	2	3	3	3	2	3	2
5	3	3	3	3	3	2	3	2	2	3	2	3

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
4	3	3	3	3	1	2	2	1	2	2	1	2

Contribution 1: Reasonable 2: Significant 3: Strong

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING

REGULATIONS-2020

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 following table

COURSE OUTCOMES		PROGRAMME OUTCOMES											
Sem	**Course Name**	a	b	c	d	e	f	g	h	i	j	k	l
I	Communicative English & Life Skills						✓	✓	✓	✓	✓	✓	
	Engineering Mathematics I	✓	✓	✓	✓							✓	✓
	Physics for Electronics Engineering	✓	✓	✓	✓							✓	✓
	Engineering Chemistry	✓	✓	✓	✓							✓	✓
	Problem solving and C Programming	✓	✓	✓	✓	✓						✓	✓
	Computer Aided Engineering Graphics	✓									✓	✓	✓
	Physics & Chemistry Laboratory	✓	✓	✓	✓							✓	✓
	C Programming Lab	✓	✓	✓	✓	✓						✓	✓
	Interpersonal Skills - Listening and Speaking Lab						✓		✓	✓	✓	✓	✓
II	Technical English					✓	✓	✓	✓	✓	✓	✓	✓
	Engineering Mathematics II	✓	✓	✓	✓							✓	✓
	Environmental Science and Engineering	✓	✓				✓	✓			✓		✓
	Core I – Fundamentals of Electrical Engineering and Circuits	✓	✓	✓	✓	✓	✓					✓	✓
	Core II – Electronic Devices	✓	✓	✓	✓	✓	✓					✓	✓
	Core III – Data Structures	✓	✓	✓									✓
	Engineering Practices Lab	✓	✓	✓	✓	✓						✓	✓
	Data Structures Lab	✓	✓	✓									✓
	Advanced Reading and Writing Lab						✓		✓	✓	✓	✓	✓
III	Linear Algebra and Partial Differential Equations	✓	✓	✓	✓					✓	✓		
	Signals and Systems	✓	✓	✓	✓	✓	✓	✓	✓				✓
	Electronic Circuits	✓	✓	✓	✓	✓	✓	✓	✓				✓
	Digital Electronics	✓	✓	✓	✓	✓	✓	✓	✓				✓
	Control Systems	✓	✓	✓	✓	✓	✓						✓
	Python Programming(Lab Integrated)	✓	✓	✓		✓			✓	✓	✓		✓
	Analog and Digital Circuits Laboratory	✓	✓	✓	✓	✓	✓	✓	✓				✓
	Foundation Lab on Internet of Things	✓	✓	✓	✓	✓	✓		✓				✓
	Aptitude and Coding skills-I	✓	✓							✓	✓		
IV	Probability and Random Processes	✓	✓	✓	✓								✓
	Communication Systems	✓	✓	✓	✓	✓							✓

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	Microprocessors and Microcontrollers	✓	✓	✓	✓	✓	✓		✓		✓		✓
	Electromagnetic Fields	✓	✓	✓	✓	✓		✓					✓
	Linear Integrated Circuits	✓	✓	✓	✓	✓							✓
	Universal Human values II: Understanding Harmony						✓	✓	✓	✓	✓	✓	✓
	Microprocessors and Microcontrollers Laboratory	✓	✓	✓	✓	✓	✓	✓	✓				✓
	Linear Integrated Circuits Laboratory	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓
	Mini Project and Industrial Internship	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Aptitude and Coding Skills-II	✓	✓							✓	✓		
V	Digital Communication	✓	✓	✓	✓	✓	✓					✓	✓
	Discrete-Time Signal Processing	✓	✓	✓	✓	✓	✓					✓	✓
	Data Communication Networks	✓	✓	✓	✓	✓	✓					✓	✓
	Transmission Lines and Waveguides	✓	✓	✓	✓	✓	✓					✓	✓
	Professional Elective I												
	Open Elective I												
	Communication Networks and DSP Laboratory	✓	✓	✓	✓	✓	✓					✓	✓
	Communication Systems Laboratory	✓	✓	✓	✓	✓	✓					✓	✓
	Foundation Lab on Machine learning	✓	✓	✓	✓	✓	✓	✓	✓				✓
	Advanced Aptitude and Coding Skills - I	✓	✓	✓						✓	✓		
VI	VLSI Design	✓	✓	✓	✓	✓	✓					✓	✓
	Embedded Systems	✓	✓	✓	✓	✓	✓					✓	✓
	Wireless Communications	✓	✓	✓	✓	✓	✓					✓	✓
	Antennas and Wave Propagation	✓	✓	✓	✓	✓	✓					✓	✓
	Professional Elective II												
	Professional Elective III												
	Embedded Systems and RTOS Laboratory	✓	✓	✓	✓	✓	✓					✓	✓
	VLSI Design Laboratory	✓	✓	✓	✓	✓	✓					✓	✓
	Innovative / Multi-Disciplinary Project	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Advanced Aptitude and Coding Skills - II	✓	✓	✓						✓	✓		
VII	RF and Microwave Engineering	✓	✓	✓	✓	✓	✓						✓
	Optical Communication and Networks	✓	✓	✓	✓	✓				✓	✓	✓	✓
	Professional Ethics in Engineering						✓	✓	✓	✓	✓	✓	✓
	Professional Elective IV												
	Professional Elective V												
	Open Elective II												
	Advanced Communication Laboratory	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓
	Design Thinking Laboratory	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Project Work - Phase I and Internship	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
VIII	Project Work - Phase II	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING
REGULATIONS-2020
CHOICE BASED CREDIT SYSTEM
I-VIII SEMESTERS CURRICULUM

SEMESTER I

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	20EL101	Communicative English & Life Skills	HS	2	2	0	0	2
2	20MA101	Engineering Mathematics I	BS	5	3	2	0	4
3	20PH102	Physics for Electronics Engineering	BS	3	3	0	0	3
4	20CH101	Engineering Chemistry	BS	3	3	0	0	3
5	20GE101	Problem Solving and C Programming	ES	3	3	0	0	3
6	20ME103	Computer Aided Engineering Graphics	ES	6	2	0	4	4
		Induction Program	MC	3 Weeks				
PRACTICALS								
7	20PC111	Physics & Chemistry Laboratory	BS	4	0	0	4	2
8	20GE111	C Programming Lab	ES	4	0	0	4	2
9	20EL111	Interpersonal Skills - Listening and Speaking Lab	HS	2	0	0	2	1
TOTAL				**32**	**16**	**2**	**14**	**24**

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SEMESTER II

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	20EL201	Technical English	HS	2	2	0	0	2
2	20MA201	Engineering Mathematics II	BS	5	3	2	0	4
3	20CH102	Environmental Science and Engineering	HS	3	3	0	0	3
4	20EC201	Core I – Fundamentals of Electrical Engineering and Circuits	PC	4	4	0	0	4
5	20EC202	Core II – Electronic Devices	PC	3	3	0	0	3
6	20CS201	Core III – Data Structures	ES	3	3	0	0	3
PRACTICALS								
7	20EM111	Engineering Practices Lab	ES	4	0	0	4	2
8	20CS211	Data Structures Lab	ES	4	0	0	4	2
9	20EL211	Advanced Reading and Writing Lab	HS	2	0	0	2	1
TOTAL				**30**	**18**	**2**	**10**	**24**

SEMESTER III

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	20MA303	Linear Algebra and Partial Differential Equations	BS	5	3	2	0	4
2	20EC301	Signals and Systems	PC	5	3	2	0	4
3	20EC302	Electronic Circuits	PC	3	3	0	0	3
4	20EC303	Digital Electronics	PC	3	3	0	0	3
5	20EE401	Control Systems	PC	4	2	2	0	3
6	20CS202	Python Programming(Lab Integrated)	ES	5	3	0	2	4
PRACTICALS								
7	20EC311	Analog and Digital Circuits Laboratory	PC	4	0	0	4	2
8	20EC312	Foundation Lab on Internet of Things	EEC	2	0	0	2	1
9	20CS313	Aptitude and Coding Skills - I	EEC	2	0	0	2	1
TOTAL				**33**	**17**	**6**	**10**	**25**

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SEMESTER IV

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	20MA401	Probability and Random Processes	BS	5	3	2	0	4
2	20EC401	Communication Systems	PC	3	3	0	0	3
3	20EC402	Microprocessors and Microcontrollers	PC	3	3	0	0	3
4	20EC403	Electromagnetic Fields	PC	4	4	0	0	4
5	20GE301	Universal Human Values II: Understanding Harmony	HS	4	2	2	0	3
6	20EC404	Linear Integrated Circuits	PC	3	3	0	0	3
PRACTICALS								
7	20EC411	Microprocessors and Microcontrollers Laboratory	PC	4	0	0	4	2
8	20EC412	Linear Integrated Circuits Laboratory	PC	4	0	0	4	2
9	20EC413	Mini Project and Industrial Internship	EEC	2	0	0	2	1
10	20CS414	Aptitude and Coding skills -II	EEC	2	0	0	2	1
TOTAL				**34**	**18**	**4**	**12**	**26**

SEMESTER V

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	20EC501	Digital Communication	PC	3	3	0	0	3
2	20EC502	Discrete-Time Signal Processing	PC	4	2	2	0	3
3	20EC503	Data Communication Networks	PC	3	3	0	0	3
4	20EC504	Transmission Lines and Waveguides	PC	3	3	0	0	3
5		Professional Elective I	PE	3	3	0	0	3
6		Open Elective I	OE	3	3	0	0	3
PRACTICALS								
7	20EC511	Communication Networks and DSP Laboratory	PC	4	0	0	4	2
8	20EC512	Communication Systems Laboratory	PC	4	0	0	4	2
9	20EC513	Foundation Lab on Machine Learning	EEC	2	0	0	2	1
10	20CS512	Advanced Aptitude and Coding Skills - I	EEC	2	0	0	2	1
TOTAL				**31**	**17**	**2**	**12**	**24**

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SEMESTER VI

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	20EC601	VLSI Design	PC	3	3	0	0	3
2	20EC602	Embedded Systems	PC	3	3	0	0	3
3	20EC603	Wireless Communications	PC	3	3	0	0	3
4	20EC604	Antennas and Wave Propagation	PC	3	3	0	0	3
5		Professional Elective II	PE	3	3	0	0	3
6		Professional Elective III	PE	3	3	0	0	3
PRACTICALS								
7	20EC611	Embedded Systems and RTOS Laboratory	PC	4	0	0	4	2
8	20EC612	VLSI Design Laboratory	PC	4	0	0	4	2
9	20EC613	Innovative / Multi-Disciplinary Project	EEC	2	0	0	2	1
10	20CS614	Advanced Aptitude and Coding Skills - II	EEC	2	0	0	2	1
TOTAL				**30**	**18**	**0**	**12**	**24**

SEMESTER VII

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	20EC701	RF and Microwave Engineering	PC	3	3	0	0	3
2	20EC702	Optical Communication and Networks	PC	3	3	0	0	3
3	20CE917	Professional Ethics in Engineering	HS	3	3	0	0	3
4		Professional Elective IV	PE	3	3	0	0	3
5		Professional Elective V	PE	3/4	3/4	0	0	3/4
6		Open Elective II	OE	3	3	0	0	3
PRACTICALS								
7	20EC711	Advanced Communication Laboratory	PC	4	0	0	4	2
8	20EC712	Project Work - Phase I and Internship	EEC	6	0	0	6	3
9	20EC713	Design Thinking Laboratory	EEC	2	0	0	2	1
TOTAL				**30/31**	**18/19**	**0**	**12**	**24/25**

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SEMESTER VIII

Sl.No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
PRACTICALS								
1	20EC811	Project Work - Phase II	EEC	20	0	0	20	10
		TOTAL		**20**	**0**	**0**	**20**	**10**

TOTAL NO. OF CREDITS: 181

HUMANITIES AND SOCIAL SCIENCES (HS)

Sl.No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	20EL101	Communicative English & Life Skills	HS	2	2	0	0	2
2	20EL111	Interpersonal Skills - Listening and Speaking Lab	HS	2	0	0	2	1
3	20EL201	Technical English	HS	2	2	0	0	2
4	20EL211	Advanced Reading and Writing Lab	HS	2	0	0	2	1
5	20CE917	Professional Ethics in Engineering	HS	3	3	0	0	3
6	20CH102	Environmental Science and Engineering	HS	3	3	0	0	3
7	20GE301	Universal Human Values II: Understanding Harmony	HS	4	2	2	0	3

BASIC SCIENCES (BS)

Sl.No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	20MA101	Engineering Mathematics-I	BS	5	3	2	0	4
2	20PH102	Physics for Electronics Engineering	BS	3	3	0	0	3
3	20CH101	Engineering Chemistry	BS	3	3	0	0	3
4	20PC111	Physics & Chemistry Laboratory	BS	4	0	0	4	2
5	20MA201	Engineering Mathematics-II	BS	5	3	2	0	4
6	20MA303	Linear Algebra and Partial Differential Equations	BS	5	3	2	0	4
7	20MA401	Probability and Random Processes	BS	5	3	2	0	4

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ENGINEERING SCIENCES (ES)

Sl.No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	20GE101	Problem Solving and C Programming	ES	3	3	0	0	3
2	20ME103	Computer Aided Engineering Graphics	ES	6	2	0	4	4
3	20GE111	C Programming Lab	ES	4	0	0	4	2
4	20CS201	Core III – Data Structures	ES	3	3	0	0	3
5	20EM111	Engineering Practices Lab	ES	4	0	0	4	2
6	20CS211	Data Structures Lab	ES	4	0	0	4	2
7	20CS202	Python Programming(Lab Integrated)	ES	5	3	0	2	4

PROFESSIONAL CORE (PC)

Sl.No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	20EC201	Core I – Fundamentals of Electrical Engineering and Circuits	PC	4	4	0	0	4
2	20EC202	Core II – Electronic Devices	PC	3	3	0	0	3
3	20EC301	Signals and Systems	PC	5	3	2	0	4
4	20EC302	Electronic Circuits	PC	3	3	0	0	3
5	20EC303	Digital Electronics	PC	3	3	0	0	3
6	20EE401	Control Systems	PC	4	2	2	0	3
7	20EC311	Analog and Digital Circuits Laboratory	PC	4	0	0	4	2
8	20EC401	Communication Systems	PC	3	3	0	0	3
9	20EC402	Microprocessors and Microcontrollers	PC	3	3	0	0	3
10	20EC403	Electromagnetic Fields	PC	4	4	0	0	4
11	20EC404	Linear Integrated Circuits	PC	3	3	0	0	3
12	20EC411	Microprocessors and Microcontrollers Laboratory	PC	4	0	0	4	2
13	20EC412	Linear Integrated Circuits Laboratory	PC	4	0	0	4	2
14	20EC501	Digital Communication	PC	3	3	0	0	3
15	20EC502	Discrete-Time Signal Processing	PC	4	2	2	0	3
16	20EC503	Data Communication Networks	PC	3	3	0	0	3
17	20EC504	Transmission Lines and Waveguides	PC	3	3	0	0	3
18	20EC511	Communication Networks and DSP Laboratory	PC	4	0	0	4	2

19	20EC512	Communication Systems Laboratory	PC	4	0	0	4	2
20	20EC601	VLSI Design	PC	3	3	0	0	3
21	20EC602	Embedded Systems	PC	3	3	0	0	3
22	20EC603	Wireless Communications	PC	3	3	0	0	3
23	20EC604	Antennas and Wave Propagation	PC	3	3	0	0	3
24	20EC611	Embedded System and RTOS Laboratory	PC	4	0	0	4	2
25	20EC612	VLSI Design Laboratory	PC	4	0	0	4	2
26	20EC701	RF and Microwave Engineering	PC	3	3	0	0	3
27	20EC702	Optical Communication and Networks	PC	3	3	0	0	3
28	20EC711	Advanced Communication Laboratory	PC	4	0	0	4	2

PROFESSIONAL ELECTIVES (PE)*

SEMESTER V

ELECTIVE – I

Sl.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	20EC901	Sensors, Actuators and Interfaces	PE	3	3	0	0	3
2	20ME927	Total Quality Management	PE	3	3	0	0	3
3	20CS401	Computer Architecture	PE	3	3	0	0	3
4	20EC902	Advanced Microprocessors and Microcontrollers	PE	3	3	0	0	3
5	20EC903	Introduction to Nano Science and Nano Technology	PE	3	3	0	0	3

SEMESTER VI

ELECTIVE – II

Sl.No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	20EC904	Introduction to MEMS and NEMS	PE	3	3	0	0	3
2	20EC905	Cryptography and Network Security	PE	3	3	0	0	3
3	20EC906	Digital Image Processing	PE	3	3	0	0	3
4	20EC907	Medical Electronics	PE	3	3	0	0	3
5	20AI401	Artificial Intelligence	PE	3	3	0	0	3
6	20IT917	Essence of Indian Traditional Knowledge	PE	3	3	0	0	3

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SEMESTER VI

ELECTIVE – III

Sl.No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	20EC908	IoT System Design and Applications	PE	3	3	0	0	3
2	20CS917	Data Science Fundamentals	PE	3	3	0	0	3
3	20EC909	Advanced Digital Signal Processing	PE	3	3	0	0	3
4	20EC910	Multimedia Compression and Communication	PE	3	3	0	0	3
5	20EI903	Robotics and Automation	PE	3	3	0	0	3
6	20EE917	Systems Programming	PE	3	3	0	0	3

SEMESTER VII

ELECTIVE – IV

Sl.No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	20EC911	Principles of Speech Processing	PE	3	3	0	0	3
2	20EC912	Cognitive Radio	PE	3	3	0	0	3
3	20IT913	Wireless Adhoc and Sensor Networks	PE	3	3	0	0	3
4	20EC913	ARM System Architecture	PE	3	3	0	0	3
5	20EC914	FPGA and ASIC Design	PE	3	3	0	0	3

SEMESTER VII

ELECTIVE – V

Sl.NO	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	20EC915	Fundamentals Of 4G/5G Wireless Communication	PE	3	3	0	0	3
2	20EC916	Satellite Communication	PE	3	3	0	0	3
3	20CB404	Introduction to Innovation, IP Management and Entrepreneurship	PE	3	3	0	0	3
4	20IT927	Indian Constitution	PE	3	3	0	0	3
5	20EE925	Linux Kernel and Device Drivers	PE	4	4	0	0	4
6	20EE933	Automotive Software Engineering	PE	3	3	0	0	3

***Professional Electives are grouped according to elective number as was done previously.**

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EMPLOYABILITY ENHANCEMENT COURSES (EEC)

Sl No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	20EC312	Foundation Lab on Internet of Things	EEC	2	0	0	2	1
2	20CS313	Aptitude and Coding Skills- I	EEC	2	0	0	2	1
3	20CS414	Aptitude and Coding Skills- II	EEC	2	0	0	2	1
4	20EC413	Mini Project and Industrial Internship	EEC	2	0	0	2	1
5	20EC513	Foundation Lab on Machine Learning	EEC	2	0	0	2	1
6	20CS512	Advanced Aptitude and coding skills -I	EEC	2	0	0	2	1
7	20EC613	Innovative / Multi-Disciplinary Project	EEC	2	0	0	2	1
8	20CS614	Advanced Aptitude and coding skills- II	EEC	2	0	0	2	1
9	20EC713	Design Thinking Laboratory	EEC	2	0	0	2	1
10	20EC712	Project Work - Phase I and Internship	EEC	6	0	0	6	3
11	20EC811	Project Work - Phase II	EEC	20	0	0	20	10

SUMMARY

S.No.	Subject Area	Credits As Per Semester								Credits Total	Percentage
		I	II	III	IV	V	VI	VII	VIII		
1	HS	3	6		3			3		15	8.29
2	BS	12	4	4	4					24	13.26
3	ES	9	7	4						20	11.05
4	PC		7	15	17	16	16	8		79	43.65
5	PE					3	6	6		15	8.29
6	OE					3		3		6	3.31
7	EEC			2	2	2	2	4	10	22	12.15
	Total	24	24	25	26	24	24	24	10	181	

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OPEN ELECTIVES

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	20EC001	Sensors and Transducers	OE	3	3	0	0	3
2	20EC002	MATLAB Programming	OE	3	3	0	0	3
3	20EC003	Medical Electronics	OE	3	3	0	0	3
4	20EC004	Industrial IoT Applications	OE	3	3	0	0	3
5	20EC005	Introduction to Image Processing	OE	3	3	0	0	3
6	20EC006	Arduino for Engineers	OE	3	3	0	0	3
7	20EC007	Electronic Materials	OE	3	3	0	0	3
8	20EC008	Introduction to Embedded System	OE	3	3	0	0	3

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SYLLABUS I & II

COURSE CODE	COURSE TITLE	L	T	P	C
20EL101	COMMUNICATIVE ENGLISH & LIFE SKILLS	2	0	0	2

OBJECTIVES:

- Strengthen their basic reading and writing skills.
- Comprehend listening contexts competently.
- Improve their speaking skills to speak fluently in real contexts.
- Develop vocabulary of a general kind and enhance their grammatical accuracy.

UNIT I COMMUNICATION BASICS **06**

Listening - short texts- short formal and informal conversations. Speaking- introducing oneself - exchanging personal information. Reading - practice in skimming - scanning and predicting. Writing-completing sentences - developing hints- free writing – Everyday expressions- collocations. Life Skills - Overview of Life Skills: significance of life skills.

UNIT II COMMUNICATION INTERMEDIATE **06**

Listening- telephonic conversations. **Speaking** – sharing information of a personal kind — greeting – taking leave. **Reading** – short comprehension passages - pre-reading-post reading-comprehension questions (multiple choice questions and /or short questions / open-ended questions) - **Writing** – paragraph writing- topic sentence - main ideas, short narrative descriptions using some suggested vocabulary and structures. **Life skills** – Self-awareness: definition, need for self-awareness; Coping with Stress and Emotions.

UNIT III COMMUNICATION VANTAGE **06**

Listening – listening to longer texts and filling up the table - **Speaking**- asking about routine actions and expressing opinions. **Reading**- Long texts (cloze reading) - **Writing**- jumbled sentences - product description - use of reference words and discourse markers. Grammar – Tenses - phrasal verbs - Wh – Questions, yes or no questions and direct / indirect questions – countable & uncountable nouns – modal verbs. **Life skills** – Assertiveness vs Aggressiveness

UNIT IV SYNERGISTIC COMMUNICATION **06**

Listening - listening to dialogues or conversations and completing exercises based on them - **Speaking**- speaking about oneself- speaking about one's friend – **Reading** - different types of texts- magazines - **Writing** - letter writing, informal or personal letters - e-mails-conventions of personal email - Language development - synonyms – antonyms. **Life Skills** –Problem Solving Techniques.

UNIT V COMMUNICATION HIGHER **06**

Listening – listening to TED talks - **Speaking** – role play – **Reading** - Biographies – **Writing**- writing short essays (analytical & issue-based essays) – dialogue writing. **Life Skills** – Leadership & Decision making.

TOTAL: 30 PERIODS

OUTCOMES:

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

- Read articles of a general kind in magazines and newspapers efficiently and identify different life skills.
- Participate efficiently in informal conversations and develop an awareness of the self and apply well-defined techniques to cope with emotions and stress.
- Comprehend conversations and short talks delivered in English.
- Write short essays of a general kind and personal letters and emails in English.
- Develop vocabulary of a general kind by enriching their reading skills.
- Use appropriate thinking and problem- solving techniques to solve new problems.

TEXT BOOKS:

1. Kumar, Suresh E and Sreehari, P. Communicative English. Orient Black Swan, 2007
2. Richards, C. Jack. 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, ISBN 978 93 528769142.
3. Elbow, Peter. Writing Without Teachers. London: Oxford University Press, 1973. Print.
4. Larry James, The First Book of Life Skills; First Edition, Embassy Books, 2016.
5. Larsen, Kristine, Stephen Hawking: A Biography, Greenwood: Publishing Group,2005.
6. Redston, Chris & Gillies Cunningham Face2Face (Pre-intermediate Student 's Book & Workbook) Cambridge University Press, New Delhi: 2005.

COURSE CODE	COURSE TITLE	L	T	P	C
20MA101	ENGINEERING MATHEMATICS–I	3	2	0	4

OBJECTIVES:

- Explain the concepts of matrix algebra.
- Make the students understand the idea of curvature, evolutes and envelopes.
- Impart the knowledge of functions of several variables.
- Introduce the concepts of Gamma and Beta integral.
- Develop an understanding on the basics of multiple integrals.

UNIT I MATRICES **9+6**

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of eigenvalues 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.

UNIT II APPLICATIONS OFDIFFERENTIALCALCULUS **9+6**

Curvature in Cartesian and Polar Co-ordinates–Centre and radius of curvature–Circle of curvature–Evolutes – Envelopes (excluding Evolute as envelope of normals).

UNIT III FUNCTIONS OFSEVERALVARIABLES **9+6**

Limits – Continuity – 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 – Lagrange's method of undetermined multipliers.

UNIT IV GAMMA, BETA INTEGRALS AND APPLICATIONS **9+6**

Gamma and Beta Integrals – Properties – Relation between Gamma and Beta functions, Evaluation of integrals using Gamma and Beta functions..

UNIT V MULTIPLEINTEGRALS **9+6**

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

TOTAL: 75 PERIODS

OUTCOMES:

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

- Diagonalize a matrix by orthogonal transformation.
- Determine the Evolute and Envelope of curves.
- Examine the maxima and minima of function of several variables.
- Apply Gamma and Beta integrals to evaluate improper integrals.
- Evaluate the area and volume by using multiple 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.
3. T. Veerarajan, "Engineering Mathematics", Tata McGraw Hill, 2nd Edition, New Delhi, 2011.

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.

COURSE CODE	COURSE TITLE	L	T	P	C
20PH102	PHYSICS FOR ELECTRONICS ENGINEERING	3	0	0	3

OBJECTIVES:

- To educate the fundamental important concepts in physics and to apply the knowledge in solving scientific and engineering problems
- To impart the basic concepts of conducting materials, semiconducting materials, opto and nanoelectronic devices, light propagation in waveguides and electro-magnetostatics and electrodynamics

UNIT I CONDUCTING MATERIALS 9

Classical free electron theory - Expression for electrical conductivity -Four probe method-determination of resistivity -Expression for Thermal conductivity- Wiedemann-Franz law - Success and failures of CFT -Effect of temperature on Fermi function - Density of energy states- Carrier concentration in metals and average energy of an electron at 0 K – Energy bands in solids.

UNIT II SEMICONDUCTING MATERIALS **9**

Intrinsic semiconductors – Energy band diagram – Direct and indirect band gap semiconductors – Carrier concentration in intrinsic semiconductors – determination of band gap - Extrinsic semiconductors - n-type and p-type semiconductors (qualitative) – Variation of Fermi level with temperature and impurity concentration – Hall effect and its applications.

UNIT III OPTO AND NANO ELECTRONIC DEVICES **9**

Carrier generation and recombination processes in semiconductors (concepts only) –LED- Organic LED- Photodetectors- Photodiodes -Solar cell – 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

UNIT IV LASER AND FIBRE OPTICS **9**

Population of energy levels, Einstein's A and B coefficients- derivation – Resonant cavity, optical amplification (qualitative) – Semiconductor lasers: homojunction and heterojunction – Engineering applications in communication.

Fibre optics -principle, numerical aperture and acceptance angle, V-number – Types of optical fibre (Material, Refractive index and Mode) – Losses in optical fibre - Fibre optic communication -Fibre optic sensors (pressure and displacement).

UNIT V ELECTRO-MAGNETOSTATICS AND ELECTRODYNAMICS **9**

Electrostatics*:* Coulomb's law - Gauss's law, Applications of Gauss's law (qualitative) - Maxwell's equation-I (equation only) - Electric field in matter: dielectrics, electric polarization, electric permittivity and susceptibility, relative permittivity, Types of polarization (electronic, ionic, orientation and space charge) - Internal field – Derivation - Clausius-Mossotti equation. Magnetostatics: Biot-Savart law and its applications (qualitative)

– Ampere's law and its applications (qualitative)-Lorentz force-Maxwell's equation-II (equations only).Electrodynamics: Faraday's law of induction, Lenz law - Maxwell's equations-III and IV (equations only) – Electromagnetic waves in dielectric medium - Electromagnetic waves in vacuum

TOTAL: 45 PERIODS

OUTCOMES:

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

- Estimate the conducting properties of materials based on CFE and QFE theories and understand the formation of energy band structures.
- Understand the basic properties of semiconducting materials and apply the concepts to determine Hall coefficient.
- Elucidate the principle and working of various opto and nanoelectronic devices and their applications.
- Attain basic knowledge on the concepts of lasers and apply in fibre optic

communication.

- Correlate electric and magnetic field behavior of electro-magnetostatics and electrodynamics.
- Understand the concepts of conducting materials, semiconducting materials and apply the same to determine resistivity and band gap, explicate the principle and working of opto and nanoelectronic devices and analyze Maxwell's equation in different forms (differential and integral) in Electro-Magnetostatics and Electrodynamics.

TEXT BOOKS:

1. M.N. Avadhanulu and P.G. Kshirsagar, "A Textbook of Engineering Physics", S. Chand and Company, New Delhi, 2014.
2. R.K. Gaur and S.L. Gupta, "Engineering Physics", Dhanpat Rai Publications (P) Ltd., Eighth Edition, New Delhi, 2001.
3. B.K. Pandey and S. Chaturvedi, "Engineering Physics", Cengage Learning India, 2012.
4. A. Marikani, "Materials Science", PHI Learning Private Limited, Eastern Economy Edition, 2017.
5. R. Wolfson, "Essential University Physics", Volume 1 and 2 with Mastering Physics, Global Edition, 3rd Edition, Pearson 2017.
6. S. O. Kasap, "Principles of Electronic Materials and Devices", McGraw-Hill Education, 2007.
7. David J Griffiths, "Introduction to Electrodynamics", Pearson Education India Learning Private Limited;, 4 th edition, 2015.
8. "J. D Kraus", "Electromagnetics", McGraw-Hill Inc. 4th edition, 1992.

REFERENCES:

1. J. Singh, "Semiconductor Optoelectronics: Physics and Technology", McGraw-Hill Inc., 1995.
2. S.M. Sze, "Semiconductor Devices: Physics and Technology", Second Edition,Wiley 2008.
3. R. E. Hummel, "Electronic Properties of Materials", Springer, 2001.
4. G. W. Hanson, "Fundamentals of Nanoelectronics", Pearson Education, 2008.
5. B.Rogers, J. Adams, P. Sumitha, "Nanotechnology: Understanding Small Systems", CRC Press, 2014.
6. D. Halliday, R.Resnick and J. Walker , "Fundamentals of Physics", Wiley Publications, 2008.
7. R. A. Serway and J. W. Jewett, "Physics for Scientists and Engineers", Volume 5, Chapters 40-46, 8th Edition, Cengage Learning, 2010.
8. P. M. Fishbane, S. Gasiorowicz , S. Thornton, "Physics for Scientists and Engineers", 3rd Edition , Chapters 1-40, 2005.

COURSE CODE	COURSE TITLE	L	T	P	C
20CH101	ENGINEERING CHEMISTRY	3	0	0	3

OBJECTIVES:

- Understand the role of chemistry in everyday life.
- Develop an understanding of the basic concepts of electro chemistry and its applications.
- Learn the principles and generation of energy in different types of batteries, fuel cells, nuclear reactors, solar cells and wind mills.
- Make them acquire basic knowledge of polymers, their classification and the applications of speciality polymers in engineering and technology.
- Understand the preparation, properties and applications of nanomaterials in various fields.

UNIT I CHEMISTRY IN EVERYDAY LIFE 8

Importance of chemistry in everyday life- food additives - types (colours, preservatives, flavours and sweeteners), effects - food adulteration – types of adulteration (intentional, incidental) - effects of food adulterants – cosmetics and personal care products (fairness creams, perfumes, deodorants, shampoos)- effects – beverages-classification – carbonated beverages – nutritive values and effects.

Water – impurities – industrial uses of water – hardness, external treatment (demineralization) – desalination (reverse osmosis).

UNIT II ELECTROCHEMISTRY 10

Introduction – terminology - conductance of electrolytes- specific conductance, equivalent conductance, molar conductance- factors affecting conductance- origin of electrode potential- single electrode potential, standard electrode potential- measurement of single electrode potential-reference electrodes (standard hydrogen electrode, calomel electrode) - electrochemical series, applications –measurement of EMF of the cell – Nernst equation (derivation), numerical problems.

Chemical sensors – principle of chemical sensors- breath analyzer and Clark oxygen analyzer

UNIT III ENERGY STORAGE DEVICES AND ENERGY SOURCES 9

Batteries – primary battery (alkaline battery) - secondary battery (Pb-acid battery, Ni-metal hydride battery, Li-ion battery) - fuel cells (H_2-O_2 fuel cell).

Nuclear Energy –nuclear reactions – fission, fusion, differences, characteristics– nuclear chain reactions –light water nuclear reactor – breeder reactor.

Renewable energysources- solar energy – thermal conversion (solar water heater and heat collector) - photovoltaic cell– wind energy.

UNIT IV POLYMERS **9**

Introduction – monomer, functionality, degree of polymerization – classification based on sources and applications – effect of polymer structure on properties - types of polymerization (addition, condensation) - thermoplastic and thermosetting resins – preparation, properties and applications of Teflon, polyvinyl chloride, polycarbonate, Bakelite.

Special polymers - biodegradable polymers - properties and applications of polycaprolactone, polyhydroxyalkanoate – properties and applications of electrically conducting polymers (poly aniline, polyvinylidene fluoride).

UNIT V NANOCHEMISTRY **9**

Introduction – synthesis – top-down process (laser ablation, chemical vapour deposition), bottom-up process (precipitation, electrochemical deposition) – properties of nanomaterials – types (nanorods, nanowires, nanotubes-carbon nanotubes, nanocomposites).

Applications of carbon nanotubes – applications of nanomaterials in electronics, information technology, medical and healthcare, energy, environmental remediation, construction and transportation industries

TOTAL:45 PERIODS

OUTCOMES:

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

- Illustrate the role of chemistry in everyday life and the industrial uses of water.
- Construct electrochemical cells and to determine the cell potential.
- Compare and analyse the different energy storage devices and to explain potential energy sources.
- Classify different types of polymeric materials and to discuss their properties and applications.
- Explain basic concepts of nanochemistry and to enumerate the applications of nanomaterials in engineering and technology.

TEXT BOOKS:

1. P. C. Jain and Monika Jain, "Engineering Chemistry", 17th edition, Dhanpat Rai Publishing Company Pvt. Ltd., New Delhi, 2018.
2. Prasanta Rath, "Engineering Chemistry", 1st edition, Cengage Learning India Pvt. Ltd., Delhi, 2015.

REFERENCES:

1. S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", 12th edition, S. Chand & Company, New Delhi, 2010.
2. Kirpal Singh, "Chemistry in daily life", 3rd edition, PHI Learning Pvt. Ltd., 2012.
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, Ludovico Cademartiri, "Nanochemistry: A Chemical Approach to Nanomaterials", 2nd edition, RSC publishers, 2015.
5. Prasanna Chandrasekhar, "Conducting polymers, fundamentals and applications - A Practical Approach", 1st edition, Springer Science & Business Media, New York, 1999.

COURSE CODE	COURSE TITLE	L	T	P	C
20GE101	PROBLEM SOLVING AND C PROGRAMMING	3	0	0	3

OBJECTIVES:

- To make the students understand the fundamentals of problem solving using Algorithm and Flowchart
- To teach the basic programming constructs for solving simple problems
- To introduce the basic concepts of arrays and strings
- To acquaint the students about functions, pointers, structures and their relationship
- To impart knowledge on the concepts of file handling

UNIT I INTRODUCTION TO ALGORITHM AND C **9**

Introduction to Computer System – Block diagram, Program Development Life Cycle

General problem Solving concepts: Algorithm and Flowchart for problem solving with Sequential Logic Structure, Decisions and Loops.

Imperative languages: Introduction to imperative language, syntax and constructs of a specific language (ANSI C), Applications

Types, Operators: Variable Names, Data Type and Sizes (Little Endian Big Endian), Constants, Declarations, Basic I/O using scanf, printf, Operators – Types, Precedence, Associativity, Proper variable naming and Hungarian Notation.

UNIT II CONTROL FLOW STATEMENTS **7**

Control Flow with discussion on structured and unstructured programming: Statements and Blocks, If-Else-If, Switch, Loops – while, do, for, break and continue, goto labels, structured and unstructured programming

UNIT III ARRAYS AND FUNCTIONS **10**

Arrays and Strings – Initialization, Declaration – One Dimensional and Two Dimensional arrays – Linear search, Binary Search, Matrix Operations (Addition and Subtraction)

Basics of functions, parameter passing and returning type, C main return as integer, External, Auto, Local, Static, Register Variables, Scope Rules, Block structure, Initialisation, Recursion, Pre-processor, Standard Library Functions and return types.

UNIT IV STRUCTURES AND POINTERS **10**

Basic Structures, Structures and Functions, Array of structures.

Pointers and address, Pointers and Function Arguments, Pointers and Arrays, Address Arithmetic, character Pointers and Functions, Pointer Arrays, Pointer to Pointer, Initialisation of Pointer Arrays, Command line arguments, Pointer to functions, complicated declarations and how they are evaluated.

Pointer of structures, Self-referential structures, Table look up, typedef, unions, Bit-fields

UNIT V FORMATTED I/O AND FILE PROCESSING **9**

Formatted Output – fprintf, Formatted Input – fscanf, Variable length argument listFiles - file access including FILE structure, fopen, fread, fwrite, stdin, sdtout and stderr, File Types – Text, Binary - Error Handling including exit, perror and error.h, Line I/O, related miscellaneous functions.

TOTAL:45 PERIODS

OUTCOMES:

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

- Develop algorithmic solutions to simple computational problems
- Develop simple applications using basic constructs
- Write programs using arrays and strings
- Design and implement applications using functions, pointers and structures.
- Design applications using sequential and random access file processing.

TEXT BOOKS:

1. Brian W Kernighan and Dennis M Ritchie, The C Programming Language, Pearson Education India, 2nd Edition, 2015.
2. Anita Goel and Ajay Mittal, " Computer Fundamentals and Programming in C", Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.

REFERENCES:

1. B. Gottfried, Programming with C, Schaum Outline Series, Fourth Edition, 2018
2. Herbert Schildt, C: The Complete Reference, McGraw Hill, Fourth Edition, 2017
3. Yashavant Kanetkar, Let Us C, BPB Publications, 16th Edition, 2018.
4. Reema Thareja, "Programming in C", 2nd Edition, Oxford University Press, 2018.
5. Zed A. Shaw, "Learn C the Hard Way: Practical Exercises on the Computational Subjects You Keep Avoiding (like C)", (Zed Shaw's Hard Way Series), 1st Edition, Addison-Wesley Professional, 2015.

COURSE CODE	COURSE TITLE	L	T	P	C
20ME103	**COMPUTER AIDED ENGINEERING GRAPHICS**	**2**	**0**	**4**	**4**

OBJECTIVES:

- To develop in students, graphic skills for communication of concepts, ideas and design of engineering products.
- To expose them to existing national standards related to technical drawings.

UNIT I INTRODUCTION TO CONVENTIONS IN ENGINEERING DRAWING AND CAD COMMANDS **18**

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning. Introduction to CAD commands- CAD user interface- coordinate systems, object selection methods, selection of units and precession. Sketching – line, circle, arc, polygon, rectangle and ellipse. Working with object snaps, layers and object properties.

Editing the objects – copy, move, trim, extend, working with arrays, mirror, scale, hatch, fillet and chamfer. Conversion of simple pictorial diagrams to orthographic view using CAD software

UNIT II PLANE CURVES **16**

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves.

UNIT III PROJECTION OF POINTS, LINES AND PLANE SURFACES **18**

Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT IV PROJECTION OF SOLIDS AND PROJECTION OF SECTIONED SOLIDS **20**

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method. Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section.

UNIT V DEVELOPMENT OF SURFACES AND ISOMETRIC PROJECTION **18**

Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones. Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions.

TOTAL:90 PERIODS

OUTCOMES:

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

- Illustrate the fundamentals and standards of engineering drawing and apply the concepts of orthographic projections using CAD software.
- Interpret and construct various plane curves.
- Develop orthographic projections of points, lines and plane surfaces.
- Make use of concepts in projection to draw projections of solids and interpret the concept in section of solids
- Interpret and visualize development of surfaces.
- Interpret and visualize isometric projection of simple solids.

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. Basant Agarwal 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 (R2008), Published by 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.

COURSE CODE	COURSE TITLE	L	T	P	C
20PC111	**PHYSICS & CHEMISTRY LABORATORY**	**0**	**0**	**4**	**2**

PHYSICS LABORATORY

L	T	P	C
0	**0**	**2**	**1**

OBJECTIVES

- To introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics, properties of matter, semiconductors and liquids.

LIST OF EXPERIMENTS (Any five experiments to be conducted**)**

1. Determination of wavelength and velocity of ultrasonic waves by Ultrasonic Interferometer.

2. Determination of thermal conductivity of a poor conductor by LEE'S Disc method.
3. (i) Determination of wavelength and divergence angle of semiconductor laser source using diffraction grating.
    a. (ii) Determination of particle size by using diffraction of semiconductor laser beam.
    b. (iii) Analysis of Numerical aperture and acceptance angle of an optical fibre.
4. Determination of Young's Modulus of a beam by non-uniform bending method.
5. Determination of the moment of inertia of the disc and rigidity modulus of wire by Torsional pendulum.
6. Spectrometer - Determination of wavelength of Mercury Spectrum using diffraction grating.
7. Determination of thickness of wire by air wedge method.
8. Determination of Young's Modulus of a beam by Uniform bending method.
9. Determination of band gap of a semiconductor.

TOTAL: 30 PERIODS

OUTCOMES:

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

- Use the ultrasonic interferometer and to determine the wavelength and velocity of ultrasonic waves of a liquid.
- Examine the thermal conductivity of a bad conductor.
- Determine the wavelength of mercury spectrum and also determine the wavelength of a laser source, particle size, divergence angle of semiconductor laser source using diffraction grating and to analyze the numerical aperture and acceptance angle of an optical fibre.
- Examine the Young's modulus of a beam by uniform and non-uniform bending and to estimate the moment of inertia of the disc and rigidity modulus of wire by torsional pendulum.
- Calculate the thickness of a thin wire by the interference pattern.
- Determine the band gap of a semiconductor.

REFERENCES:

1. Physics laboratory manual, Department of Physics, R.M.K.Engineering college, 2019.
2. Wilson J.D. and Hernandez C.A., - Physics Laboratory Experiments, Houghton Mifflin Company, New York, 2005.

CHEMISTRY LABORATORY

L	T	P	C
0	**0**	**2**	**1**

OBJECTIVES

- To make the students acquire practical skills through volumetric and instrumental analysis

LIST OF EXPERIMENTS

1. Determination of total, temporary and permanent hardness of water by EDTA method.
2. Conductometric titration of strong acid vs. strong base.
3. Determination of strength of acids in a mixture using a conductivity meter.
4. Determination of strength of given hydrochloric acid using a pH meter.
5. Estimation of the iron content of the given solution using apotentiometer.
6. Estimation of the iron content of the water sample using a spectrophotometer (thiocyanate method).
7. Estimation of sodium present in water using aflame photometer.
8. Determination of themolecular weight of polyvinyl alcohol using Ostwald viscometer.
9. Determination of corrosion rate by weight loss method.
10. Determination of flash and fire point of a lubricating oil (Pensky Martens apparatus).
11. Determination of concentration of a given solution by constructing a galvanic cell.

TOTAL: 30 PERIODS

OUTCOMES:

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

- Analyse the given hard water sample and estimate different types of hardness present.
- Observe and analyse the change in conductivity of an acid(s) when added with base through conductometry.
- Examine the change in pH when an acid is added with a base using pH meter.
- Understand the redox reactions and its impact on emf values through potentiometry.
- Determine the flash and fire point of an oil.
- Assess the corrosion rate of a given metal.
- Construct an electrochemical cell to determine the concentration of the given solution.

REFERENCES:

1. J. Mendham, R. C. Denney, J. D. Barnes, M. J. K. Thomas and B. Sivasankar, "Vogel's Quantitative Chemical Analysis", 6th edition, Pearson Education Pvt. Ltd., 2009

COURSE CODE	COURSE TITLE	L	T	P	C
20GE111	C PROGRAMMING LABORATORY	0	0	4	2

OBJECTIVES

- To make the students write simple programs using basic constructs
- To familiarize the concepts of strings, pointers, functions and structures
- To equip the students on the knowledge of file processing concepts

LIST OF EXPERIMENTS

1. Constructing Flow charts using RAPTOR tools.
2. Programs using I/O statements and expression
3. Write a program to find whether the given line is horizontal or vertical.
4. Write a program to calculate the distance between two points p1(x1,y1), p2(x2,y2).
5. Write a program to calculate the force for the given mass and acceleration.
6. Write a program to calculate the Young's modulus.
7. Write a program to calculate the type of solution based on its pH value.
8. Write a program to temperature conversion (Fahrenheit to Celsius and vice versa)
9. Programs using decision-making constructs.
10. Write a program to find whether the given year is leap year or Not? (Hint: not every centurion year is a leap. For example 1700, 1800 and 1900 is not a leap year)
11. Design a calculator to perform the operations, namely, addition, subtraction, multiplication, division and square of a number.
12. Check whether a given number is Armstrong number or not?
13. Given a set of numbers like, find sum of weights based on the following conditions.
    - 5 if it is a perfect cube.
    - 4 if it is a multiple of 4 and divisible by 6.
    - 3 if it is a prime number.

    Sort the numbers based on the weight in the increasing order as shown below
    <10,its weight>, <36,its weight>, <89,its weight>

14. Populate an array with height of persons and find how many persons are above the average height.
15. Populate a two dimensional array with height and weight of persons and compute the Body Mass Index of the individuals.
16. Given a string ―a$bcd./fg‖ find its reverse without changing the position of special characters.(Example input:a@gh%;j and output:j@hg%;a)
17. Convert the given decimal number into binary, octal and hexadecimal numbers using user defined functions.
18. From a given paragraph perform the following using built-in functions:
    a. Find the total number of words.
    b. Capitalize the first word of each sentence.
    c. Replace a given word with another word.
19. Solve towers of Hanoi using recursion.
20. Sort the list of numbers using pass by reference.
21. Generate salary slip of employees using structures and pointers. Create a structure Employee with the following members:
    EID, Ename, Designation, DOB, DOJ, Basicpay
    Note that DOB and DOJ should be implemented using structure within structure.
22. Compute internal marks of students for five different subjects using structures and functions.
23. Insert, update, delete and append telephone details of an individual or a company into a telephone directory using random access file.
24. Count the number of account holders whose balance is less than the minimum balance using sequential access file.
25. Mini project: Create a ―Railway reservation system with the following modules
    - Booking
    - Availability checking
    - Cancellation
    - Prepare chart

TOTAL: 60 PERIODS

OUTCOMES:

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

- Write programs for simple applications making use of basic constructs, arrays and strings.
- Develop programs involving functions, recursion, pointers, and structures.
- Create applications using sequential and random access file processing.

TEXT BOOKS

1. Brian W Kernighan and Dennis M Ritchie, The C Programming Language, Pearson Education India, 2nd Edition, 2015.
2. Anita Goel and Ajay Mittal, " Computer Fundamentals and Programming in C", Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.

REFERENCES:

1. B. Gottfried, Programming with C, Schaum Outline Series, Fourth Edition, 2018
2. Herbert Schildt, C: The Complete Reference, McGraw Hill, Fourth Edition, 2017
3. Yashavant Kanetkar, Let Us C, BPB Publications, 16th Edition, 2018.
4. Reema Thareja, "Programming in C", 2nd Edition, Oxford University Press, 2018.
5. Zed A. Shaw, "Learn C the Hard Way: Practical Exercises on the Computational Subjects You Keep Avoiding (like C)", (Zed Shaw's Hard Way Series), 1st Edition, Addison-Wesley Professional, 2015.

OURSE CODE	COURSE TITLE	L	T	P	C
20EL111	INTERPERSONAL SKILLS (LISTENING & SPEAKING)	0	0	2	1

OBJECTIVES:

- Equip and strengthen the English language skills.
- Provide guidance and practice to engage in specific academic speaking activities and enhance writing skills with specific reference to technical writing(interview skills).
- Improve general and academic listening skills.
- Demonstrate their presentation skills competently

UNIT I **6**

Listening as a key skill- its importance- speaking - give personal information - ask for personal information - express ability - enquire about ability - ask for clarification Improving pronunciation - pronunciation basics - taking lecture notes - preparing to listen to a lecture - articulate a complete idea as opposed to producing fragmented utterances.

UNIT II **6**

Listen to a process information- give information, as part of a simple explanation – conversation starters: small talk - stressing syllables and speaking clearly - intonation patterns - compare and contrast information and ideas from multiple sources- converse with reasonable accuracy over a wide range of everyday topics.

UNIT III **6**

Deliver a five-minute informal talk - greet - respond to greetings - describe health and symptoms - invite and offer - accept - decline - take leave - listen for and follow the gist- listen for detail.

UNIT IV **6**

Being an active listener: giving verbal and non-verbal feedback - participating in a group discussion - summarizing academic readings and participating in conversations.

UNIT V **6**

Formal and informal talk - listen to follow and respond to explanations, directions and instructions in academic and business contexts - strategies for presentations and interactive communication - group/pair presentations - negotiate disagreement in group work.

TOTAL: 30 PERIODS

OUTCOMES:

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

- Listen and respond appropriately.
- Participate in group discussions.
- Make effective presentations.
- Participate confidently and appropriately in conversations both formal and informal.

TEXT BOOKS:

1. Brooks, Margret. Skills for Success. Listening and Speaking. Level 4 Oxford University Press, Oxford: 2011.
2. Dhanavel, S P. English and Soft Skills, Volume Two, Orient Black Swan, ISBN 978 93 528769142.

REFERENCES:

1. Bhatnagar, Nitin and Mamta Bhatnagar. Communicative English for Engineers and Professionals. Pearson: New Delhi, 2010.
2. Hughes, Glyn and Josephine Moate. Practical English Classroom. Oxford University Press: Oxford, 2014.
3. Ladousse, Gillian Porter. Role Play. Oxford University Press: Oxford, 2014.
4. Richards, C. Jack. & David Bholke. Speak Now Level 3. Oxford University Press, Oxford: 2010
5. Vargo, Mari. Speak Now Level 4. Oxford University Press: Oxford, 2013.

COURSE CODE	COURSE TITLE	L	T	P	C
20EL201	TECHNICAL ENGLISH	2	0	0	2

OBJECTIVES:

- Develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
- Foster their ability to write convincing job applications and effective reports.
- Demonstrate their speaking skills to make technical presentations, participate in group discussions.
- Strengthen their listening skill which will help them comprehend lectures and talks in their areas of specialization.

UNIT I INTRODUCTION - TECHNICAL ENGLISH 6

Listening- Listening to talks mostly of a scientific/technical nature and completing information-gap exercises- **Speaking** –Asking for and giving directions- **Reading** – reading short technical texts from journals- newspapers- **Writing**- purpose statements – extended definitions – writing instructions – checklists – recommendations-Vocabulary Development-technical vocabulary. Language Development –subject verb agreement - compound words.

UNIT II READING ANDSTUDY SKILLS 6

Listening- Listening to longer technical talks and completing exercises based on them-**Speaking** -describing a process-**Reading**– reading longer technical texts- identifying the various transitions in a text- paragraphing- **Writing**- interpreting charts, graphs- Vocabulary Development-vocabulary used in formal letters/emails and reports Language Development-impersonal passive voice, numerical adjectives.

UNIT III TECHNICAL WRITING AND GRAMMAR 6

Listening- Listening to classroom lectures/ talks on engineering/technology -**Speaking** – introduction to technical presentations- **Reading** – longer texts both general and technical, practice in speed reading; **Writing**-Describing a process, use of sequence words- Vocabulary Development- sequence words- Misspelled words. Language Development- embedded sentence

UNIT IV REPORT WRITING 6

Listening- Listening to documentaries and making notes. **Speaking** – mechanics of presentations-**Reading** – reading for detailed comprehension- **Writing**- Report Writing (accident and survey) - minutes of a meeting - Vocabulary Development- finding suitable synonyms-paraphrasing-. Language Development-reported speech.

UNIT V GROUP DISCUSSION AND JOB APPLICATIONS 6

Listening- TED talks; **Speaking** –participating in a group discussion **-Reading**– reading and understanding technical articles **Writing**– email etiquette- job application – cover letter – Résumé preparation (via email and hard copy)- Vocabulary Development- verbal analogies - Language Development- clauses- if conditionals.

TOTAL : 30 PERIODS

OUTCOMES:

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

- Read technical texts and write area- specific texts effortlessly.
- Listen and comprehend lectures and talks in their area of specialization successfully.
- Speak appropriately and effectively in varied formal and informal contexts.
- Write reports and winning job applications.

TEXT BOOKS:

1. Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.
2. Sudharshana.N.P and Saveetha C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.

REFERENCES:

1. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007.
2. Herbert, A. J. The Structure of Technical English.Longman.1976.
3. Kumar, Suresh. E. Engineering English. Orient Black swan: Hyderabad,2015.
4. Means, L. Thomas and Elaine Langlois, English & Communication for Colleges. Cengage Learning, USA: 2007.
5. Raman, Meenakshi and Sharma, Sangeetha- Technical Communication Principles and Practice. Oxford University Press: New Delhi,2014.

COURSE CODE	COURSE TITLE	L	T	P	C
20MA201	ENGINEERING MATHEMATICS–II	3	2	0	4

OBJECTIVES:

- Explain various techniques in solving ordinary differential equations.
- Make the students understand the concepts of vector differentiation and integration.
- Introduce the concepts of Laplace transforms and its applications.
- Develop an understanding on analytic function, conformal mapping and complex integration

UNIT I ORDINARYDIFFERENTIALEQUATIONS 9+6

Higher order linear differential equations with constant coefficients – Method of variation of parameters – Cauchy's and Legendre's linear equations – Simultaneous first order linear equations with constant coefficients**.**

UNIT II VECTORCALCULUS 9+6

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

UNIT III LAPLACE TRANSFORMS 9+6

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) – Initial and final value theorems – Solution of linear ordinary differential equation of second order with constant coefficients using Laplace transformation techniques

UNIT IV COMPLEX DIFFERENTIATION AND CONFORMAL MAPPING 9+6

Functions of a complex variable – Analytic functions: Necessary conditions – Cauchy-Riemann equations and sufficient conditions (Statement only) – Harmonic and orthogonal properties of analytic function – Harmonic conjugate – Construction of analytic functions – Conformal mapping: $w = z + k$, kz, $1/z$, z^2 and bilinear transformation.

UNIT V COMPLEXINTEGRATION 9+6

Complex integration – Statement and applications of Cauchy's integral theorem and Cauchy's integral formula – Taylor's and Laurent's series expansions – Singular points – Residues – Statement and applications of Cauchy's residue theorem – Evaluation of real definite integrals as contour integrals around unit circle and semi-circle (excluding poles on the real axis)

TOTAL: 75 PERIODS

OUTCOMES:

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

- Solve the higher order linear differential equations.
- Determine the gradient of a scalar field, divergence and curl of a vector fields and interpret their physical meaning and evaluate line, surface and volume integrals by vector integration.
- Apply Laplace Transforms method for solving linear ordinary differential equation.
- Construct an analytic function and analyze conformal mapping.
- Evaluate the real integrals using complex integration.

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.
3. T. Veerarajan, "Engineering Mathematics", Tata McGraw Hill, 2nd Edition, New Delhi, 2011.

REFERENCES:

1. M. K. Venkataraman, "Engineering Mathematics, Volume II", 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.

COURSE CODE	COURSE TITLE	L	T	P	C
20CH102	ENVIRONMENTAL SCIENCE AND ENGINEERING	3	0	0	2

OBJECTIVES:

- Appreciate the natural resources of environment which are inherently created for supporting life.
- Learn scientific and technological solutions to current day pollution issues.
- Study the interrelationship between living organisms and environment
- Understand the integrated themes of biodiversity.
- Appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.

UNIT I NATURAL RESOURCES 11

Introduction - scope and importance of environment – need for public awareness.
Forest resources- Use and over-exploitation, deforestation - timber extraction, mining, dams and their effects on forests and tribal people. **Water resources** - Use and over- utilization of surface and ground water, conflicts over water, dams-benefits and problems. **Mineral resources**- Use and exploitation, environmental effects of extracting and using mineral

resources. **Food resources**- World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity. **Energy resources** - Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. **Land resources**- Land as a resource, land degradation, soil erosion and desertification – role of an individual in conservation of natural resources - case studies.

UNIT II POLLUTION AND ITS MANAGEMENT **11**

Pollution – causes, effects and control measures - Air pollution- Water pollution - Soil pollution - Marine pollution - Noise pollution - Thermal pollution - Nuclear hazards - nuclear accidents and holocaust - role of an individual in prevention of pollution – case studies.
Waste management - causes, effects and control measures of municipal solid wastes, e-waste, plastic waste.

UNIT III ECOSYSTEMS AND BIODIVERSITY **9**

Introduction to ecosystems – structure and function of an ecosystem – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids - types, characteristic features, structure and functions of - Forest ecosystem - Grassland ecosystem - Desert ecosystem - Aquatic ecosystems (lakes, oceans)
Introduction to biodiversity – types (genetic, species and ecosystem diversity) –values of biodiversity – threats to biodiversity - endangered and endemic species – conservation of biodiversity (in-situ and ex-situ conservation) - India as a mega-diversity nation – hot-spots of biodiversity in India

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT **8**

Sustainable development – sustainable development goals - water conservation, rain water harvesting, watershed management – resettlement and rehabilitation - consumerism and waste products, value education.
Disaster management- floods, drought, earthquake, tsunami, cyclone and landslides - case studies.
Environmental ethics- issues and possible solutions – environment protection act – air (prevention and control of pollution) act – water (prevention and control of pollution) act – wildlife protection act – forest conservation act.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT **6**

Introduction - population growth, variation among nations, population explosion, family welfare programme – women and child welfare - environment and human health – endemic/epidemic/pandemic, COVID – 19, HIV / AIDS– role of information technology in environment and human health –environmental impact assessment- case studies.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Illustrate the importance and conservation of natural resources.
- Assess the impact of various pollutants and suggest appropriate pollution control methods.
- Explain the basic structure of ecosystem and the conservation of biodiversity.
- Analyze the social issues related to environment and recommend suitable solutions.
- Investigate the trends in population explosion and assess its impact.

TEXT BOOKS:

1. Anubha Kaushik and C. P. Kaushik, "Perspectives in environmental studies", New Age International, 6th edition, 2018.
2. Benny Joseph, "Environmental Science and Engineering", Tata McGraw-Hill, New Delhi, 2017.
3. Gilbert M. Masters, Wendell P. Ela "Introduction to Environmental Engineering and Science", 3rd edition, Pearson Education, 2015.

REFERENCES:

1. William P. Cunningham and Mary Ann Cunningham, "Environmental Science: A Global Concern", McGraw Hill, 14th edition, 2017.
2. G. Tyler Miller and Scott E. Spoolman, "Environmental Science", Cengage Learning India Pvt. Ltd., Delhi, 14th edition, 2014.
3. Erach Bharucha, "Textbook of Environmental Studies", Universities Press Pvt. Ltd., Hyderabad, 2nd edition, 2015.

COURSE CODE	COURSE TITLE	L	T	P	C
20EC201	FUNDAMENTALS OF ELECTRICAL ENGINEERING AND CIRCUITS	4	0	0	4

OBJECTIVES:

- To develop an understanding of the fundamental laws, theorems, elements of electric circuits and to analyze dc and ac circuits
- To understand transient response behaviour of electric circuits.
- To introduce different methods of circuit analysis using network theorems, duality and topology

UNIT I FUNDAMENTALS OF ELECTRICAL ENGINEERING 12

Fundamental concepts of dc and ac circuits, Steady state solution of DC circuits, Circuit laws and their applications in solving problems

Introduction to AC Circuits, Sinusoidal steady state analysis, Power and Power factor, Single phase and three phase balanced circuits.

UNIT II NETWORK THEOREMS FOR DC AND AC CIRCUITS **12**

Source transformation, Superposition theorem, Thevenin's& Norton's theorems, Reciprocity and Maximum power transfer theorem

UNIT III RESONANCE AND COUPLED CIRCUITS **12**

Resonance - Series resonance - Parallel resonance, Variation of impedance with frequency - Variation in current through and voltage across L and C with frequency, Bandwidth - Q factor – Selectivity, Self inductance - Mutual inductance - Dot rule - Coefficient of coupling - Analysis of multi winding coupled circuits, Series, parallel connection of coupled inductors - Single tuned and double tuned coupled circuits

UNIT IV TRANSIENT ANALYSIS **12**

Natural response - Forced response Transient response of RC, RL and RLC circuits to excitation by step signal, impulse signal and exponential sources Complete response of RC, RL and RLC circuits to sinusoidal excitation

UNIT V TWO PORT NETWORKS 12

Two port networks, Z parameters, Y parameters, Transmission(ABCD) parameters, Hybrid(H) parameters Interconnection of two port networks

TOTAL: 60 PERIODS

OUTCOMES:

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

- Develop the capacity to analyze electrical circuits using mesh and nodal analysis
- Apply the circuit theorems in real time
- Analyse resonance and coupled circuits
- Analyse the transient response for DC circuits
- Explain the two port networks and parameters
- Design ,understand and evaluate the AC and DC circuits.

TEXT BOOKS:

1. Charles K. Alexander, Matthew N. O. Sadiku, Fundamentals of Electric Circuits, 2017, Sixth Edition, Tata McGraw Hill Education Private Limited, India.
2. AbhijitChakrabarti, Circuit Theory Analysis and Synthesis, 2018, Seventh Edition, Dhanpat Rai and Co.

REFERENCES:

1. S.K.Bhattacharya " Basic Electrical and Electronics Engineering",Pearson India,2011.
2. Joseph Edminister and Mahmood Nahvi, ―Electric Circuits‖, Schaum's Outline Series, Tata McGraw Hill Publishing Company, New Delhi, Fifth Edition Reprint 2016.
3. W.H.Hayt, J.E.Kemmerly & S.M.Durbin, Engineering Circuit Analysis, 2019, Ninth Edition, McGraw Hill Education, New Delhi, India.
4. Allan R. Hambley, Electrical Engineering – Principles & Applications, 2017, Seventh Edition, Pearson Education, Noida, India
5. A.Bruce Carlson, ―Circuits: Engineering Concepts and Analysis of Linear Electric Circuits‖,Cengage Learning, India Edition 2nd Indian Reprint 2009.
6. Allan H.Robbins, Wilhelm C.Miller, ―Circuit Analysis Theory and Practice‖,
    a. Cengage Learning, Fifth Edition, 1st Indian Reprint 2013.

COURSE CODE	COURSE TITLE	L	T	P	C
20EC202	ELECTRONIC DEVICES	3	0	0	3

OBJECTIVES:

- To make the students understand the fundamentals of electronic devices.
- To acquaint the semiconductor properties and formation of PN Junction diode and its characteristics
- To explain the operation and applications of BJT and FET
- To study the operation of special diodes and examine their characteristics
- To describe the functionality of power semiconductor devices and classify various types of optoelectronic devices

UNIT I PN JUNCTION DIODE **9**

Theory of PN junction diode – Energy band structure of open-circuited PN junction – Quantitative theory of PN diode currents – Diode current equation– Static and dynamic resistance levels – Transition and diffusion capacitances, Temperature dependence of V-I characteristics of diode – Switching characteristics, Breakdown in PN junction diodes – Diode as a circuit element – Piecewise Linear diode model – PN diode applications

UNIT II BIPOLAR JUNCTION TRANSISTOR **9**

BJT: Construction of BJT – Transistor biasing – Operation of NPN and PNP transistors–Types of configurations– Transistor as an amplifier - Large signal, dc and small signal CE values of current gain –Breakdown in transistors – Ebers-Moll Model.

UNIT III FIELD EFFECT TRANSISTOR **9**

Construction and operation of N-channel JFET – Characteristic parameters of JFET– Expression for saturation drain current – Slope of V-I characteristics – Biasing for zero current drift - Comparison of BJT and JFET – Applications of JFET, Construction and operation of N-Channel and P-Channel MOSFET – Enhancement and depletion type MOSFET – Characteristics – Threshold voltage – Channel length modulation – Comparison of N-channel and P- channel MOSFETs–Comparison of MOSFET with JFET –Applications of MOSFETs in CMOS circuits.

UNIT IV SPECIAL SEMICONDUCTOR DEVICES **9**

Construction, Principle of operation, characteristics and applications of Zener diode, Backward diode, Varactor diode, Step Recovery Diode, Point contact diode – Metal-Semiconductor junction – Schottky diode – Tunnel diode – Gunn Diode – Impatt Diode – PIN Diode – PIN Photodiode - Avalanche Photodiode - DUAL GATE MOSFET – FINFET– MESFET.

UNIT V POWER SEMICONDUCTOR & OPTOLECTRONIC DEVICES **9**

Power Semiconductor Devices: Construction, Principle of operation, characteristics and applications of UJT, PNPN Diode, SCR, LASCR, DIAC, TRIAC, GTO Thyristors – Power BJT – Power MOSFET – DMOS – VMOS.

Optoelectronic Devices: Photoconductive sensors – Photoconductive cell – Photovoltaic sensors – Photo emissive sensors –Light emitters - LCD, Alpha numeric displays, LCD Panels, Plasma display Panels - Optocoupler, CCD, BBD.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Understand the basics of electron devices
- Explain the basics of device physics and working principle of PN Junction diode
- Describe the construction, operation and applications of BJT, JFET and MOSFET
- Understand the device physics of metal-semiconductor junctions and working principle of special semiconductor devices
- Explain the construction and working principle of power semiconductor devices and optoelectronic and display devices

TEXT BOOKS:

1. Donald A Neaman, Semiconductor Physics and Devices, McGraw Hill, Fourth Edition, 2017.
2. Salivahanan S and Sureshkumar N, Electronic Devices and Circuits, McGraw Hill Education, Fourth Edition, 2017.

REFERENCES:

1. Ben G Streetman and Sanjay Kumar Banerjee, Solid State Electronic Devices, Pearson, Seventh Edition, 2015
2. Jacob Millman, Christos C. Halkias and SatyabrataJit, Electronic Devices and Circuits, McGraw Hill, Fourth Edition, 2015.
3. Robert Boylestad and Louis Nashelsky, Electron Devices and Circuit Theory, Pearson, Eleventh Edition, 2013.
4. Thomas L. Floyd, Electronic Devices, Pearson, Ninth Edition, 2016.
5. Tyagi M.S, Introduction to Semiconductor Materials and Devices, Wiley, 2008.
6. David A Bell, Electric Circuits and Electronic Devices, Oxford University Press, 2010.
7. Robert F Pierret, Semiconductor Device Fundamentals, Pearson, 1996.

COURSE CODE	COURSE TITLE	L	T	P	C
20CS201	DATA STRUCTURES	3	0	0	3

OBJECTIVES:

- To understand the concepts of ADTs
- To learn linear data structures – lists, stacks, and queues
- 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 **9**

Algorithm analysis-What to analyze-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).

UNIT II LINEAR DATA STRUCTURES – STACKS, QUEUES **9**

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 - Circular Queue – Priority Queue - deQueue – applications of queues.

UNIT III NON LINEAR DATA STRUCTURES – TREES **9**

Tree ADT – tree traversals - Binary Tree ADT – expression trees – applications of trees – binary search tree ADT –Threaded Binary Trees- AVL Trees – B-Tree - B+ Tree – Priority Queues – Applications of priority queues.

UNIT IV NON LINEAR DATA STRUCTURES - GRAPHS **9**

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

UNIT V SEARCHING, SORTING AND HASHING TECHNIQUES **9**

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

TOTAL: 45 PERIODS

OUTCOMES:

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

- Implement abstract data types for linear data structures.
- Apply the appropriate linear data structures to solve problems.
- Identify and use appropriate tree data structures in problem solving.
- Choose appropriate Graph representations and solve real-world applications.
- Critically analyze the various sorting and searching algorithms.

TEXT BOOKS:

1. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C”, 2nd Edition, Pearson Education, 2016.
2. Reema Thareja, “Data Structures Using C”, Second Edition, Oxford University Press, 2014.

REFERENCES:

1. Narasimha Karumanchi, “Data Structure and Algorithmic Thinking with Python: Data Structure and Algorithmic Puzzles”, CareerMonk Publications, 2020.
2. Jean-Paul Tremblay and Paul Sorenson, “An Introduction to Data Structures with Application”, McGraw-Hill, 2017.
3. Mark Allen Weiss, “Data Structures and Algorithm Analysis in Java”, Third Edition, Pearson Education, 2012.
4. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, “Fundamentals of Data Structures in C”, Second Edition, University Press, 2008.
5. Ellis Horowitz, Sartaj Sahni, Dinesh P Mehta, “Fundamentals of Data Structures in C++”,Second Edition, Silicon Press, 2007.

COURSE CODE	COURSE TITLE	L	T	P	C
20EM111	ENGINEERING PRACTICES LABORATORY	0	0	4	2

OBJECTIVES:

- To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.

GROUP A (CIVIL & MECHANICAL)

I CIVILENGINEERING PRACTICE 15

Buildings:

(a) Study of plumbing and carpentry components of residential and industrial buildings Safety aspects.

Plumbing Works:

(a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
(b) Study of pipe connections requirements for pumps and turbines.
(c) Preparation of plumbing line sketches for water supply and sewage works.
(d) Hands-on-exercise:
Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.
(e) Demonstration of plumbing requirements of high-rise buildings.

Carpentry using Power Tools only:

(a) Study of the joints in roofs, doors, windows and furniture.
(b) Hands-on-exercise:
Woodwork, joints by sawing, planning and cutting.

II MECHANICAL ENGINEERING PRACTICE 15

Welding:

(a) Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.
(b) Gas welding practice

Basic Machining:

(a) Simple Turning and Taper turning
(b) Drilling Practice

Sheet Metal Work:

(a) Forming &Bending:
(b) Model making – Trays and funnels.
(c) Different type of joints

Machine assembly practice:

(a) Study of centrifugal pump
(b) Study of air conditioner

Demonstration on:

(a) Smithy operations, upsetting, swaging, setting down and bending. Example Exercise – Production of hexagonal headed bolt.
(b) Foundry operations like mould preparation for gear and step conepulley.
(c) Fitting: Exercises – Preparation of square fitting and V – fitting models.

GROUP B (ELECTRICAL & ELECTRONICS)

III ELECTRICAL ENGINEERING PRACTICE 15

1. Study of various safety measures in Electrical System
2. Draw and demonstrate the layout for a residential house wiring using energy meter, switches, fuse, indicator, LED lamp, fluorescent lamp with one of the lamps to be controlled by 2 different switches
3. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit (series and parallel circuit).
4. Measurement of energy using single-phase energy meter for incandescent lamp and LED lamp.
5. Measurement of resistance to earth of an electrical equipment

IV ELECTRONICS ENGINEERING PRACTICE 15

1. Study of Electronic components (fixed and Variable):
   i. Resistor – Measurement of resistance using colour coding and digital multimeter.
   ii. Capacitor – Measurement of capacitance using identification code, LCR meter
   iii. Inductor – Measurement of inductance using colour coding and LCR meter
2. Study of Electronic equipment:
   i. Signal generation using AFO (sine, square, triangle for various frequency and amplitude ranges)
   ii. Measurement of amplitude, frequency, peak-peak, RMS, period, DC level of sine, square and triangle waveform using CRO and DSO.
   iii. Measurement of DC voltage and current using analog and digital meters
3. Study of Electronic accessories:
   i. Circuit connection using Breadboard and wires.
   ii. Circuit connection using general purpose PCB by Soldering practice techniques.
4. Study of logic gates AND, OR, EX-OR and NOT by demonstration.
5. Generation of Clock Signal.
6. Measurement of ripple factor of HWR and FWR.
7. Study of Iron box, fan and regulator (resistive and electronics type), emergency lamp, Power Tools: (a) Range Finder (b) Digital Live-wire detector

TOTAL: 60 PERIODS
(Part A:30 periods and Part B : 30 periods)

OUTCOMES:

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

- Develop carpentry components and pipe connections including plumbing works.
- Make use of welding equipments to join the structures
- Analyse the basic machining operations
- Develop the models using sheet metal works
- Illustrate on centrifugal pump, Air conditioner, operations of smithy, foundry and fittings
- Fabricate carpentry components and pipe connections including plumbing works.
- Carry out simple wiring as per the layout given
- Measures various electrical parameters like Voltage, Current, Power factor, Energy, Earth resistance etc.
- Calculate ripple factor of a given waveform, use logic gates for simple applications.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

CIVIL

1. Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings.	15Sets.
2. Carpentry vice (fitted to workbench)	15Nos.
3. Standard wood working tools	15Sets.
4. Models of industrial trusses, door joints, furniture joints	5each
5. Power Tools: (a)Rotary Hammer	2Nos
(b) Demolition Hammer	2Nos
(c) Circular Saw	2 Nos
(d) Planer	2 Nos
(e) Hand Drilling Machine	2Nos
(f) Jigsaw	2 Nos

MECHANICAL

1. Arc welding transformer with cables and holders	5Nos.
2. Welding booth with exhaust facility	5Nos.
3. Welding accessories like welding shield, chipping hammer, Wire brush, etc.	5 Sets.
4. Oxygen and acetylene gas cylinders, blow pipe and other Welding outfit.	2 Nos.
5. Centre lathe	2 Nos.
6. Hearth furnace, anvil and smithy tools	2 Sets.
7. Moulding table, foundry tools	2 Sets.
8. Power Tool: Angle Grinder	2 Nos
9. Study-purpose items: centrifugal pump, air-conditioner	One each.

ELECTRICAL

1. Assorted electrical components for house wiring (One Way Switch, Two Way Switch, Lamp Holder, Ceiling rose, LED lamp, fluorescent lamp etc) -15 Nos.

2. Electrical measuring instruments (Ammeter, Voltmeter, DRB, DIB etc) - 1 each
3. Earth Tester - 1 No.
4. Energy Meter, Ammeter, Voltmeter, Lamp load / Resistive load - 1 each

ELECTRONICS

1. Soldering guns - 10 No.
2. Assorted electronic components for making circuits (Resistor, Capacitor, Inductor, logic gates etc) - 50 Nos.
3. Small PCBs, Breadboard -10 Nos.
4. Multimeters - 10 Nos.
5. LCR Meter, DSO - 1No.
6. CRO, AFO - 5 Nos.
7. Study purpose items: Iron box, fan and regulator, emergency lamp, Range Finder, Digital Live-wire detector - 1 each

COURSE CODE	COURSE TITLE	L	T	P	C
20CS211	DATA STRUCTURES LABORATORY	0	0	4	2

OBJECTIVES:

- To implement the basic data structures for solving simple problems.
- To implement linear and non-linear data structures
- To understand the different operations of search trees
- To implement graph traversal algorithms
- To get familiarized to sorting and searching algorithms

LIST OF EXPERIMENTS:

1. Array Manipulation
    a. Find k^{th} smallest element in an unsorted array
    b. Find the sub array with given sum
    c. Matrix manipulations – Addition, Subtraction, Multiplication
    d. Job Sequencing: Given an array of jobs where every job has a deadline and a profit. Profit can be earned only if the job is finished before the deadline. It is also given that every job takes a single unit of time, so the minimum possible deadline for any job is 1. How to maximize total profit if only one job can be scheduled at a time. Print the sequence of jobID order to maximize total profit.
2. String manipulations:
    a. Reversing a set of words and count the frequency of each letter in the string.
    b. 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.
    c. Remove all the occurrences of string S2 in string S1 and print the remaining.
3. Pointers
    a. Manipulating two dimensional arrays using pointers.
    b. Print all permutations of a given string using pointers.
4. Dynamic Memory Allocation
    a. Find Largest Number.
    b. Print the list in reverse order.
5. Array implementation of List, Stack and Queue ADTs.
6. Linked list implementation of List, Stack and Queue ADTs.

7. Applications of List, Stack and Queue ADTs.
8. Implementation of Binary Trees and operations of Binary Trees.
9. Implementation of Binary Search Trees.
10. Implementation of AVL Trees.
11. Implementation of Heaps using Priority Queues.
12. Graph representation and Traversal algorithms.
13. Implement searching and sorting algorithms. Analyze and compare the time taken for various algorithms with best, average and worst case inputs.

TOTAL : 60 PERIODS

OUTCOMES:

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

- Write functions to implement linear and non-linear data structure operations.
- Suggest and use appropriate linear / non-linear data structure operations for solving a given problem.
- Implement different operations of search trees.
- Implement appropriate Graph representations and traversals t:o solve real-world applications.
- Implement and analyze the various searching and sorting algorithms.

COURSE CODE	COURSE TITLE	L	T	P	C
20EL211	ADVANCED READING & WRITING	0	0	2	1

OBJECTIVES:

- Strengthen their reading skills.
- Enhance writing skills with specific reference to technical writing.
- Apply their critical thinking skills.
- Provide more opportunities to develop their project and proposal writing skills.

UNIT I **6**

Reading - Strategies for effective reading - Writing -Write a descriptive paragraph - Predicting content using photos and title.

UNIT II **6**

Reading - Use of graphic organizers to review and aid comprehension. Writing - Write an opinion paragraph

UNIT III **6**

Reading - speed reading techniques - Writing - Elements of a good essay- Analytical Essay.

UNIT IV **6**

Reading - Genre and Organization of Ideas – Writing - Email writing - Job application

UNIT V **6**

Reading - Critical reading and thinking -Writing - letter of recommendation - Vision statement

TOTAL: 30 PERIODS

OUTCOMES:

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

- Write different types of essays.
- Write winning job applications.
- Read and evaluate texts critically.
- Display critical thinking in various professional contexts.

TEXT BOOKS:

1. Debra Daise, CharlNorloff, and Paul Carne Reading and Writing (Level 4) Oxford University Press: Oxford, 2011.
2. Gramer F. Margot and Colin S. Ward Reading and Writing (Level 3) Oxford University Press: Oxford, 2011.

REFERENCES:

1. Davis, Jason and Rhonda Liss. Effective Academic Writing (Level 3) Oxford University Press: Oxford, 2006.
2. Elbow, Peter. Writing Without Teachers. London: Oxford University Press, 1973. Print.
3. E. Suresh Kumar and et al. Enriching Speaking and Writing Skills. Second Edition. Orient Black swan: Hyderabad, 2012
4. Goatly, Andrew. Critical Reading and Writing. Routledge: United States of America, 2000.
5. Petelin, Roslyn and Marsh Durham. The Professional Writing Guide: Knowing Well and Knowing Why. Business & Professional Publishing: Australia, 2004.
6. Withrow, Jeans and et al. Inspired to Write. Readings and Tasks to develop writing skills. Cambridge University Press: Cambridge, 2004.

R.M.K. ENGINEERING COLLEGE

(An Autonomous Institution, Affiliated to Anna University, Chennai)

RSM NAGAR, KAVARAIPETTAI – 601 206

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SEMESTER-III

COURSE CODE	COURSE TITLE	L	T	P	C
20EC301	SIGNALS AND SYSTEMS	4	0	0	4

OBJECTIVES:

- To summarize the basic properties of Signals and Systems and their classification
- To analyze Continuous Time signals using Laplace transform and Fourier transform
- To characterize 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 12

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

UNIT II ANALYSIS OF CONTINUOUS TIME SIGNALS 12

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

UNIT III LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS 12

Differential Equation-Block diagram representation-impulse response, convolution integrals-Fourier and Laplace transforms in analysis of CT systems.

UNIT IV ANALYSIS OF DISCRETE TIME SIGNALS 12

Baseband Sampling - DTFT – Properties of DTFT - Z transform – Properties of Z transform. Sampling using MATLAB.

UNIT V LINEAR TIME INVARIANT DISCRETE TIME SYSTEMS 12

Difference Equations - Block diagram representation - Impulse response - Convolution sum-Discrete Fourier and Z transform analysis of Recursive & Non-Recursive systems. Convolution Sum using MATLAB.

TOTAL: 60 PERIODS

OUTCOMES:

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

CO1: Analyze the properties of Signals and Systems
CO2: Apply Fourier transform and Laplace transform in Continuous Time signal analysis
CO3: Analyze Continuous Time LTI systems using Fourier and Laplace transforms
CO4: Apply DTFT and Z transform in Discrete Time signal analysis
CO5: Analyze Discrete Time LTI systems using DTFT and Z transform
CO6: Apply 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. A.Nagoor Kani, Signals and Systems, McGraw Hill, 2018.

REFERENCES:

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

NPTEL LINK: https://nptel.ac.in/courses/108/106/108106163/

COURSE CODE	COURSE TITLE	L	T	P	C
20EC302	ELECTRONIC CIRCUITS	3	0	0	3

OBJECTIVES:

- To analyze biasing of BJT and BJT amplifiers
- To analyze biasing of MOSFET and MOSFET amplifiers
- To compute the frequency response of BJT and MOSFET
- To acquire knowledge of feedback amplifiers and oscillators
- To illustrate the operation of power amplifiers

UNIT I BJT AMPLIFIERS 9

Load line, Q-point, Biasing methods for BJT, Analysis of CE, CB and CC amplifiers using hybrid-pi equivalent circuit, BJT Differential amplifier – CMRR, Multistage amplifiers - Cascade amplifier, Darlington amplifier, Cascode amplifier.

UNIT II MOSFET AMPLIFIERS 9

Load line, Q-point, Biasing methods for MOSFET, Analysis of CS, CD and CG MOSFET amplifiers using hybrid-pi equivalent circuits, MOSFET Differential amplifier – CMRR, Multistage Amplifiers - Cascade amplifier, Cascode amplifier.

UNIT III 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, Miller effect and Miller capacitance, High frequency analysis of MOSFET CS amplifier.

UNIT IV FEEDBACK AMPLIFIERS AND OSCILLATORS 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, Barkhausen criterion, Colpitts, Hartley, Clapp oscillator, Phase shift, Wien bridge and crystal oscillators.

UNIT V POWER AMPLIFIERS 9

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

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Analyze biasing of BJT and BJT amplifiers
CO2: Analyze biasing of MOSFET and MOSFET amplifiers
CO3: Compute the frequency response of amplifiers
CO4: Acquire the knowledge of feedback amplifiers
CO5: Acquire the knowledge of oscillators
CO6: Illustrate the operation of power amplifiers

TEXT BOOKS:

1. Donald. A.Neamen, Electronic Circuits Analysis and Design, 3rd Edition, McGraw-Hill Education (India) Private Ltd., 2010.

2. Robert L. Boylestad and Louis Nasheresky, Electronic Devices and Circuit Theory, 11th Edition, Pearson Education/PHI, 2015.

REFERENCES:

1. David A. Bell, Electronic Devices and Circuits, 5th Edition, Oxford University Press, 2010.
2. Sedra and Smith, Micro Electronic Circuits, 7th Edition, Oxford University Press, 2015.
3. Millman J, Halkias. C. and Sathyabrada Jit, Electronic Devices and Circuits, 4th Edition, McGraw Hill Education (India) Private Ltd., 2015.
4. Jacob Millman and Arvin Grabel, Micro Electronics, 2nd Edition, McGraw-Hill Education (India) Pvt Limited, 2017.
5. Floyd, Electronic Devices, 9th Edition, Pearson Education, 2012.

NPTEL LINK:

https://nptel.ac.in/courses/108/102/108102097/
https://nptel.ac.in/courses/108/102/108102095/

COURSE CODE	COURSE TITLE	L	T	P	C
20EC303	DIGITAL ELECTRONICS	3	0	0	3

OBJECTIVES:

- To acquire the knowledge in Digital fundamentals, Boolean algebra and its applications in digital systems
- To design various combinational digital circuits using logic gates
- To analyze and design synchronous and asynchronous sequential circuits
- To explain the various semiconductor memories and related technology
- To describe the electronic circuits involved in the making of logic gates

UNIT I NUMBER SYSTEMS & LOGIC GATE MINIMIZATION 9

Number Systems – Decimal, Binary, Octal, Hexadecimal, 1's and 2's complements, Codes – Binary, BCD, Excess 3, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Minterms and Maxterms, Karnaugh map Minimization and Quine-McCluskey method of minimization.

UNIT II COMBINATIONAL CIRCUIT DESIGN 9

Design of Half and Full Adders, Half and Full Subtractors, Binary Parallel Adder/Subtractor – Carry look ahead Adder, BCD Adder, Multiplexer, Demultiplexer, Magnitude Comparator, Decoder, Encoder, Priority Encoder, Parity checker – Parity generator – Code converters – Verilog HDL for combinational circuits.

UNIT III SYNCHRONOUS SEQUENTIAL CIRCUITS 9

Flip flops–SR, JK, T, D, Master/Slave FF–operation and excitation tables, Asynchronous and Synchronous Counters-Design, Shift registers, Universal Shift Register. Shift register counters - Design of clocked sequential circuits-Moore/Mealy models, state minimization, state assignment, circuit implementation –Verilog HDL for sequential circuits.

UNIT IV ASYNCHRONOUS SEQUENTIAL CIRCUITS 9

Design of fundamental mode and pulse mode circuits–Cycles and Races, Race free assignments, Hazards, Essential Hazards – Design Hazard Free Switching circuits.

UNIT V MEMORY DEVICES AND DIGITAL INTEGRATED CIRCUITS 9

Basic memory structure ROM: PROM – EPROM – EEPROM –Flash memories: RAM – Static and dynamic RAM – Programmable Logic Devices: Programmable Logic Array (PLA) – Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA) – Implementation of combinational logic circuits using PLA, PAL. Digital integrated circuits: Logic levels, propagation delay, power dissipation, fan-out and fan-in, noise margin, logic families and their electrical behavior -RTL, TTL, ECL, CMOS.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Implement Boolean expression using logic gates

CO2: Design Combinational circuits for a given function using logic gates

CO3: Implement synchronous and asynchronous sequential circuits for a given application

CO4: Summarize the types of memory devices

CO5: Design the combinational logic circuits using Programmable Logic Devices
CO6: Analyze the various logic families and their characteristics

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/

COURSE CODE	COURSE TITLE	L	T	P	C
20EC304	CONTROL SYSTEMS	3	0	0	3

COURSE OBJECTIVES:

- To understand 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 analyse the open loop and closed loop frequency response of linear systems
- To introduce stability analysis and design of compensators of linear systems
- To introduce 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 and thermal systems – Transfer function – AC and DC servomotors – Block diagram reduction techniques – Signal flow graphs - Applications ofControl system.

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, PIDmodes of feedback control – Time response analysis - Effect of addition of poles and zeros in Second order system.

UNIT III FREQUENCY RESPONSE ANALYSIS 9

Frequency response analysis – Bode plot – Polar plot Determination of closed loop response from open loop response - Correlation between frequency domain and time domainspecifications.

UNIT IV STABILITY AND COMPENSATOR DESIGN 9

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

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.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Develop mathematical model of linear mechanical and electrical systems

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

CO3: Determine the applications of P, PI, PID controllers

CO4: Analyze the frequency response of open and closed loop systems

CO5: Estimate the stability and suitable compensators for the given system

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

TEXTBOOKS

1. Nagarath,I.J. and Gopal,M., "Control Systems Engineering", New Age International Publishers, 2017.
2. Benjamin C.Kuo, "Automatic Control Systems", Wiley, 2014.

REFERENCES

1. Katsuhiko Ogata, "Modern Control Engineering", Pearson, 2015.
2. Richard C. Dorf and Bishop, R.H., "Modern Control Systems", Pearson Education, 14th edition, 2016.
3. John J.D., Azzo Constantine, H. and Houpis Sttuart, N Sheldon, "Linear Control System Analysis and Design with MATLAB", CRC Taylor & Francis2013.
4. Rames C. Panda and T.Thyagarajan, "An Introduction to Process Modelling Identification and Control of Engineers", Narosa Publishing House, 2017.
5. M.Gopal, "Control System: Principle and design", McGraw Hill Education, 2018.
6. NPTEL Video Lecture Notes on "Control Engineering" by Prof.S.D.Agashe, IIT Bombay.

COURSE CODE	COURSE TITLE	L	T	P	C
20EC311	ANALOG AND DIGITAL CIRCUITS LABORATORY	0	0	4	2

OBJECTIVES:

- To demonstrate the characteristics of basic electronic devices such as Diode and BJT
- To analyze the frequency response of CE, CB, CC and CS Amplifier
- To demonstrate the feedback amplifiers and oscillators
- Perform SPICE simulation of Electronic Circuits
- Design and implement the Combinational and sequential logic circuits

LIST OF ANALOG EXPERIMENTS:

1. Characteristics of PN Junction Diode and Zener diode
2. Input - output Characteristics of BJT
3. Frequency Response of CE, CC and CS amplifiers
4. Darlington Amplifier
5. Cascode / Cascade amplifiers
6. Feedback amplifiers
7. RC Phase shift oscillator
8. Hartley and Colpitts Oscillator

LIST OF EXPERIMENTS USING SPICE:

9. Analysis of Frequency Response of BJT using Spice.
10. Analysis of Frequency Response of MOSFET using Spice.
11. Wien bridge oscillator using Spice.

LIST OF DIGITAL EXPERIMENTS

1. Design and implementation of Adders and subtractors using logic gates
2. Design and implementation of code converters using logic gates (i) BCD to excess-3 code and vice-versa (ii)Binary to gray and vice-versa
3. Design and implementation of Multiplexer and De-multiplexer using logic gates
4. Design and implementation of encoder and decoder using logic gates
5. Construction and verification of 4-bit ripple counter and Mod-10/Mod-12 Ripple counters
6. Design and implementation of 3-bit synchronous up/down counter

TOTAL: 60 PERIODS

OUTCOMES:

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

CO1: Analyze the characteristics of basic electronic devices

CO2: Analyze the frequency response of the amplifiers

CO3: Analyze the feedback amplifiers and oscillators

CO4: Simulate frequency response of the amplifiers using spice tool

CO5: Simulate frequency response of the oscillators using spice tool

CO6: Design and test the digital logic circuits

LAB EQUIPMENT REQUIREMENTS

S.No.	EQUIPMENTS FOR ANALOG LAB	Count
1	CRO/DSO(30MHz)	15
2	Signal Generator/Function Generators (3MHz)	15
3	Dual Regulated Power Supplies (0–30V)	15
4	Standalone desktop PCs with SPICE software	15
5	Transistor/FET (BJT-NPN-PNP and NMOS/PMOS)	50

Components and Accessories:
Resistors, Capacitors, Inductors, diodes, Zener Diodes, Bread Boards, Transformers.

SPICE Circuit Simulation Software: (any public domain or commercial software)

S.No.	EQUIPMENTS FOR DIGITAL LAB	Count
1	Dual power supply/single mode power supply	15
2	IC Trainer Kit	15
3	Bread Boards	15
4	Seven segment display	15
5	Multimeter	15
6	ICs 7400/ 7402 / 7404 / 7486/ 7408 / 7432/ 7483/ 74150/ 74151/ 74147/ 7445 / 7476/ 7491/ 555/ 7494 / 7447/ 74180/ 7485/ 7473 / 74138 / 7411/ 7474	50 each

COURSE CODE	COURSE TITLE	L	T	P	C
20EC312	FOUNDATION LAB ON INTERNET OF THINGS	0	0	2	1

OBJECTIVES:

- To impart necessary and practical knowledge of components of Internet of Things and develop skills required to build real-life IoT based projects

LIST OF EXPERIMENTS

1. Familiarization with Arduino/Raspberry Pi and perform necessary software installation.
2. To interface LED/Buzzer with Arduino/Raspberry Pi and write a program to turn ON LED for 1sec after every 2seconds.
3. To interface Push button/Digital sensor (IR/LDR) with Arduino/Raspberry Pi and write a program to turn ON LED when push button is pressed or at sensor detection.
4. To interface DHT11 sensor with Arduino/Raspberry Pi and write a program to print temperature and humidity readings.
5. To interface motor using relay with Arduino/Raspberry Pi and write a program to turn ON motor when push button is pressed.
6. To interface OLED with Arduino/Raspberry Pi and write a program to print temperature and humidity readings on it.
7. To interface Bluetooth with Arduino/Raspberry Pi and write a program to send sensor data to smart phone using Bluetooth.
8. To interface Bluetooth with Arduino/Raspberry Pi and write a program to turn LED ON/OFF when ‘1’/’0’ is received from smart phone using Bluetooth.
9. Write a program on Arduino/Raspberry Pi to upload temperature and humidity data to ThingSpeak cloud.
10. Write a program on Arduino/Raspberry Pi to retrieve temperature and humidity data from ThingSpeak cloud.
11. To install MySQL database on Raspberry Pi and perform basic SQL queries.
12. Write a program on Arduino/Raspberry Pi to publish temperature data to MQTT broker.
13. Write a program on Arduino/Raspberry Pi to subscribe to MQTT broker for temperature data and print it.
14. Write a program to create TCP server on Arduino/Raspberry Pi and respond with humidity data to TCP client when requested.
15. Write a program to create UDP server on Arduino/Raspberry Pi and respond with humidity data to UDP client when requested.

TOTAL: 30 PERIODS

OUTCOMES:

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

CO1: Acquire knowledge on Internet of Things and its hardware and software components

CO2: Demonstrate to interface I/O devices, sensors & communication modules

CO3: Analyze by connecting and exchanging data with other devices and systems over the Internet.

CO4: Analyze to remotely monitor data and control devices

CO5: Analyze the issues involved in the design of IoT application in terms of performance, efficiency and response time

CO6: Develop real life IoT based projects

REFERENCES:

1. Vijay Madisetti, Arshdeep Bahga, Ïnternet of Things, A Hands on Approach, University Press, 2014.
2. Dr. SRN Reddy, Rachit Thukral and Manasi Mishra, Introduction to Internet of Things: Apractical Approach, ETI Labs.
3. Pethuru Rajand Anupama C.Raman, The Internet of Things: Enabling Technologies, Platforms, and Use Cases, CRC Press, 1st Edition, Auerbach Publications, 2017.
4. Jeeva Jose, Internet of Things, Khanna Publishing House, Delhi, 1st Edition, Khanna Publishing House, 2018.

LAB EQUIPMENT REQUIREMENTS

Sl. No.	Description	Quantity
1.	Arduino Uno With USB Cable	10
2.	Bread Board (GL-840)	10
3.	LED (3 Color Each-5)	10
4.	Resistor (10Ω,10KΩ)	10
5.	Hookup Wire	30
6.	RGB LED	10
7.	Push Button	10
8.	IR-Sensor	10
9.	Buzzer	10
10.	Piezo Sensor	10
11.	Potentiometer (10KΩ)	10

12.	Temperature Sensor	10
13.	Blutooth Module	10
14.	7 Segment Display	10
15.	DC Toy Motor	10
16.	Ultrasonic Sensor	10
17.	WiFi Module	10
18.	System With Internet Connection	10

R.M.K. ENGINEERING COLLEGE

(An Autonomous Institution, Affiliated to Anna University, Chennai)

RSM NAGAR, KAVARAIPETTAI – 601 206

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SEMESTER- IV

COURSE CODE	COURSE TITLE	L	T	P	C
20EC401	COMMUNICATION SYSTEMS	3	0	0	3

OBJECTIVES:

- To discuss the concepts of various analog modulation schemes and their spectral characteristics
- To summarize various types of noises in communication system
- To analyze the effect of noise in communication systems
- To describe the concepts of sampling and quantization
- To discuss the concepts of pulse modulation techniques

UNIT I AMPLITUDE MODULATION 9

Amplitude Modulation- DSBSC, DSBFC, SSB, VSB - Modulation index, Spectra, Power relations and Bandwidth – AM Generation – Square law and Switching modulator, AM detection - Envelope detector, DSBSC Generation – Balanced and Ring Modulator, DSBSC detection – Coherent detector, SSB Generation – Filter, Phase Shift and Third Methods, VSB Generation – Filter Method –comparison of different AM techniques.

UNIT II ANGLE MODULATION 9

Phase and frequency modulation, Narrow Band and Wide band FM – Modulation index, Spectra, Power relations and Transmission Bandwidth - FM modulation –Direct and Indirect methods, FM Demodulation – FM to AM conversion, FM Discriminators - PLL as FM Demodulator.

UNIT III NOISE CHARACTERIZATION 9

Noise sources – Noise figure, noise temperature and noise bandwidth – Noise in cascaded systems. Hilbert Transform, Pre-envelope & complex envelope - Representation of Narrow band noise –In-phase and quadrature components, Envelope and Phase components.

UNIT IV NOISE PERFORMANCE IN AM AND FM SYSTEMS 9

AM Super heterodyne Receiver - Noise performance analysis in AM systems, AM Threshold

effect, FM Super heterodyne Receiver, Noise performance analysis in FM systems – FM Threshold effect, Pre-emphasis and de-emphasis for FM, Comparison of noise performance of AM and FM Systems.

UNIT V PULSE MODULATION TECHNIQUES 9

Baseband sampling – Aliasing-Quantization - Uniform & non-uniform quantization - quantization noise - Logarithmic Companding – PAM, PPM, PWM, PCM – TDM, FDM.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Compare different Amplitude Modulation Schemes for their efficiency and bandwidth
CO2: Summarize the concepts of Angle Modulation Systems
CO3: Explain different types of Noise in Communication Systems
CO4: Analyze the behaviour of a communication system in presence of noise
CO5: Summarize the principles of Sampling and Quantization
CO6: Describe the concepts of Pulse modulation Techniques

TEXT BOOKS:

1. J.G. Proakis, M. Salehi, Fundamentals of Communication Systems, Pearson Education 2014.
2. Simon Haykin, Communication Systems, 4th Edition, John Wiley & Sons, 2016.

REFERENCES:

1. B.P. Lathi, Modern Digital and Analog Communication Systems, 5th Edition, OxfordUniversity Press, 2018.
2. D. Roody, J. Coolen, Electronic Communications, 4th edition, PHI 2012.
3. Sklar, Digital Communication: Fundamentals and Applications, 2nd Edition, PearsonEducation India, 2014.
4. Couch.L., Modern Communication Systems, 8th Edition, Pearson, 2013.
5. H P Hsu, Schaum Outline Series, Analog and Digital Communications, 3rd Edition,TMH 2017.

NPTEL LINK: https://nptel.ac.in/courses/117/102/117102059/

COURSE CODE	COURSE TITLE	L	T	P	C
20EC402	MICROPROCESSORS AND MICROCONTROLLERS	3	0	0	3

OBJECTIVES:

- To explain the Architecture of 8086 microprocessor
- To summarize the design aspects of I/O and Memory Interfacing circuits
- To interface microprocessors with supporting chips
- To explain the Architecture of 8051 microcontroller
- To demonstrate a microcontroller based system

UNIT I 8086 MICROPROCESSOR 9

Introduction to 8086 – Microprocessor architecture – Addressing modes - Instruction set and assembler directives – Assembly language programming – Modular Programming – Linking and Relocation - Stacks - Procedures – Macros – Interrupts and interrupt service routines – Byte and String Manipulation.

UNIT II 8086 SYSTEM BUS STRUCTURE 9

8086 signals – Basic configurations – System bus timing –System design using 8086 – I/O programming – Introduction to Multiprogramming – System Bus Structure – Multiprocessor configurations – Coprocessor - Closely coupled and loosely Coupled configurations – Introduction to advanced processors.

UNIT III INTERFACING MICROPROCESSOR 9

Memory Interfacing and I/O interfacing - Parallel communication interface – Serial communication interface – D/A and A/D Interface - Timer – Keyboard /display controller – Interrupt controller – DMA controller – Programming and applications Case studies: Traffic Light control, LED display, LCD display, Keyboard display interface and Alarm Controller.

UNIT IV MICROCONTROLLER 9

Architecture of 8051 – Special Function Registers (SFRs) - I/O Pins, Ports and Circuits - Instruction set - Addressing modes - Assembly language programming.

UNIT V INTERFACING MICROCONTROLLER 9

Programming 8051 Timers - Serial Port Programming - Interrupts Programming – LCD & Keyboard Interfacing - ADC, DAC & Sensor Interfacing - External Memory Interface- Stepper Motor and Waveform generation – Introduction to PIC16X Microcontroller - Comparison of Microprocessor, Microcontroller, PIC microcontroller.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Acquire knowledge on the architecture of 8086 microprocessor and 8051microcontroller

CO2: Apply programming techniques in developing the assembly language program for microprocessor applications

CO3: Apply programming techniques in developing the assembly language program for microcontroller applications

CO4: Analyze various types of interfacing devices with other peripheral devices

CO5: Design and Construct Memory Interfacing Circuits

CO6: Design and construct Microprocessor and Microcontroller based systems

TEXT BOOKS:

1. Yu-Cheng Liu, Glenn A.Gibson, Microcomputer Systems: The 8086 / 8088 Family - Architecture, Programming and Design, 2nd Edition, Pearson, 2015.
2. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, The 8051 Microcontroller and Embedded Systems: Using Assembly and C, 2nd Edition, Pearson Education, 2011.

REFERENCES:

1. Doughlas V.Hall, Microprocessors and Interfacing, Programming and Hardware,TMH, 2012.
2. A.K.Ray, K.M.Bhurchandi, Advanced Microprocessors and Peripherals 3rd Edition, Tata McGraw Hill, 2012.
3. Martin P Bates, Programming 8 – bit PIC Microcontroller in C with Interactive Hardware Simulation, Newnes, 2008.
4. Walter A Triebel and Avatar Singh, The 8088 and 8086 Microprocessors – Programming, Interfacing, Software, Hardware and Applications, 4th Edition, Pearson, 2007.
5. Scott MacKenzie, Raphael Chung-Wei Phan, The 8051 Microcontroller, 4th Edition, PearsonEducation, 2008.

NPTEL LINK: https://nptel.ac.in/courses/108/105/108105102/

COURSE CODE	COURSE TITLE	L	T	P	C
20EC403	ELECTROMAGNETIC FIELDS	4	0	0	4

OBJECTIVES:

- To acquire knowledge on conceptual and basic mathematical understanding of three-dimensional coordinate systems using fundamental theorems
- To analyze fields and potentials due to static electric charges
- To evaluate static magnetic fields using basic laws
- To summarize the concepts of coupling between the electric and magnetic fields under time varying conditions
- To summarize the propagation of plane waves in lossless and lossy media

UNIT I INTRODUCTION TO VECTOR ALGEBRA 12

Review of Vector Algebra - Introduction to Co-ordinate Systems – Rectangular – Cylindrical and Spherical Co-ordinate Systems – Introduction to Line, Surface and Volume Integrals – Gradient, Divergence and Curl – Significance of Stokes theorem and Divergence theorem.

UNIT II STATIC ELECTRIC FIELDS 12

Coulomb's Law in Vector Form – Electric Field Intensity – Principle of Superposition – Electric Field due to discrete charges and continuous charge distributions - Electric Field due to finite and infinite line, circular disc and infinite sheet of charge.
Electric Scalar Potential – Relationship between Potential and Electric field - Potential due to an infinite line and Electrical Dipole - Electric Flux Density – Gauss Law and its Applications. Poisson's and Laplace equations – Electric Polarization - Nature of dielectric materials- Capacitance – Capacitance of various geometries using Laplace equation – Electrostatic Energy and Energy Density – Boundary conditions for Electric Fields – Electric Current – Current Density – Point form of ohm's law – Continuity Equation for Current.

UNIT III STATIC MAGNETIC FIELDS 12

Biot-Savart Law– Magnetic Field Intensity due to finite and infinite wire, circular and rectangular loop – Ampere's Circuital Law and its applications - Magnetic Flux Density.

Lorentz Force Equation – Force on a differential current element, Force between current elements – Force and Torque on a closed loop – Magnetic Moment – Magnetic Vector Potential.

Inductance – Inductance of loops and Solenoids – Mutual Inductance. Energy Density in Magnetic Fields – Nature of magnetic materials – Magnetization and Permeability - Magnetic boundary conditions.

UNIT IV TIME VARYING ELECTRIC AND MAGNETIC FIELDS 12

Faraday's law, Displacement Current – Ampere's Circuital Law – Maxwell's Equation inIntegral and Differential form - Maxwell's equation in Phasor form.
Poynting Vector – Power Flow in a Co-axial cable – Instantaneous, Average and Complex Poynting Vector.

UNIT V ELECTROMAGNETIC WAVES 12

Wave Equations and their solutions – Uniform Plane Waves – Wave equation in Phasor form –Plane waves in Free space and in Homogenous medium.
Wave equation for a conducting medium – Plane waves in lossy dielectrics – Propagation in good conductors – Skin effect.
Linear, Elliptical and Circular Polarization – Reflection of Plane Waves from a conductor –Normal incidence – Reflection of Plane Waves by a perfect dielectric – Normal incidence.

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of this course, the student will be able to
CO1: Demonstrate the understanding of three-dimensional coordinate systems
CO2: Analyze fields and potentials due to static charges
CO3: Analyze static magnetic fields
CO4: Interpret Maxwell's equations in integral, differential and phasor forms and explain their physical meaning
CO5: Explain electromagnetic wave propagation in lossless and lossy media
CO6: Solve simple problems requiring estimation of electric and magnetic field quantities based on the above concepts

TEXT BOOKS:

1. W.H.Hayt & J.A. Buck,Engineering Electromagnetics,9th Edition, TMH,2020.
2. Matthew N.O.Sadiku,Elements of Engineering Electromagnetics,7th Edition, OxfordUniversity Press, 2018.

REFERENCES:

1. E.C.Jordan & K.G. Balmain, Electromagnetic Waves and Radiating Systems,2ndEdition, Pearson Education/PHI, 2015.
2. David K.Cheng, Field and Wave Electromagnetics, 2nd Edition Revised, PearsonEdition, 2013.
3. G.S.N. Raju, Electromagnetic Field Theory & Transmission Lines, Pearson Education,2006.
4. David. J. Griffiths, Introduction to Electrodynamics, 4thEdition, Pearson Education,Noida, India, 2014.
5. Joseph Edminister, Mahmood Nahvi, Schaum's Outline of Electromagnetics, 5thEdition, McGraw-Hill Education, 2019.

NPTEL LINK: https://nptel.ac.in/courses/117/103/117103065/

COURSECODE	COURSE TITLE	L	T	P	C
20EC404	LINEAR INTEGRATED CIRCUITS	3	0	0	3

OBJECTIVES:

- To describe the characteristics of operational amplifiers
- To design op–amp circuits for a variety of engineering applications
- To outline the working principles of ADC and DAC
- To analyze the functions and applications of analog multipliers and PLL
- To summarize the concepts of waveform generators and voltage regulators

UNIT I BASICS OF OPERATIONAL AMPLIFIERS 9

Advantages of ICs over discrete components, Classification, Basic information about Op-Amps – Ideal Operational Amplifier - General Operational Amplifier stages and internalcircuit diagrams of IC 741, DC and AC performance characteristics, CMRR, Slew Rate, Open and Closed loop configurations.

UNIT II APPLICATIONS OF OPERATIONAL AMPLIFIERS 9

Basic Op-Amp Circuits: Sign Changer, Scale Changer, Phase Shift Circuits, Voltage Follower, Adder, Subtractor, Linear Applications: V-to-I and I-to-V Converters, Instrumentation Amplifier, Integrator, Differentiator, Non-linear Applications:

Logarithmic Amplifier, Antilogarithmic Amplifier, Comparators, Schmitt trigger, Active Filters: Low- Pass, High-Pass and Band-Pass Butterworth Filters.

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 - switches for D/A converters, high speed sample-and-hold circuits, A/D Converters – specifications - Flash type - Successive Approximation type - Single Slope type – Dual Slope type - A/D Converter using Voltage-to-Time Conversion - Over-sampling A/D Converters, Sigma – Delta converters

UNIT IV ANALOG MULTIPLIER AND PLL 9

Analog Multiplier using Emitter Coupled Transistor Pair - Gilbert Multiplier cell – Variable transconductance technique, Analog Multiplier ICs and their applications, PLL: Operation of the basic PLL, Closed loop analysis, Voltage Controlled Oscillator, Monolithic PLL IC 565, application of PLL for AM detection, FM detection, FSK modulation and demodulation and Frequency synthesizing and clock synchronization.

UNIT V WAVEFORM GENERATORS AND VOLTAGE REGULATORS 9

Waveform generators: Sine-wave generators, Square wave, Triangular wave generator, Saw-tooth wave generator, **IC 555 Timer:** Monostable operation and its applications, Astable operation and its applications. **IC Voltage regulators:** Three terminal fixed and adjustable voltage regulators - IC 723 general purpose regulator - Monolithic switching regulator, Low Drop – Out (LDO) Regulators - Switched capacitor filter IC MF10, Frequency to Voltage and Voltage to Frequency converters, Audio Power amplifier, Video Amplifier.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Describe the significance and applications of Integrated Circuits
CO2: Demonstrate various Mathematical Circuit applications using IC 741
CO3: Classify and comprehend the working principle of Data Converters
CO4: Apply the Analog Multiplier and Phase Locked Loop for recent applications
CO5: Design Waveform Generators using Op-amp circuits and analyze IC 555 Timers
CO6: Demonstrate the use of IC regulators and Low dropout regulators for voltage regulation applications

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 Linear Integrated 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, 3rd Edition, McGraw Hill Education, 2018.

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

COURSECODE	COURSE TITLE	L	T	P	C
20EC411	MICROPROCESSORS AND MICROCONTROLLERS LABORATORY	0	0	4	2

OBJECTIVES:

- To familiarize Assembly Language Program concepts, features and Coding methods
- To write Assembly Language Program for arithmetic and logical operations in 8086
- To differentiate Serial and Parallel Interface
- To write Assembly Language Program for arithmetic and logical operations in 8051
- To interface different I/Os with Microprocessors

LIST OF EXPERIMENTS:

8086 Programs

1. Basic arithmetic and Logical operations
2. Move a data block without overlap
3. Code conversion and decimal arithmetic.
4. Sorting and searching

8051 Experiments

5. Basic arithmetic and Logical operations
6. Square and Cube program
7. Find 2's complement of a number
8. Unpacked BCD to ASCII

Interfacing Experiments of 8086/8051

9. Traffic light controller
10. Key board and Display - 8279
11. Programmable Timer - 8253/8254
12. Programmable peripheral Interface - 8255
13. A/D and D/A interface
14. Stepper motor control
15. Serial Communication between two kits

TOTAL: 60 PERIODS

OUTCOMES:

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

CO1: Write ALP Programs for Arithmetic and logical operations

CO2: Analyze to interface different I/Os with processor

CO3: Analyze waveforms using Microprocessors

CO4: Write programs in 8051

CO5: Demonstrate to interface different I/Os with Microcontroller

CO6: Demonstrate to perform serial communications between two kits

LAB EQUIPMENT REQUIREMENTS

HARDWARE:

8086 development kits - 30 nos
Interfacing Units - Each 10 nos
Microcontroller - 30 nos

SOFTWARE:

Intel Desktop Systems with MASM - 30 nos
8086 Assembler
8051 Cross Assembler

COURSECODE	COURSE TITLE	L	T	P	C
20EC412	LINEAR INTEGRATED CIRCUITS LABORATORY	0	0	4	2

OBJECTIVES:

- To describe the characteristics of operational amplifiers
- To apply operational amplifiers in linear and nonlinear applications
- To analyze the characteristics of oscillators
- To acquire the basic knowledge of special function IC
- To simulate operational amplifier circuits using PSPICE

LIST OF EXPERIMENTS:

DESIGN AND TESTING OF

1. Inverting, Non inverting and differential amplifiers.
2. Integrator and Differentiator.
3. Instrumentation amplifier using Op-amp
4. Active low-pass, High-pass and band-pass filters.
5. Astable & Monostable multivibrators using Op-amp
6. Schmitt Trigger using Op-amp.
7. Phase shift and Wien bridge oscillators using Op-amp.
8. Astable and Monostable multivibrators using NE555 Timer.
9. R-2R Ladder Type D- A Converter using Op-amp.
10. DC power supply using LM723.

SIMULATION USING PSPICE:

1. Integrator/Differentiator using op-amp.
2. Active low-pass, High-pass and band-pass filters using Op-amp.
3. Astable and Monostable multivibrators using NE555 timer.
4. Schmitt trigger using Op-amp.

TOTAL: 60 PERIODS

OUTCOMES:

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

CO1: Analyze operational amplifiers in linear and nonlinear applications
CO2: Design Amplifiers, Oscillators, D-A converters using Operational Amplifiers
CO3: Design Filters using Op-Amp and performs an experiment on frequency response
CO4: Design Voltage Regulators and DC power supply using ICs
CO5: Analyze the performance of Filters using PSPICE
CO6: Analyze the performance of Multivibrators using PSPICE

LAB EQUIPMENT REQUIREMENTS

S.No.	EQUIPMENTS	COUNT
1	CRO/DSO (Min 30MHz)	15
2	Signal Generator /Function Generators (2 MHz)	15
3	Dual Regulated Power Supplies (0 – 30V)	15
4	Digital Multimeter	15
5	IC Tester	5
6	Standalone desktops PC	15
7	Components and Accessories	50

Components and Accessories:
Transistors, Resistors, Capacitors, Diodes, Zener Diodes, Bread Boards, Transformers, Wires, Power transistors, Potentiometer, A/D and D/A Convertors, LEDs .

Note: Op-Amps uA741, LM 301, LM311, LM 324, LM317, LM723, 7805, 7812, 2N3524, 2N3525, 2N3391, AD 633, LM 555, LM 565 may be used.

COURSECODE	COURSE TITLE	L	T	P	C
20EC413	MINI PROJECT/INDUSTRIAL INTERNSHIP	0	0	2	1

OBJECTIVES:

- To define, formulate and analyze real world problem in the field of Electronicsand 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

Mini Project:

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 novelfeatures.

Internship: (Internship during vacation)

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.

Course Evaluation	
Miniproject	**Weight**
Project final report	40%
Presentation/Simulation/ Demonstration	40%
Viva voce	20%

Course Evaluation	
Internship	**Weight**
Presentation/Viva voce	40%
Internship completion Certificate from company	30%
Project based on Internship	30%

TOTAL:30 PERIODS

OUTCOMES:

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 a 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

V SEMESTER

COURSE CODE	COURSE TITLE	L	T	P	C
20EC501	DIGITAL COMMUNICATION	3	0	0	3

OBJECTIVES:

- To study the limits set by information theory
- To study the various waveform coding schemes
- To learn the various baseband transmission schemes
- To understand the various band pass signaling schemes
- To know the fundamentals of channel coding

UNIT I INFORMATION THEORY **9**

Discrete Memoryless source, Information, Entropy, Mutual Information - Discrete Memoryless channels – Binary Symmetric Channel, Channel Capacity - Hartley - Shannon law - Source coding theorem - Shannon - Fano & Huffman codes.

UNIT II WAVEFORM CODING AND REPRESENTATION **9**

Prediction filtering and DPCM — Delta Modulation — ADPCM & ADM principles-Linear Predictive Coding- Properties of Line codes- Power Spectral Density of Unipolar / Polar RZ & NRZ — Bipolar NRZ — Manchester.

UNIT III BASEBAND TRANSMISSION AND RECEPTION **9**

ISI — Nyquist criterion for distortion less transmission — Pulse shaping — Correlative coding — Eye pattern — Receiving Filters- Matched Filter, Correlation receiver, Adaptive Equalization.

UNIT IV DIGITAL MODULATION SCHEME **9**

Geometric Representation of signals — Generation, detection, Timing Extraction, PSD & BER of Coherent BPSK, BFSK & QPSK — QAM — Carrier Synchronization – Timing Synchronization— Structure of Non-coherent Receivers — Principle of DPSK.

UNIT V ERROR CONTROL CODING **9**

Channel coding theorem — Linear Block codes — Hamming codes — Cyclic codes — Convolutional codes — Viterbi Decoder.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Understand the limits set by information theory

CO2: Understand the various waveform coding schemes

CO3: Design and implement base band transmission schemes

CO4: Design and implement band pass signaling schemes

CO5: Analyze the spectral characteristics of band pass signaling schemes and their noise performance

CO6: Design Error control coding schemes

TEXT BOOKS:

1. Haykin S, Digital Communications, John Wiley, 2005.
2. Sklar B, Digital Communication Fundamentals and Applications, Pearson Education, Second Edition, 2009.

REFERENCES:

1. Proakis J.G, Digital Communication, Tata Mc Graw Hill Company, Fifth Edition, 2018.
2. Lathi B. P, Modern Digital and Analog Communication Systems, Oxford University Press, Third Edition, 2007.
3. Hsu H.P, Schaum's Outline Series – Analog and Digital Communications, Tata Mc Graw Hill Company, Third Edition, 2006.
4. Roody D, Coolen J, Electronic Communications, PHI, Fourth Edition, 2006.
5. Wayne Tomasi - Electronic Communication Systems, Pearson Education India, 2008.

NPTEL LINK: https://nptel.ac.in/courses/108/102/108102120/

COURSE CODE	COURSE TITLE	L	T	P	C
20EC502	DISCRETE TIME SIGNAL PROCESSING	2	2	0	3

OBJECTIVES:

- To learn Discrete Fourier Transform, properties of DFT and its application to linear filtering
- To understand the design of Infinite Impulse Response filters for filtering undesired signals
- To understand the design of Finite Impulse Response filters for filtering undesired signals
- To understand the effects of finite precision representation on digital filters
- To summarize the characteristics of Digital Signal Processors

UNIT I DISCRETE FOURIER TRANSFORM 12

Review of discrete-time signals & systems - DFT and its properties, FFT algorithms & Radix-2 DIT FFT-Radix-2 DIF FFT, Overlap-add & overlap-save methods.

UNIT II DESIGN OF INFINITE IMPULSE RESPONSE FILTERS 12

Analog filters – Butterworth filters, Chebyshev Type I filters (upto 3rd order), Analog Transformation of prototype LPF to BPF /BSF/ HPF, Transformation of analog filters into equivalent digital filters using Impulse invariant method and Bilinear Z transform method- Realization structures for IIR filters - direct, cascade, parallel forms.

UNIT III DESIGN OF FINITE IMPULSE RESPONSE FILTERS 12

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

UNIT IV FINITE WORD LENGTH EFFECTS 12

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 - scaling to prevent overflow.

UNIT V DIGITAL SIGNAL PROCESSORS 12

DSP Architectures Harward, VonNeuman, VLIW, Types of Digital Signal Processors, Pipelining, Multiply and accumulate unit, TMS 320C5X DSP architecture, addressing modes, instruction set and programming.

TOTAL: 60 PERIODS

OUTCOMES:

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

CO1: Apply Discrete Fourier Transform for the analysis of digital signals and systems
CO2: Design and realize a frequency selective digital IIR filters
CO3: Design and realize FIR filters
CO4: Characterize the quantization effects in digital filters
CO5: Analyze the performance degradation of digital signal processing systems due to finite

Precision

CO6: Analyze the architectural details of digital signal processors

TEXT BOOKS:

1. John G. Proakis, Dimitris G. Manolakis, Digital signal processing - principles, algorithms and applications, Pearson Education, Fourth Edition, 2007.
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. A. NagoorKani, Digital Signal Processing , McGraw Hill Education,Second Edition, 2017
4. Salivahanan S, Digital Signal Processing, McGraw Hill Education, Fourth Edition, 2019.
5. Andreas Antoniou,Digital Signal Processing, Tata Mc Graw Hill, 2006.

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

COURSE CODE	COURSE TITLE	L	T	P	C
20EC503	DATA COMMUNICATION NETWORKS	3	0	0	3

OBJECTIVES:

- Understand the division of network functionalities into layers
- Be familiar with the components required to build different types of networks
- Categorize various unicast and multicast protocols and infer their functionalities
- Learn the flow control and congestion control algorithms
- Illustrate the various services offered by the Application layer

UNIT I FUNDAMENTALS & LINK LAYER 9

Overview of Data Communications- Networks – Building Network and its types– Overview of Internet - Protocol Layering - OSI Mode – Physical Layer – Overview of Data and Signals -Introduction to Data Link Layer - Link layer Addressing- Error Detection and Correction.

UNIT II MEDIA ACCESS & INTERNETWORKING 9

Overview of Data link Control and Media access control - Ethernet (802.3) - Wireless LANs – Available Protocols – Bluetooth– WiFi –Zigbee - Network layer services – Packet Switching – IPV4 Address – Network layer protocols (IP, ICMP, Mobile IP).

UNIT III ROUTING 9

Routing - Unicast Routing – Algorithms – Protocols – Multicast Routing and its basics – Overview of Intra-domain and Inter-domain Protocols – Overview of IPv6 Addressing – Transition from IPv4 to IPv6.

UNIT IV TRANSPORT LAYER 9

Introduction to Transport layer –Protocols- User Datagram Protocols (UDP) and Transmission Control Protocols (TCP) –Services – Features – TCP Connection – State Transition Diagram – Flow, Error and Congestion Control - QoS – Application requirements.

UNIT V APPLICATION LAYER 9

Application Layer Paradigms – Client Server Programming – World Wide Web and HTTP - DNS- - Electronic Mail (SMTP, POP3, IMAP, MIME) –Need for Cryptography and Network Security – Firewalls.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Identify the components required to build different types of networks

CO2: Choose the required functionality at each layer for given application

CO3: Identify solution for each functionality at each layer

CO4: Trace the flow of information from one node to another node in the network

CO5: Understand and differentiate the various unicast and multicast protocols for routing data.

CO6: Quote the various utilities of the application layer and identify its functionalities

TEXT BOOKS:

1. Behrouz A. Forouzan, Data Communication and Networking, Fifth Edition, Tata McGraw – Hill, 2013.
2. Andrew S. Tanenbaum & David J. Wetherall, Computer Networks -, Fifth Edition, Pearson Education,2012.

REFERENCES:

1. James F. Kurose, Keith W. Ross, Computer Networking - A Top-Down Approach Featuring the Internet, Seventh Edition, Pearson Education, 2016.
2. Nader. F. Mir, Computer and Communication Networks, Pearson Prentice Hall Publishers, Second Edition, 2014.
3. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker,Computer Networks: An Open-Source Approach, Mc Graw Hill Publisher, 2011.
4. Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Fifth Edition, Morgan Kaufmann Publishers 2011.
5. Tanenbaum Andrew S - Structured Computer Organization, Fifth Edition, Prentice Hall India Learning Private Limited.

NPTEL LINK: https://nptel.ac.in/courses/106/105/106105082/

COURSE CODE	COURSE TITLE	L	T	P	C
20EC504	TRANSMISSION LINES AND WAVE GUIDES	3	0	0	3

OBJECTIVES:

- To introduce the various types of transmission lines and to discuss the losses associated with it
- To give thorough understanding about impedance transformation and matching
- To use the Smith chart in problem solving
- To impart knowledge on characteristic impedance of symmetrical network and various filters
- To summarize different types of waveguides and understand the distribution of electromagnetic fields within waveguides using Maxwell's equations.

UNIT I INTRODUCTION TO TRANSMISSION LINE THEORY 9

Common types of transmission lines used in circuits, lumped circuit model for transmission line, General theory of Transmission lines– general solution – The infinite line – Wavelength, velocity of propagation – Waveform distortion – the distortion less line – Loading and different methods of loading – Line not terminated in Z_0 – Reflection coefficient – calculation of current, voltage, power delivered and efficiency of transmission – Input and Transfer impedance – Open and short circuited lines – Reflection factor and Reflection loss.

UNIT II HIGH FREQUENCY TRANSMISSION LINES 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 – Open and shortcircuited lines – Power and impedance measurement on lines – Reflection losses – Measurement of VSWR and wavelength.

UNIT III IMPEDANCE MATCHING IN HIGH FREQUENCY LINES 9

Impedance matching: Quarter wave transformer – Half wave transformer- Impedance matching by stubs – Single stub and double stub matching – Smith chart – Solutions of problems using Smith chart.

UNIT IV PASSIVE FILTERS 9

Characteristic impedance of symmetrical networks – filter fundamentals, Design of filters: Constant K – Low Pass, High Pass, Band Pass, Band Elimination, m- derived sections – low pass, high pass composite filters.

UNIT V WAVE GUIDES 9

General solutions for TEM, TE and TM waves- Parallel plate waveguide, Rectangular waveguide, Circular waveguide, Characteristics of wave guide- guide wavelength, cut off wave length, cut off frequency, wave impedance, phase constant, phase velocity, group velocity, power and attenuation, Excitation of different modes in waveguides.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Obtain solutions to transmission line equations with characteristic impedance, input impedance and propagation constant.
CO2: Analyze and give thorough understanding about high frequency line, power and impedance measurements.
CO3: Design and interpret the impedance matching transmission line sections using single stub, double stub using Smith Chart.
CO4: Design and analyze various types of filters.
CO5: Analyze the field components of different waveguides based on various modes of E and H field.
CO6: Understand the various excitation modes in waveguides.

TEXT BOOKS:

1. John D Ryder, Networks lines and fields,Second Edition, Pearson,2015.
2. David K. Cheng, Field and Wave Electromagnetics, Second Edition, Pearson, Noida, India,2014.

REFERENCES:

1. Edward C. Jordon and Keith G. Balmain, Electromagnetic waves and Radiating systems, Second Edition, PHI, New York, USA,2015.
2. G.S.N Raju Electromagnetic Field Theory and Transmission Lines, Fourth Edition, Pearson Education, 2013.
3. Joseph Edminister, Electromagnetics, TMH, Second Edition, Schaum's Series, 2017.
4. Umesh Sinha, Transmission Lines and Networks, Filters & Transmission Lines, Sathya Prakash, 2010.
5. Ulaby F.T, Michelson E and Ravaioli U, Fundamentals of Applied Electromagnetics, Sixth Edition, Pearson Education, 2015.

NPTEL LINK:https://nptel.ac.in/courses/117/101/117101056/

COURSE CODE	COURSE TITLE	L	T	P	C
20EC511	COMMUNICATION NETWORKS AND DSP LABORATORY	0	0	4	2

OBJECTIVES:

- To learn to implement the different protocols
- To be familiar with the various routing algorithms
- To use the simulation tool.
- To perform basic signal processing operations such as Linear convolution, Circular convolution, Auto correlation, Cross correlation and Frequency analysis in MATLAB
- To implement FIR and IIR Filters in MATLAB and DSP Processor

LIST OF EXPERIMENTS (CN)

1. Ethernet LAN Protocol
2. Wireless LAN Protocol
3. Implementation of Distance Vector Routing using Packet Tracer
4. Implementation of Link State Routing using Packet Tracer
5. Implementation of Data encryption and decryption
6. Implementation and study of stop and wait, Go-back-N and selective reject protocols
7. Token ring and token bus protocols

LIST OF EXPERIMENTS (DSP)

MATLAB / EQUIVALENT SOFTWARE PACKAGE

8. Generation of elementary Discrete-Time sequences
9. Linear and Circular convolutions
10. Auto correlation and Cross correlation
11. Frequency Analysis using DFT
12. Design of FIR filters (LPF/HPF/BPF/BSF) and demonstrates the filtering operation
13. Design of Butterworth and Chebyshev IIR Filters (LPF/HPF/BPF/BSF) and demonstrates the filtering operations

DSP PROCESSOR BASED IMPLEMENTATION

14. Generation of various signals and random noise
15. Design and demonstration of FIR and IIR Filters

TOTAL: 60 PERIODS

OUTCOMES:

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

CO1: Implement the different protocols

CO2: Implement and compare the various routing algorithms

CO3: Use the simulation tool.

CO4: Carryout basic signal processing operations

CO5: Demonstrate their abilities towards MATLAB based implementation of various DSP systems

CO6: Design and Implement the FIR and IIR Filters in DSP Processor for performing filtering operation over real-time signals

COURSE CODE	COURSE TITLE	L	T	P	C
20EC512	COMMUNICATION SYSTEMS LABORATORY	0	0	4	2

OBJECTIVES:

- To visualize the effects of sampling and TDM
- To implement AM & FM modulation schemes
- To implement and simulate PCM & DM
- To simulate Digital Modulation schemes
- To simulate Error control coding schemes

LIST OF EXPERIMENTS:

1. Signal Sampling and reconstruction
2. Time Division Multiplexing
3. AM Modulator and Demodulator
4. FM Modulator and Demodulator
5. Pulse Code Modulation and Demodulation
6. Delta Modulation and Demodulation
7. Line coding schemes
8. Simulation of ASK, FSK, and BPSK generation schemes
9. Simulation of DPSK, QPSK and QAM generation schemes
10. Simulation of signal constellations of BPSK, QPSK and QAM
11. Simulation of ASK, FSK and BPSK detection schemes
12. Simulation of Linear Block and Cyclic error control coding schemes
13. Simulation of Convolutional coding scheme
14. Communication link simulation

TOTAL: 60 PERIODS

OUTCOMES:

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

CO1: Simulate & validate the various functional modules of a communication system.

CO2: Develop time division multiplexing concepts in real applications.

CO3: Perform experiments in converting analog information into digital data via sampling, quantization, and coding

CO4: Demonstrate their knowledge in base band signaling schemes through implementation of digital modulation schemes.

CO5: Apply various channel coding schemes & demonstrate their capabilities towards the improvement of the noise performance of communication system.

CO6: Simulate end-to-end communication Link

COURSE CODE	COURSE TITLE	L	T	P	C
20EC513	FOUNDATION LAB ON MACHINE LEARNING	0	0	2	1

OBJECTIVES:

- Introduction to Python programming Language
- Implementation of Search Algorithms
- Introduction to Artificial Intelligence
- Introduction to Machine Learning Algorithms
- Introduction to Deep Learning Algorithms

LIST OF EXPERIMENTS

1. Implement A* Search algorithm.
2. Implement AO* Search algorithm.
3. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
4. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
5. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.
6. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
7. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.
8. Developing a face recognition program with Open MV camera.
9. Train a voice recognition model by Tensor Flow and use Arduino Nano BLE 33 Sense to recognize voice and take action for different voice inputs.(Training and running a Machine Learning model)

Select appropriate data set for your experiment and draw graphs

TOTAL: 30 PERIODS

OUTCOMES:

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

CO1:Implement AI algorithms.

CO2: Demonstrate AI algorithms

CO3:Implement ML algorithms

CO4:Demonstrate ML algorithms

CO5:Implement different algorithms

CO6:Evaluate different algorithms

COURSE CODE	COURSE TITLE	L	T	P	C
20CS512	ADVANCED APTITUDE AND CODING SKILLS - I	0	0	2	1

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 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

2. Logical Reasoning – Phase I 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

3. Quantitative Ability - Phase I 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

4. Automata Fix – Phase I Advanced

Logical, Compilation and Code reuse

TOTAL: 30 PERIODS

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
20EC601	VLSI DESIGN	3	0	0	3

OBJECTIVES:

- To study the fundamentals of CMOS circuits and its characteristics.
- To learn the design and realization of combinational digital circuits.
- To learn the design and realization of sequential digital circuits.
- To summarize architectural choices and performance tradeoffs involved in designing and realizing the circuits in CMOS technology
- To learn the different FPGA architectures and testability of VLSI circuits

UNIT I INTRODUCTION TO MOS TRANSISTOR 9

MOS Transistor, CMOS logic, Inverter, Layout Design Rules, Gate Layouts, Stick Diagrams, Long-Channel I-V Characteristics, C-V Characteristics, Non ideal I-V Effects, DC Transfer characteristics, RC Delay Model, Elmore Delay, Linear Delay Model, Logical effort, Parasitic Delay, Delay in Logic Gate, Scaling.

UNIT II COMBINATIONAL MOS LOGIC CIRCUITS 9

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

UNIT III SEQUENTIAL CIRCUIT DESIGN 9

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.

UNIT IV DESIGN OF ARITHMETIC BUILDING BLOCKS AND SUBSYSTEM 9

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

UNIT V IMPLEMENTATION STRATEGIES AND TESTING 9

FPGA Building Block Architectures, FPGA Interconnect Routing Procedures. Design for Testability: Ad Hoc Testing, Scan Design, BIST, IDDQ Testing, Boundary Scan

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Examine the basics of CMOS technology.

CO2: Analyze and discuss the issues in designing Combinational logic circuits.

CO3: Analyze and discuss the issues in designing sequential logic circuits.

CO4: Design of arithmetic building blocks.

CO5: Define the basics of FPGA design.

CO6: Understand the logic of Testing of ICs.

TEXT BOOKS:

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

REFERENCES:

1. M.J. Smith, Application Specific Integrated Circuits‖, Addisson Wesley, 1997.
2. Sung-Mo kang, Yusuf leblebici, Chulwoo Kim ―CMOS Digital Integrated Circuits: Analysis & Design, Fourth Edition McGraw Hill Education,2013.
3. Wayne Wolf, Modern VLSI Design: System On Chip, Pearson Education, 2007.
4. John F walkerly, Digital Design Principles and Practices, Third Edition., PHI/Pearson Education, 2005.
5. Samir Palnitkar, Verilog HDL: A Guide to Digital Design and Synthesis, Prentice Hall PTR Second Edition,2003

NPTEL LINK:https://onlinecourses.nptel.ac.in/noc21_ee09/preview

COURSE CODE	COURSE TITLE	L	T	P	C
20EC602	EMBEDDED SYSTEMS	3	0	0	3

OBJECTIVES:

- Be familiar with the embedded computing platform design and analysis.
- Learn the architecture and programming of ARM processor.
- Be exposed to the basic concepts of real time operating system and scheduling.
- Be familiar with different applications of embedded system
- To learn the applications of embedded systems in various domains.

UNIT I INTRODUCTION TO EMBEDDED SYSTEM DESIGN 9

Complex systems and microprocessors– Embedded system design process –Design example: Model train controller- Design methodologies- Design flows – Requirement Analysis – Specifications-System analysis and architecture design – Quality Assurance techniques -Designing with computing platforms – consumer electronics architecture –platform-level performance analysis.

UNIT II ARM PROCESSOR AND PERIPHERALS 9

ARM Architecture Versions – ARM Architecture – Instruction Set – Stacks and Subroutines – Features of the LPC 214X Family – Peripherals – The Timer Unit – Pulse Width Modulation Unit – UART – Block Diagram of ARM9 and ARM Cortex M3 MCU.

UNIT III EMBEDDED PROGRAMMING 9

Components for embedded programs- Models of programs- Assembly, linking and loading – compilation techniques- Program level performance analysis – Software performance optimization – Program level energy and power analysis and optimization – Analysis and optimization of program size- Program validation and testing.

UNIT IV PROCESSES AND OPERATING SYSTEMS 9

Introduction – Multiple tasks and multiple processes – Multirate systems- Preemptive real time operating systems- Priority based scheduling- Interprocess communication mechanisms – Evaluating operating system performance- power optimization strategies for processes –Example Real time operating systems-POSIX-Windows CE. – Distributed embedded systems .

UNIT V APPLICATIONS OF EMBEDDED SYSTEMS 9

Data compressor - Alarm clock - Audio player - Software modem-Digital still camera - Telephone answering machine-Engine control unit – Video accelerator.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Acquire knowledge on basic components of embedded system design

CO2: Analyze the concepts of embedded systems.

CO3: Describe the architecture and programming of ARM processor.

CO4:.Use the system design techniques to develop software for embedded systems.

CO5: Acquire knowledge on fundamentals of RTOS and its various scheduling policies

CO6: Model real-time consumer/industrial applications using embedded-system concepts

TEXT BOOKS:

1. Marilyn Wolf, Computers as Components, Principles of Embedded Computing System Design, Fourth Edition, Morgan Kaufmann Publisher (An imprint from Elsevier), 2016.
2. Alexander G. Dean, Embedded Systems Fundamentals with Arm Cortex-M based Microcontrollers: A Practical Approach, ARM Education media, Paperback ,2017

REFERENCES:

1. LylaB. Das,Embedded Systems: An Integrated Approach Pearson Education, 2013.
2. JonathanW.V alvano,―Embedded Microcomputer Systems Real Time Interfacing, Second Edition Cengage Learning,2012.
3. Raymond J.A.Buhr, DonaldL. Bailey,―An Introduction to Real-Time Systems-From Design to Networking with C/C++, PrenticeHall,1999.
4. C.M.Krishna, Kang G.Shin,―Real-time Systems, International Editions,McGraw Hill 1997
5. Sriram V Iyer, Pankaj Gupta, Embedded Real Time Systems Programming, Tata McGraw Hill, 2017.

NPTEL LINK :https://nptel.ac.in/courses/106/105/106105193/

COURSE CODE	COURSE TITLE	L	T	P	C
20EC603	WIRELESS COMMUNICATIONS	3	0	0	3

OBJECTIVES:

- 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.

UNIT II 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, p/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

Equalisation – 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

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. UpenaDalal, Wireless Communication, Oxford University Press,2009.
2. Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2007.
3. Simon Haykin& Michael Mohar, Modern Wireless Communications Pearson Education, 2007.
4. David Tse and Pramod Viswanath, Fundamentals of Wireless Communication, Cambridge University Press, 2005 .
5. Van Nee, R. and Ramji Prasad, OFDM for wireless multimedia communications, Artech House, 2000 .

NPTEL LINK:https://onlinecourses.nptel.ac.in/noc22_ee65/preview

COURSE CODE	COURSE TITLE	L	T	P	C
20EC604	ANTENNA AND WAVE PROPAGATION	3	0	0	3

OBJECTIVES:

- To give insight of the fundamental characteristics and parameters of antennas
- To give a thorough understanding of the radiation characteristics of different types of HF and VHF antennas
- To understand operating principles and design concepts of antenna arrays
- To design & analyze microwave frequency antennas and also to bring awareness of antenna applications in various types of communication
- To create an awareness about the different types of propagation of radio waves at different frequencies

UNIT I FUNDAMENTALS OF RADIATION 9

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

UNIT II HF AND VHF ANTENNAS 9

Wire Antennas, Short dipole, Halfwave dipole, Folded dipole, V-antenna, Rhombic antenna, Loop antenna, Yagi-Uda antenna

UNIT III ANTENNA ARRAYS 9

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

UNIT IV UHF AND MICROWAVE ANTENNAS 9

Principle of frequency independent antennas –Spiral antenna, Helical antenna, Log periodic antenna. Radiation from rectangular apertures, Horn antenna, Reflector antenna, Slot antennas, Micro strip antenna, EBG structure, Frequency Reconfigurable antennas, Dielectric antennas.

UNIT V PROPAGATION OF RADIO WAVES 9

Modes of propagation , Structure of atmosphere , Ground wave propagation , Space wave propagation, Tropospheric propagation ,Sky wave propagation ,Ionospheric propagation-Structure of Ionosphere, Skip distance, Virtual height, critical frequency , Maximum usable frequency,Fading.

TOTAL: 45 PERIODS

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 wired antennas and dipoles.

CO3: Design and analyze antenna arrays

CO4: Design and analyze special antennas such as frequency independent and aperture antennas

CO5: Identify the type of radio-wave propagation for different communication.

CO6: Appropriate identification of an antenna for a specific application.

TEXT BOOKS:

1. J. D. Krauss, R. J. Marhefka and A. S. Khan, Antenna and Wave Propagation, Fourth Edition, Tata McGraw-Hill, New Delhi, India,2012.
2. Warren L. Stutzman and Gary A. Thiele, Antenna theory and Design, Third Edition, Wiley & Sons, New York, USA, 2013.

REFERENCES:

1. Edward C. Jordan and Keith G. Bal main, Electromagnetic Waves and Radiating Systems, Second Edition ,Prentice Hall of India, 2015.
2. Constantine.A.Balanis, Antenna Theory Analysis and Design,Third Edition, Wiley & Sons, New York, USA, 2016.
3. Rajeswari Chatterjee, Antenna Theory and Practice, Second Edition, New Age International Publishers, 2006.
4. Robert S. Elliott Antenna Theory and Design Wiley Student Edition, 2006.
5. Albert Sabban, Wideband RF Technologies and Antennas in Microwave Frequencies, Wiley, New York USA, 2016.

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

COURSE CODE	COURSE TITLE	L	T	P	C
20EC611	EMBEDDED SYSTEMS AND RTOS LABORATORY	0	0	4	2

OBJECTIVES:

- To learn the working of ARM processor
- To understand the Building Blocks of Embedded Systems
- To learn the concept of memory map and memory interface
- To write programs to interface memory, I/Os with processor
- To study the interrupt performance

LIST OF EXPERIMENTS:

1. Study of ARM evaluation system
2. ADC interfacing using ARM.
3. DAC interfacing using ARM.
4. Interfacing LED and PWM using ARM.
5. Interfacing real time clock and serial port.
6. Interfacing keyboard and LCD.
7. Interfacing EPROM using ARM .
8. Interrupt pooling using ARM.
9. Interrupt performance characteristics of ARM and FPGA.
10. Flashing of LEDS.
11. Interfacing stepper motor and temperature sensor.
12. Implementing zigbee protocol with ARM.

TOTAL: 60 PERIODS

OUTCOMES:

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

CO1: Understand ARM processor and Building Blocks of Embedded Systems

CO2: Write programs in ARM for a specific Application

CO3: Interface memory, A/D and D/A convertors with ARM system

CO4: Analyze the performance of interrupt

CO5: Write program for interfacing keyboard, display, motor and sensor.

CO6: Formulate a mini project using embedded system

COURSE CODE	COURSE TITLE	L	T	P	C
20EC612	VLSI DESIGN LABORATORY	0	0	4	2

OBJECTIVES:

- To learn Hardware Descriptive Language (Verilog/VHDL)
- To learn the fundamental principles of VLSI circuit design in digital and analog domain
- To familiarize fusing of logical modules on FPGAs
- To develop familiarity and confidence with designing, and testing digital circuits.
- To provide hands on design experience with professional design (EDA) platforms.

LIST OF EXPERIMENTS:

DIGITAL SUBSYSTEM DESIGN USING HDL

1. Design of 4-Bit Ripple Carry Adder & 4-Bit Carry Look Ahead Adder
2. Design of 4-Bit Array Multiplier & 4-Bit Booth Multiplier
3. Design of 4-Bit ALU
4. Design of 4-Bit Synchronous Up/Down Counter & 4-Bit Ripple Counter
5. Design of 4-Bit Universal Shift Register
6. Design of Moore and Mealy FSMs

For the experiments 1 – 6,

- Use VHDL/Verilog to model either in structural and/or behavioral domains
- Simulate it using by Xilinx/Altera Software
- Implement by Xilinx/Altera FPGA
- Verify the functionality using Xilinx/Altera FPGA Trainer Kit

CMOS DIGITAL CIRCUIT DESIGN

7. Basic CMOS gates
8. CMOS Latches & Flip Flops using the Cells developed in Expt. No. 7
9. Half Adder, Full Adder, Half Subtractor& Full Subtractor using the Cells developed in Expt. No. 7
10. 4-Bit Synchronous Up/Down Counter using the Cells developed in Expt. No. 8

For the experiments 7 – 10,

- Design & Construct at circuit level
- Perform Post Layout Simulation to perform static and dynamic analysis
- CAD Tools: Cadence/mentor Graphics/Mentor Graphics/Tanner

TOTAL: 60 PERIODS

OUTCOMES:

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

CO1: Write HDL code for basic as well as advanced digital integrated circuit
CO2: Import the logic modules into FPGA Boards
CO3: Synthesize Place and Route the digital IPs
CO4: Design and Simulate Digital & Analog ICB locks using EDA tools
CO5: Extract the layouts of Digital & Analog ICB locks using EDA tools
CO6: To anlayze the results of logic and timing simulations and to use theses simulation results to debug digital systems.

COURSE CODE	COURSE TITLE	L	T	P	C
20EC613	INNOVATIVE/MULTI DISCIPLINARY PROJECTS	0	0	2	1

OBJECTIVES:

- To propose and select the appropriate and cost-effective solution for technical project.
- To analyze the various methodologies and technologies and discuss with team for solving the problem.
- To design, Implement, test and verify the engineering solution related to problem definition.
- To develop hardware or software and select appropriate modern tools for their project specific problem.
- To Compile, Comprehend and Present the work carried out

Course Evaluation

Project final report	30%
Presentation/Simulation	30%
Demonstration	20%
Viva voce	20%

OUTCOMES:

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

CO1: Identify challenging practical problems, solutions to cope up with present scenario of Electronics and Communication Engineering field.

CO2: Illustrate the different frameworks for project management and its control techniques.

CO3: Apply technical knowledge and project management skills for solving the problem.

CO4: analyze the technical aspects of the project with a comprehensive and systematic approach.

CO5: Explain the different techniques for managing the project life cycle and cost estimation.

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

COURSE CODE	COURSE TITLE	L	T	P	C
20CS614	ADVANCED APTITUDE AND CODING SKILLS - II	0	0	2	1

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 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

2. 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

3. 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

4. Automata Fix – Phase II Advanced

Logical, Compilation and Code reuse

5. Automata - 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

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..

PROFESSIONAL ELECTIVES (PE)*
SEMESTER V
ELECTIVE – I

COURSE CODE	COURSE TITLE	L	T	P	C
20EC901	SENSORS, ACTUATORS AND INTERFACES	3	0	0	3

OBJECTIVES:

- To understand static and dynamic characteristics of measurement systems.
- To study various types of sensors.
- To compare the performance of self-generating sensors
- To examine different types of actuators and their usage.
- To study State-of-the-art digital and semiconductor sensors.

UNIT I INTRODUCTION TO MEASUREMENT SYSTEMS 9

Introduction to measurement systems: general concepts and terminology, measurement systems, sensor classification, general input-output configuration, methods of correction, performance characteristics: static characteristics of measurement systems, systematic errors, random errors, dynamic characteristics of measurement systems: zero-order, first-order, and second-order measurement systems and response.

UNIT II RESISTIVE AND REACTIVE SENSORS 9

Resistive sensors: potentiometers, strain gages, resistive temperature detectors, magneto resistors, light-dependent resistors, Signal conditioning for resistive sensors: Wheatstone bridge, sensor bridge calibration and compensation, Instrumentation amplifiers, sources of interference and interference reduction, Reactance variation and electromagnetic sensors, capacitive sensors, differential, inductive sensors, linear variable differential transformers (LVDT), magneto elastic sensors, hall effect sensors, Signal conditioning for reactance-based sensors .

UNIT III SELF-GENERATING SENSORS 9

Self-generating sensors: thermoelectric sensors, piezoelectric sensors, pyroelectric sensors, photovoltaic sensors, electrochemical sensors, Signal conditioning for self-generating sensors: chopper and low-drift amplifiers, offset and drifts amplifiers, electrometer amplifiers.

UNIT IV ACTUATORS DRIVE CHARACTERISTICS AND APPLICATIONS 9

Relays, Solenoid drive, Stepper Motors, Voice-Coil actuators, Servo Motors, DC motors and motor control, 4-to-20 mA Drive, Hydraulic actuators, variable transformers: synchros, resolvers, Inductosyn, resolver-to-digital and digital-to-resolver converters.

UNIT V DIGITAL SENSORS AND SEMICONDUCTOR DEVICE SENSORS 9

Digital sensors: position encoders, variable frequency sensors – quartz digital thermometer, vibrating wire strain gages, saw sensors, digital flow meters, Sensors based on semiconductor junctions: thermometers based on semiconductor junctions, magneto diodes and magneto transistors, photodiodes and phototransistors, sensors based on MOSFET transistors, CCD imaging sensors , ultrasonic sensors, fiber-optic sensors.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Summarize the static and dynamic characteristics of measurements.

CO2: Correlate various resistive sensors

CO3: Interpret reactive and capacitive sensors

CO4: Analyze the performance of self-generating sensors.

CO5: Infer different types of self-generating sensors

CO6: Describe digital and semiconductor sensors.

TEXT BOOKS:

1. Andrzej M. Pawlak Sensors and Actuators in Mechatronics Design and Applications, 2006.
2. E.O. Doeblin, Measurement System : Applications and Design, McGraw Hill publications,2003.

REFERENCES:

1. Curtis D. Johnson, Process Control Instrumentation Technology, Eighth Edition, Pearson Education Limited 2014
2. D.Patranabis, Sensors and Transducers, TMH 2003.
3. Graham Brooker, Introduction to Sensors for ranging and imaging, Yesdee, 2009.
4. Herman K.P. Neubrat, Instrument Transducers , An Introduction to Their Performance and Design, Oxford University Press. 1999
5. Jon Wilson , Sensor Technology Handbook, Newne 2004.

NPTEL LINK:https://nptel.ac.in/courses/108/105/108105064/

COURSE CODE	COURSE TITLE	L	T	P	C
20ME927	TOTAL QUALITY MANAGEMENT	3	0	0	3

OBJECTIVES:

Students completing this course are expected to:

- Understand the techniques for the implementation of quality management in manufacturing and services processes.
- Explain the Quality Management principles and process.
- Discuss the importance of Quality in an organization.
- Understand the ISO Quality systems.
- Summarise 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 - Internal Audits - Registration- ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction - ISO 14000 Series Standards - Concepts of ISO 14001 - Requirements of ISO 14001 - Benefits of EMS.

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TOTAL: 45 PERIODS

OUTCOMES:

After successful completion of the course, the students 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 Third Edition, Indian Reprint, Sixth Impression, 2020.

REFERENCES:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", Eighth Edition, 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.
4. ISO 9001-2015 standards

COURSE CODE	COURSE TITLE	L	T	P	C
20CS401	COMPUTER ARCHITECTURE	3	0	0	3

OBJECTIVES:

- To know the basic principles and operations of digital computers.
- To design Arithmetic and Logic Unit for various fixed and floating point operations
- To develop pipeline architectures for RISC Processors.
- To understand Various Memory systems & I/O interfacings
- To understand Parallel Processor and Multi-Processor Architectures

UNIT I COMPUTER FUNDAMENTALS 9

Computer Types - Functional Units — Basic Operational Concepts — Number Representation and Arithmetic Operations - Performance Measurement — Instruction Set Architecture - Memory Locations and Addresses - Instructions and Instruction Sequencing - Addressing Modes.

UNIT II COMPUTER ARITHMETIC 9

Addition and Subtraction of Signed Numbers - Design of Fast Adders - Multiplication of Unsigned Numbers - Multiplication of Signed Numbers - Fast Multiplication - Integer Division - Floating-Point Numbers and Operations.

UNIT III BASIC PROCESSING UNIT AND PIPELINING 10

Basic Processing Unit: Concepts - Instruction Execution - Hardware Components - Instruction Fetch and Execution Steps -Control Signals - Hardwired Control.
Pipelining: Basic Concept - Pipeline Organization- Pipelining Issues - Data Dependencies - Memory Delays - Branch Delays - Resource Limitations - Performance Evaluation -Superscalar Operation.

UNIT IV I/O AND MEMORY 8

Input/Output Organization: Bus Structure - Bus Operation - Arbitration - Interface Circuits - Interconnection Standards - USB, SATA. The Memory System: Basic Concepts - Semiconductor RAM Memories - Read-only Memories - Direct Memory Access - Memory Hierarchy - Cache Memories - Performance Considerations - Virtual Memory - Memory Management Requirements - Secondary Storage.

UNIT V PARALLEL PROCESSING AND MULTICORE COMPUTERS 9

Parallel Processing: Use of Multiple Processors - Symmetric Multiprocessors - Cache Coherence - Multithreading and Chip Multiprocessors - Clusters - Nonuniform Memory Access Computers - Vector Computation - Multicore Organization.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Understand the basic principles and operations of digital computers.
- Design Arithmetic and Logic Unit to perform fixed and floating point operations
- Develop pipeline architectures for RISC Processors.
- Understand Various Memory systems & I/O interfacings.
- Understand Parallel Processor and Multi Processor Architectures

TEXTBOOKS:

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Computer organization, Tata McGraw Hill, Sixth Edition, 2012.
2. David A. Patterson and John L. Hennessy Computer Organization and Design-The Hardware/Software Interface Fifth Edition, Morgan Kaufmann, 2013.

3. Reinforcement Learning, second edition, An Introduction, Richard S. Sutton, Andrew G. Barto, 2018.

REFERENCES:

1. John P.Hayes, Computer Architecture and Organization, Third Edition, TataMcGraw Hill, 2012
2. David A. Patterson and John L. Hennessy Computer Organization and Design-The Hardware/Software Interface, Sixth Edition, Morgan Kaufmann, 2021.
3. John L. Hennessy and David A. Patterson, Computer Architecture – A Quantitate Approach, Morgan Kaufmann / Elsevier Publishers, Fifth Edition,2012.

COURSE CODE	COURSE TITLE	L	T	P	C
20CS401	COMPUTER ARCHITECTURE	3	0	0	3

OBJECTIVES:

- To describe the basic principles and operations of digital computers.
- To design arithmetic and logic unit for various fixed and floating point operations
- To construct pipeline architectures for RISC processors.
- To explain various memory systems & I/O interfacings
- To discuss parallel processor and multi-processor architectures

UNIT I COMPUTER FUNDAMENTALS **9**

Computer Types - Functional Units − Basic Operational Concepts − Number Representation and Arithmetic Operations - Performance Measurement − Instruction Set Architecture - Memory Locations and Addresses - Instructions and Instruction Sequencing – Addressing Modes.

UNIT II COMPUTER ARITHMETIC **9**

Addition and Subtraction of Signed Numbers - Design of Fast Adders - Multiplication of Unsigned Numbers - Multiplication of Signed Numbers - Fast Multiplication - Integer Division -Floating-Point Numbers and Operations.

UNIT III BASIC PROCESSING UNIT AND PIPELINING **10**

Basic Processing Unit: Concepts - Instruction Execution - Hardware Components – Instruction Fetch and Execution Steps -Control Signals - Hardwired Control.

Pipelining: Basic Concept - Pipeline Organization- Pipelining Issues - Data Dependencies -Memory Delays - Branch Delays - Resource Limitations - Performance Evaluation –Superscalar Operation.

UNIT IV I/O AND MEMORY **8**

Input/Output Organization: Bus Structure - Bus Operation - Arbitration - Interface Circuits -Interconnection Standards - USB, SATA. The Memory System: Basic Concepts - Semiconductor RAM Memories - Read-only Memories - Direct Memory Access – Memory Hierarchy - Cache Memories - Performance Considerations - Virtual Memory – Memory Management Requirements - Secondary Storage.

UNIT V PARALLEL PROCESSING AND MULTICORE COMPUTERS **9**

Parallel Processing: Use of Multiple Processors - Symmetric Multiprocessors - Cache Coherence-Multithreading and Chip Multiprocessors - Clusters - Nonuniform Memory Access Computers- Vector Computation - Multicore Organization.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Explain the basic principles and operations of digital computers.
CO2: Design Arithmetic and Logic Unit to perform fixed and floating point operations
CO3: Develop pipeline architectures for RISC Processors.
CO4: Summarize Various Memory systems & I/O interfacings.
CO5: Recognize Parallel Processor and Multi Processor Architectures

TEXT BOOKS:

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Computer organization, Tata McGraw Hill, Sixth Edition, 2012.
2. David A. Patterson and John L. Hennessy Computer Organization and Design-The Hardware/Software Interface Fifth Edition, Morgan Kaufmann, 2013.

REFERENCES:

1. John P.Hayes, Computer Architecture and Organization, Third Edition, TataMcGraw Hill, 2012.
2. David A. Patterson and John L. Hennessy Computer Organization and Design-The Hardware/Software Interface, Sixth Edition, Morgan Kaufmann, 2021.
3. John L. Hennessy and David A. Patterson, Computer Architecture – A Quantitate Approach, Morgan Kaufmann / Elsevier Publishers, Fifth Edition,2012.

COURSE CODE	COURSE TITLE	L	T	P	C
20EC902	ADVANCED MICROPROCESSORS AND MICROCONTROLLERS	3	0	0	3

OBJECTIVES:

- To gain knowledge on the architecture of Intel 32- and 64-bit microprocessors and salient features associated with them.
- To familiarize the features, specification of modern microcontrollers.
- To gain knowledge on the 32 bit microcontrollers based ARM architecture.
- To introduce the concept of RISC and CISC microcontrollers.
- To study the architecture of PIC and MSP430 family microcontrollers

UNIT I HIGH PERFORMANCE CISC ARCHITECTURES 9

Introduction to IA-32 architecture – Intel Pentium Processors family tree – MemoryManagement – Branch prediction logic - Superscalar architecture – Hyper threading technology– 64 bit extension technology – Intel 64 bit architecture - Intel Core processor family tree –Turbo boost technology – Smart cache - features of Nehalem microarchitecture.

UNIT II HIGH PERFORMANCE RISC ARCHITECTURE – ARM 9

RISC architecture merits and demerits – The programmer's model of ARM Architecture – 3-stage pipeline ARM organization– ARM instructionexecution – Salient features of ARM instruction set - ARM architecture profiles (A, R and Mprofiles).

UNIT III ARM CORTEX PROCESSORS 9

Introduction to the Cortex-M Processor Family - ARM 'Cortex-M3' architecture formicrocontrollers – Thumb 2 instruction technology – Internal Registers - Nested VectoredInterrupt controller - Memory map - Interrupts and exception handling – Applications of CortexM3architecture

UNIT IV MSP430 MICROCONTROLLERS 9

Functional Block diagram of MSP430F2003 - Memory Mapped CPU, Exceptions, Architectureof MSP430 - Processor Addressing Modes - Instruction Set, Interrupts, Digital in-outs, Timer,Communication interfaces.

UNIT V PIC MICROCONTROLLER 9

CPU architecture – Instruction set – Interrupts – Timer I2C Interfacing – UART – A/D Converter – PWM and introduction to C-Compilers.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Explain the salient features of CISC microprocessors based on IA-32 bit and IA-64 bit architectures

CO2: Explain the salient features of RISC processors based on ARM architecture and different application profiles of ARM core

CO3: Explain about ARM – M3 architecture and its salient features.

CO4: Implement designs using MSP430 and ARM processors.

CO5: Discriminate RISC and CISC processors, and work with PIC microcontrollers

CO6: Design and develop microcontroller based smart electronic system and home appliances.

TEXT BOOKS:

1. Barry B Breg, The Intel Microprocessors, PHI, 2008.
2. Steve Furber, ARM System – On – Chip architecture, Addision Wesley, 2000.

REFERENCES:

1. Intel Inc, Intel 64 and IA-32 Architectures Developers Manual, Volume-I, 2016.
2. Joseph Yiu, The Definitive Guide to the ARM ® Cortex-M3, Newnes, 2010.
3. John H Davies, MSP430 Microcontroller Basics, Elsevier, 2008.
4. Trevor Martin, The Designers Guide to the Cortex-M Processor Family, Newnes,2013.
5. John .B.Peatman , Design with PIC Microcontroller, Prentice Hall, 1997.

NPTEL LINK:https://onlinecourses.nptel.ac.in/noc22_ee12/preview

COURSE CODE	COURSE TITLE	L	T	P	C
20EC903	INTRODUCTION TO NANO SCIENCE AND NANO TECHNOLOGY	3	0	0	3

OBJECTIVES:

- Understand the fundamentals of nanotechnology
- Give a general introduction to different classes of nanomaterials
- Improve their knowledge on various synthesis methods of nanomaterials
- Understand characterization techniques involved in nanotechnology
- Familiarize themselves with nanotechnology potentialities

UNIT I BASICS AND SCALE OF NANOTECHNOLOGY 9

Introduction and scientific revolutions, Time and length scale in structures, Definition of a nanosystem, Dimensionality and size dependent phenomena, Surface to volume ratio, Fraction of surface atoms and surface energy, Surface stress and surface defects, Properties at nanoscale – optical & mechanical, Properties at nanoscale – electronic & magnetic.

UNIT II DIFFERENT CLASSES OF NANOMATERIALS 9

Classification based on dimensionality, Quantum dots, wells and wires, Carbon-based nano materials – fullerences and buckyballs, Carbon nanotubes and graphene, Metal based nano materials – Nanogold and Nanosilver, Metal oxide based nano materials, Nanocomposites and nanopolymers, Nanoglasses and nano ceramics, Biological nanomaterials.

UNIT III SYNTHESIS OF NANOMATERIALS 9

Chemical methods: Metal nanocrystals by reduction, Solvothermal synthesis and photochemical synthesis, Sonochemical routes and chemical vapor deposition (CVD), Metal oxide chemical vapor deposition (MOCVD), Physical methods: Ball milling, Electrodeposition techniques, Spray pyrolysis and flame pyrolysis, DC/RF magnetron sputtering, Molecular beam epitaxy (MBE).

UNIT IV FABRICATION AND CHARACTERIZATION OF NANOSTRUCTURES 9

Nanofabrication: Photolithography and its limitation and electron beam lithography (EBL), Nanoimprinting and soft lithography patterning, Characterization: Field emission scanning electron microscopy (FESEM) and environmental scanning electron microscopy (ESEM), High resolution transmission electron microscope (HRTEM), Scanning tunneling microscope (STM), Surface enhanced raman spectroscopy (SERS), X-ray photoelectron spectroscopy (XPS), Auger electron spectroscopy (AES), Rutherford backscattering spectroscopy (RBS).

UNIT V MICROTECHNOLOGIES AND NANOTECHONOLOGY 9

Immobilization of biological elements-Transduction principles-Lab-on-chip sensors-Integrated sensors: system organization and functions-Interface electronics-Universal transducer interface-Microtechnologies: introduction to microsystems engineering-Systems development: methods and tools, constructive andconnective techniques- Nanotechnology: product prospects - application trends-Procedures and techniques: the making of ultrathin films.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Identify the basics and scale of nanotechnology.

CO2: Analyze the different classes of nanomaterials.

CO3: Apply synthesis of nanomaterials.

CO4: Analyze the fabrication and characterization of nanostructures.

CO5: Use of sensors in nanotechnology

CO6: Discuss the application of micro technologies and nanotechnology.

TEXT BOOKS:

1. T. Pradeep, A Textbook of Nanoscience and Nanotechnology, Tata McGraw Hill Education Pvt. Ltd.,2012.
2. Hari Singh Nalwa, Nanostructured Materials and Nanotechnology, Academic Press, 2008.

REFERENCES:

1. C.Dupas, P.Houdy, M.Lahmani, Nanoscience: Nanotechnologies and Nanophysics, Springer-Verlag Berlin Heidelberg, 2007.
2. A. S. Edelstein and R. C. Cammarata, Nanomaterials: Synthesis, Properties and Applications, Institute of Physics Pub., 2001.
3. Jacob Fraden, Handbook of Modern Sensors: Physics, Designs, and Applications, Springer; Fourth Edition 2010.
4. Gerard Meijer, Smart sensor systems, Wiley, 2008.
5. W Gopel, J. Hesse, J. N. Zemel, Sensors A Comprehensive Survey Vol. 9, Wiley-VCH, 1995.

NPTEL LINK:https://nptel.ac.in/courses/118/104/118104008/

SEMESTER VI
ELECTIVE – II

COURSE CODE	COURSE TITLE	L	T	P	C
20EC904	INTRODUCTION TO MEMS AND NEMS	3	0	0	3

OBJECTIVES:

- To understand the concepts of micro electromechanical devices and quantum mechanics
- To learn the fabrication process of Microsystem
- To understand design concepts of microsensors and nano sensors
- To understand design of micro actuators and nano actuators.
- To understand the packaging and characterization of MEMS/NEMS.

UNIT I INTRODUCTION TO MEMS AND NEMS 9

Introduction to micro systems, Advantages of MEMS, Materials for MEMS. Potential applications of MEMS and NEMS. Introduction to NEMS, Issues of nano scaling, Giant magneto resistance and multilayer structures, Nano structured materials, Atomic structures and Quantum mechanics, Schrodinger Equation and Wave function Theory

UNIT II FABRICATION OF MEMS AND NEMS 9

Photolithography, Ion Implantation, Diffusion, Oxidation. Thin film depositions: LPCVD, Sputtering, Evaporation, Electroplating; Etching techniques: Dry and wet etching, electrochemical etching; Micromachining: Bulk Micromachining, Surface Micromachining, LIGA, SOI MUMPS.

UNIT III MICRO AND NANO SENSORS 9

Acoustic sensor – Quartz crystal microbalance, surface acoustic wave, Flextural plate wave, shear horizontal; Vibratory gyroscope, Capacitive and Piezo Resistive Pressure sensors, Nano gas sensor.

UNIT IV MICRO AND NANO ACTUATORS 9

Electrostatic actuators – parallel plate capacitor, Interdigitated finger capacitor, piezoelectric actuators, Thermal actuators, Actuators using shape memory alloys; Microgrippers, Micromotors, Microvalves, Micropumps, Nano energy harvester.

UNIT V PACKAGING AND CHARACTERIZATION OF MEMS AND NEMS 9

Micro / nano systems packaging, Essential packaging technologies, Selection of packaging materials; SEM, TEM, AFM, STM, Spectroscopic techniques for Nano characterization.

TOTAL: 45 PERIODS

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

CO1: Understand the basics of micro/nano electromechanical structures, devices and systems including their theoretical foundations, applications and advantages.

CO2: Recognize the use of materials in micro/nano fabrication and describe the fabrication processes including surface micromachining, bulk micromachining and LIGA.

CO3: Analyze the key performance aspects of micro/nano electromechanical transducers.

CO4: Infer the structure, construction and working applications of nano sensors and nano actuators.

CO5: Understand the techniques for characterization and packaging requirements of MEMS/NEMS.

CO6: Discover the various spectroscopic techniques for characterization of nano particles.

TEXT BOOKS:

1. Sergey Edward Lyshevski, MEMS and NEMS: Systems, Devices, and Structures, CRC Press, 2002.
2. Chang Liu, Foundations of MEMS, Pearson education India limited, 2006.

REFERENCES:

1. Vinod Kumar Khanna Nanosensors: Physical, Chemical, and Biological, CRC press, 2012.

2. Tai Ran Hsu, MEMS and Microsystems Design and Manufacture, Tata Mcgraw Hill, 2002.

3. Mahalik N P, MEMS, Tata McGraw Hill, 2007.

4. Manouchehr E Motamedi, MOEMS: Micro-Opto-Electro-Mechanical Systems, SPIE press, First Edition, 2005.

5. John A Pelesco, David H Bernstein : Modeling MEMS and NEMS, CRC Press Inc, First Edition, 2002.

NPTEL LINK: https://nptel.ac.in/courses/117/105/117105082/

COURSE CODE	COURSE TITLE	L	T	P	C
20EC905	CRYPTOGRAPHY AND NETWORK SECURITY	3	0	0	3

OBJECTIVES:

- To understand the basics of network security and its architecture.
- To analyze the various Symmetric Key Cryptography algorithms.
- To analyze the various Public Key Cryptography algorithms.
- To analyze the various authentication algorithms in real time applications.
- To understand the different network security schemes and its security standard.

UNIT I INRODUCTION **9**

Security trends - Legal, Ethical and Professional Aspects of Security, Need for Security at Multiple levels, Security Policies - Model of network security – Security attacks, services and mechanisms – OSI security architecture – Classical encryption techniques: substitution techniques, transposition techniques, steganography,Key Range and Key Size - Foundations of modern cryptography: perfect security – information theory– cryptanalysis.

UNIT II SYMMETRIC KEY CRYPTOGRAPHY **9**

MATHEMATICS OF SYMMETRIC KEY CRYPTOGRAPHY: Algebraic structures - Modular arithmetic - Euclid's algorithm- Congruence and matrices

SYMMETRIC KEY CIPHERS: SDES – Block cipher Principles of DES – Strength of DES - Block cipher design principles – Block cipher mode of operation – Differential and linear cryptanalysis - Evaluation criteria for AES – Advanced Encryption Standard

UNIT III PUBLIC KEY CRYPTOGRAPHY **9**

MATHEMATICS OF ASYMMETRIC KEY CRYPTOGRAPHY: Primes – Primality Testing – Factorization – Euler's totient function, Fermat's and Euler's Theorem - Chinese Remainder Theorem –- ASYMMETRIC KEY CIPHERS: RSA cryptosystem – Key distribution – Key management – Diffie Hellman key exchange - ElGamal cryptosystem.

UNIT IV MESSAGE AUTHENTICATION AND INTEGRITY **9**

Authentication requirement – Authentication function – MAC – Introduction to cryptographic hash algorithms. Hash function – Security of hash function and MAC – SHA –Digital signature and authentication protocols – DSS- Entity Authentication: Biometrics, Passwords, Challenge Response protocols.

UNIT V SECURITY PRACTICE AND SYSTEM SECURITY **9**

Electronic Mail security – PGP, S/MIME – IP security, IP Security Architecture - SYSTEM SECURITY: Malicious software – viruses, Worms, Attack agents – Firewalls.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Understand the fundamentals of networks security, security architecture, threats and vulnerabilities

CO2: Apply the different cryptographic operations of symmetric cryptographic algorithms.

CO3: Apply the different cryptographic operations of public key cryptography.

CO4: Apply the various Authentication schemes to simulate different applications.

CO5: Understand various challenges for cybersecurity practices.

CO6: Describe some System security standards.

TEXT BOOKS:

1. William Stallings ,Cryptography and Network Security: Principles and Practice, Sixth Edition, Pearson, ISBN13:9780133354690, 2014

2. Behrouz A. Forouzan and Debdeep Mukhopadhyay, Cryptography and Network Security, Second Edition, Tata McGraw Hill, 2013

REFERENCES:

1. C K Shyamala, N Harini and Dr. T R Padmanabhan: Cryptography and Network Security, Wiley India Pvt.Ltd

2.. H. C. A. van Tilborg, Fundamentals of Cryptology, Kluwer Academic Publishers, 2000.

3.P. Garrett, Making and Breaking Codes: An Introduction to Cryptology, Prentice-Hall, 2001

4. W. Cheswick, S. Bellovin and A. Rubin, Firewalls and Internet Security. Repelling the Wiley Hacker, 2nd Ed, Addison-Wesley, 2003.

5. C. Kauffman, R. Perham and M. Speciner, Network Security: Private Communication in a Public World, Prentice-Hall, 1994.

NPTEL LINK:https://nptel.ac.in/courses/106/105/106105162/

COURSE CODE	COURSE TITLE	L	T	P	C
20EC906	DIGITAL IMAGE PROCESSING	3	0	0	3

OBJECTIVES:

• To know and understand the basics and fundamentals of digital image processing, such as

digitization, sampling, quantization, and 2D-transforms.

• To understand of images using the techniques of smoothing, sharpening and enhancement.

• To understand the restoration concepts and filtering techniques.

• To learn the basics of segmentation, features extraction, compression

• To learn about the basics of recognition

UNIT I DIGITAL IMAGE FUNDAMENTALS 9

Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels - Color image fundamentals - RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms - DFT, DCT.

UNIT II IMAGE ENHANCEMENT 9

Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement.

UNIT III IMAGE RESTORATION 9

Image Restoration - degradation model, Properties, Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering

UNIT IV IMAGE SEGMENTATION 9

Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation – Region growing – Region splitting and merging – Morphological processing- erosion and dilation, Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm.

UNIT V IMAGE COMPRESSION AND RECOGNITION 9

Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Understand the basics and fundamentals of digital image processing.

CO2: Understand of images using the techniques of smoothing

CO3: Understand of images using the techniques of sharpening and enhancement

CO4: Learn the basics of segmentation

CO5: Learn the basics of features extraction, compression

CO6: Learn about the basics of recognition

TEXT BOOKS:

1. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, Pearson, Third Edition, 2010.
2. Anil K. Jain, Fundamentals of Digital Image Processing, Pearson, 2002.

REFERENCES:

1. Kenneth R. Castleman, Digital Image Processing, Pearson, 2007.

2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, Digital Image Processing using MATLAB, Pearson Education, Inc., 2011.
3. D,E. Dudgeon and RM. Mersereau, Multidimensional Digital Signal Processing, Prentice Hall Professional Technical Reference, 1990.
4. William K. Pratt, Digital Image Processing, John Wiley, New York, 2002.

5. Milan Sonka et al Image processing, analysis and machine vision, Brookes/Cole, Vikas Publishing House, Second Edition, 1999.

NPTEL LINK:https://nptel.ac.in/courses/117/105/117105135/

COURSE CODE	COURSE TITLE	L	T	P	C
20EC907	MEDICAL ELECTRONICS	3	0	0	3

OBJECTIVES:

• To gain knowledge about the various physiological parameters both electrical and non-electrical and the methods of recording and also the method of transmitting these parameters

• To study about the various assist devices used in the hospitals

• To gain knowledge about equipment used for physical medicine and the various recently developed diagnostic and therapeutic techniques

• To understand the physical medicine methods eg. ultrasonic, shortwave, microwave surgical diathermies , and bio-telemetry principles and methods

• To know about recent trends in medical instrumentation

UNIT I ELECTRO-PHYSIOLOGY AND BIO-POTENTIAL RECORDING 9

Sources of bio medical signals, Bio-potentials, Biopotential electrodes, ECG,EEG, EMG, PCG, typical waveforms and signal characteristics

UNIT II BIO-CHEMICAL AND NON ELECTRICAL PARAMETERMEASUREMENT 9

Colorimeter, Blood flow meter, Cardiac output, respiratory, blood pressure, temperature and pulse measurement

UNIT III ASSIST DEVICES 9

Cardiac pacemakers, DC Defibrillator, Dialyser, Ventilators

UNIT IV PHYSICAL MEDICINE AND BIOTELEMETRY 9

Diathermies- Shortwave, ultrasonic and microwave type and their applications, Surgical Diathermy, Biotelemetry.

UNIT V RECENT TRENDS IN MEDICAL INSTRUMENTATION 9

Telemedicine, Insulin Pumps, Radio pill, Endomicroscopy, Brain machine interface, Lab on a chip.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Know the human body electro- physiological parameters and recording of bio-potentials

CO2: Comprehend the non-electrical physiological parameters and their measurement – body temperature, blood pressure, pulse, blood cell count, blood flow meter etc.

CO3: Interpret the various assist devices used in the hospitals viz. pacemakers, defibrillators, dialyzers and ventilators

CO4: Understand physical medicine methods eg. ultrasonic, shortwave, microwave surgical diathermies

CO5: Understand about bio-telemetry principles and methods

CO6: Know about recent trends in medical instrumentation

TEXT BOOKS:

1. Leslie Cromwell, Biomedical Instrumentation and Measurement, Prentice Hall of India, New Delhi, 2007.

2.Alan S. Morris, Reza Langari, Measurement and Instrumentation Theory and Application, Elsevier, 2020.

REFERENCES:

1. Khandpur, R.S., Handbook of Biomedical Instrumentation, TATA Mc Graw-Hill, New Delhi, 2003.
2. John G.Webster, Medical Instrumentation Application and Design, Third Edition, Wiley India Edition, 2007.
3. Joseph J.Carr and John M.Brown, Introduction to Biomedical Equipment Technology, John Wiley and Sons, New York, ISO9001-2015 Standards, 2004
4. J. G. Webster, Medical Instrumentation Application and Design, Wiley Publication, 2015.
5. D. Jennings, B.C.H. Turton, Introduction to Medical Electronics Applications, Elsevier Ltd,1995.

NPTEL LINK: https://nptel.ac.in/courses/108/105/108105101/

COURSE CODE	COURSE TITLE	L	T	P	C
20AI401	ARTIFICIAL INTELLIGENCE	3	0	0	3

OBJECTIVES:

- To explain the foundations of AI and various intelligent agents
- To discuss problem solving search strategies and game playing
- To describe logical agents and first-order logic
- To illustrate problem-solving strategies with knowledge representation mechanism for solving hard problems
- To explain the basics of learning and expert systems.

UNIT I ARTIFICIAL INTELLIGENCE AND INTELLIGENT AGENTS 9

Introduction to AI – Foundations of Artificial Intelligence - Intelligent Agents – Agents and Environments - Concept of rationality – Nature of environments – Structure of agents - Problem solving agents – Example Problems - Search Algorithms – Uninformed Search Strategies

UNIT II PROBLEM SOLVING 9

Heuristic search strategies – heuristic functions- Game Playing – Mini-max Algorithm - Optimal decisions in games – Alpha-beta search –Monte-Carlo search for Games - Constraint satisfaction problems – Constraint propagation – Backtracking search for CSP – Local search for CSP – Structure of CSP

UNIT III LOGICAL AGENTS 9

Knowledge-based agents – Logic - Propositional logic – Propositional theorem proving – Propositional model checking – Agents based on propositional logic. First-Order Logic – Syntax and semantics – Using First-Order Logic - Knowledge representation and engineering – Inferences in first-order logic – Propositional Vs First-Order Inference - Unification and First-Order Inference - Forward chaining – Backward chaining - Resolution

UNIT IV KNOWLEDGE REPRESENTATION AND PLANNING 9

Ontological engineering – Categories and objects – Events – Mental objects and modal logic – Reasoning systems for categories – Reasoning with default information Classical planning – Algorithms for classical planning – Heuristics for planning – Hierarchical planning – non-deterministic domains – Time, schedule, and resources - Analysis

UNIT V LEARNING AND EXPERT SYSTEMS 9

Forms of Learning – Developing Machine Learning systems – Statistical Learning - Deep Learning: Simple feed-forward network - Neural Networks – Reinforcement Learning: Learning from rewards – Passive and active Reinforcement learning.

Expert Systems: Functions – Main structure – if-then rules for representing knowledge – developing the shell – Dealing with uncertainty.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Understand the fundamental knowledge of modern probability theory and standard distributions.

CO2: Categorize the probability models and function of random variables based on one and two dimensional random variables.

CO3: Employ the concept of testing the hypothesis in real life problems.

CO4: Implement the analysis of variance for real life problems.

CO5: Apply the statistical quality control in engineering and management problems

TEXT BOOKS:

1. Peter Norvig and Stuart Russel, Artificial Intelligence: A Modern Approach, Pearson, Fourth Edition, 2020.
2. Bratko, Prolog: Programming for Artificial Intelligence, Fourth Edition, Addison-Wesley Educational Publishers Inc., 2011.

REFERENCES:

1. Elaine Rich, Kevin Knight and B.Nair, Artificial Intelligence Third Edition, McGraw Hill, 2017.
2. Melanie Mitchell, Artificial Intelligence: A Guide for Thinking Humans. Series: Pelican Books, 2020
3. Ernest Friedman-Hill, Jess in Action, Rule-Based Systems in Java, Manning Publications, 2003
4. Nils J. Nilsson, The Quest for Artificial Intelligence, Cambridge University Press, 2009
5. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems,First Edition by Patterson, Pearson, India, 2015

COURSE CODE	COURSETITLE	L	T	P	C
20IT917	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	3	0	0	3

OBJECTIVES:

- Facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system.
- Make the students understand the traditional knowledge and analyze it andapply 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, Indigenous Knowledge (IK), characteristics, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge

UNIT II PROTECTION OF TRADITIONAL KNOWLEDGE 9

The need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.

UNIT IIII LEGAL FRAMEWORK AND TK 9

The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of ForestRights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFRAct); The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016.

UNIT IV TRADITIONAL KNOWLEDGE AND INTELLECTUAL PROPERTY 9

Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge

UNIT V TRADITIONAL KNOWLEDGE IN DIFFERENT SECTORS 9

Traditional knowledge and engineering, Traditional medicine system, 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

OUTCOMES:

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

CO1: Illustrate the concepts of Indian traditional knowledge.

CO2: Apply the concept of protection of traditional knowledge.

CO3: Analyze the legal framework and traditional knowledge.

CO4: Interpret the concept of traditional knowledge and intellectual property.

CO5: Analyze and apply traditional knowledge to their day-to- day life.

TEXTBOOK:

1. Amit Jha, Traditional Knowledge System in India, Atlantic Publishers, 2002

REFERENCES:

1. Kapil Kapoor, Michel Danino, Knowledge Traditions and Practices of India, Central Board of Secondary Education, 2012.

SEMESTER VI
ELECTIVE – III

COURSE CODE	COURSE TITLE	L	T	P	C
20EC908	IoT System design and Applications	3	0	0	3

OBJECTIVES:

- To impart necessary and practical knowledge of components of Internet of Things.
- To nurture the skills required to build real-life IoT based projects.
- To develop knowledge in Industrial Internet of Things (IIoT) fundamentals.
- To gain conceptual understanding of networking and wireless communication protocols used in IIoT deployments
- To design an Internet of Medical Things (IoMT) environment in Health Care.

UNIT I Introduction to IoT **9**

Architectural Overview, Design principles and needed capabilities, IoT Applications, Sensing, Actuation, Basics of Networking, M2M and IoT Technology Fundamentals- Devices and gateways, Data management, Business processes in IoT, Everything as a Service(XaaS), Role of Cloud in IoT, Security aspects in IoT.

UNIT II Elements of IoT **9**

Hardware Components- Computing (Arduino, Raspberry Pi), Communication, Sensing, Actuation, I/O interfaces. Software Components- Programming API's (using Python/Node.js/Arduino) for Communication Protocols-MQTT, ZigBee, Bluetooth, CoAP, UDP, TCP.

UNIT III IoT Application Development **9**

Solution framework for IoT applications- Implementation of Device integration, Data acquisition and integration, Device data storage- Unstructured data storage on cloud/local server, Authentication, authorization of devices.

UNIT IV IIoT Architecture **9**

Various Architectures of 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

UNIT V IoMT Introduction **9**

IoMT and its working. Tracking assets and resources, Internet of things in hospitals, collection and integration of clinical data, Major benefits of IoT in healthcare, Disadvantages of IoT in healthcare.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Understand internet of Things and its hardware and software components

CO2: Interface I/O devices, sensors & communication modules

CO3: Remotely monitor data and control devices

CO4: Develop real life IoT based projects

CO5: Apply sensors and various protocols for industry standard solutions
CO6: Design various applications using IoT in Healthcare Technologies.

TEXT BOOKS:

1. Vijay Madisetti, ArshdeepBahga, Ïnternet of Things, A Hands on Approach, University Press
2. Veneri, Giacomo, and Antonio Capasso. Hands-on Industrial Internet of Things: Create a Powerful Industrial IoT Infrastructure Using Industry 4.0, First Edition, Packt Publishing Ltd, 2018.

REFERENCES:

1. Reis, Catarina I., and Marisa da Silva Maximiano, eds. Internet of Things and advanced application in healthcare, First Edition, IGI Global, 2016.
2. Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things, First Edition, Apress, 2017
3. Dr. SRN Reddy, RachitThukral and Manasi Mishra, Introduction to Internet of Things: A practical Approach, ETI Labs
4. Pethuru Raj and Anupama C. Raman, The Internet of Things: Enabling Technologies, Platforms, and Use Cases, CRC Press
5. Raj Kamal, Internet of Things: Architecture and Design, McGraw Hill

NPTEL LINK:https://onlinecourses.nptel.ac.in/noc22_cs53/

COURSE CODE	COURSE TITLE	L	T	P	C
20CS917	DATA SCIENCE FUNDAMENTALS	3	0	0	3

OBJECTIVES:

- To explain the fundamentals of data science
- To experiment and implement python libraries for data science
- To apply and implement basic classification algorithms
- To apply clustering and outlier detection approaches.
- To present and interpret data using visualization tools in Python

UNIT I INTRODUCTION 9

Data Science: Benefits and uses – facets of data - Data Science Process: Overview – Defining research goals – Retrieving data – data preparation - Exploratory Data analysis – build the model – presenting findings and building applications - Data Mining - Data Warehousing – Basic statistical descriptions of Data

UNIT II PYTHON LIBRARIES FOR DATA SCIENCE 9

Launching the IPython Shell - Launching the Jupyter Notebook - IPython Magic Commands - The Basics of NumPy Arrays-Universal Functions – Aggregations – Computation on Arrays – Fancy Indexing – Sorting arrays – Structured data – Data manipulation with Pandas – Data Indexing and Selection – Handling missing data – Hierarchical indexing – Combining datasets – Aggregation and Grouping – String operations – Working with time series – High performance Pandas.

UNIT III CLASSIFICATION 9

Basic Concepts – Decision Tree Induction – Bayes Classification Methods – Rule-Based Classification – Model Evaluation and Selection.

Bayesian Belief Networks – Classification by Backpropagation – Support Vector Machines – Associative Classification – K-Nearest-Neighbor Classifiers – Fuzzy Set Approaches - Multiclass Classification - Semi-Supervised Classification.

UNIT IV CLUSTERING AND OUTLIER DETECTION 9

Cluster Analysis – Partitioning Methods – Evaluation of Clusters – Probabilistic Model-Based Clustering – Outliers and Outlier Analysis – Outlier Detection Methods – Statistical Approaches – Clustering and Classification-Based Approaches.

UNIT V DATA VISUALIZATION 9

Importing Matplotlib – Simple line plots – Simple scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – customization – three dimensional plotting - Geographic Data with Base map - Visualization with Seaborn.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Explain the fundamentals of data science

CO2: Experiment python libraries for data science

CO3: Apply and implement basic classification algorithms

CO4: Implement clustering and outlier detection approaches

CO5: Present and interpret data using visualization tools in Python

TEXT BOOKS:

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publications, 2016.
2. Jiawei Han, Micheline Kamber, Jian Pei, "Data Mining: Concepts and Techniques", Third Edition, Morgan Kaufmann, 2012
3. Jake Vander Plas, "Python Data Science Handbook: Essential Tools for Working with Data", Kindle Edition, 2017

REFERENCES:

1. Roger D. Peng, R Programming for Data Science, Lulu.com, 2016
2. Laura Igual, Santi Seguí, "Introduction to Data Science: A Python Approach to Concepts, Techniques and Applications", First Edition, Springer, 2017
3. Peter Bruce, Andrew Bruce, "Practical Statistics for Data Scientists: 50 Essential Concepts", Third Edition, O'Reilly, 2017
4. Avrim Blum, John Hopcroft, Ravi Kannan, "Foundations of Data Science", First Edition, Cambridge University Press, 2020.

COURSE CODE	COURSE TITLE	L	T	P	C
20EC909	ADVANCED DIGITAL SIGNAL PROCESSING	3	0	0	3

OBJECTIVES:

- To learn analysis & characterization of discrete-time random processes.
- To enunciate the significance of estimation of power spectral density of random processes.
- To introduce the principles of optimum filters such as Wiener and Kalman filters.
- To introduce the principles of adaptive filters and their applications to communication engineering.
- To introduce the concepts of multi-resolution analysis.

UNIT I DISCRETE-TIME RANDOM PROCESSES 9

Discrete random processes – Ensemble averages – Wide sense stationary process – Properties - Ergodic process – Sample mean & variance - Auto-correlation and Auto-correlation matricesProperties – White noise process – Weiner Khitchine relation - Power spectral density – Filtering random process – Spectral Factorization Theorem – Special types of Random Processes – AR,MA, ARMA Processes – Yule-Walker equations.

UNIT II SPECTRUM ESTIMATION 9

Bias and Consistency of estimators - Non-Parametric methods – Periodogram – Modified Periodogram – Barlett's method – Welch's mehod – Blackman-Tukey method – Parametric methods – AR, MA and ARMA spectrum estimation - Performance analysis of estimators..

UNIT III SIGNAL MODELING AND OPTIMUM FILTERS 9

Introduction- Least square method – Pade approximation – Prony's method – Levinson Recursion – Lattice filter - FIR Wiener filter – Filtering – Linear Prediction – Non Causal and Causal IIR Weiner Filter -– Mean square error – Discrete Kalman filter

UNIT IV ADAPTIVE FILTERS 9

Principles and properties of adaptive filters - FIR adaptive filters. Adaptive algorithms - steepest descent algorithm, the LMS algorithm - convergence. Applications of adaptive filtering - noise cancellation, channel equalization.

UNIT V MULTIRESOLUTION ANALYSIS 9

Short-time Fourier transform - Heisenberg uncertainty principle. Principles of multi-resolution analysis - sub-band coding, the continuous and discrete wavelet transform - properties. Applications of wavelet transform - noise reduction, image compression.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Characterize stationary and non-stationary random signals.

CO2: Articulate and apply the concepts of special random processes in practical applications

CO3: Choose appropriate spectrum estimation techniques for a given random process

CO4: Apply optimum filters appropriately for a given communication application.

CO5: Apply appropriate adaptive algorithm for processing non-stationary signals.

CO6: Apply and analyze wavelet transforms for signal and image processing based applications.

TEXT BOOKS:

1. Monson H. Hayes, Statistical digital signal processing and modeling, John Wiley and Sons Inc. New York, Indian reprint 2008.
2. P. P. Vaidyanathan, Multirate systems and filter banks, Prentice Hall Inc. 1993

REFERENCES:

1. John G. Proakis, Dimitris G. Manolakis, Digital signal processing - principles, algorithms and applications, Pearson Education, Fourth Edition, 2007.
2. Sophoncles J. Orfanidis, Optimum signal processing, McGraw Hill, 2000.
3. Monson H. Hayes, Statistical Digital Signal Processing and Modeling, John Wiley and Sons Inc., New York, 2006
4. S. Kay, Modern spectrum Estimation theory and application, Prentice Hall, Englehood a. Cliffs, NJ1988
5. Simon Haykin, Adaptive Filter a. Theory, Prentice Hall, Englehood Cliffs, NJ1986

NPTEL LINK: https://nptel.ac.in/courses/117/101/117101001/

COURSE CODE	COURSE TITLE	L	T	P	C
20EC910	MULTIMEDIA COMPRESSION AND COMMUNICATION	3	0	0	3

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 various image formats.
- To understand the QoS issues in multimedia network
- To introduce communication protocols for multimedia networking

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 7

Static and Dynamic Huffman coding – Arithmetic coding –Lempel-Ziv coding – LZW coding.

UNIT IV GUARANTEED SERVICE MODEL 10

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 10

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

OUTCOMES:

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

CO1:Design audio compression techniques

CO2:Configure image compression techniques

CO3:Configure video compression techniques

CO4:Configure text compression techniques

CO5:Select suitable service model for specific application

CO6:Configure multimedia communication network

TEXT BOOK:

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 KittiWongthawaravat, Multimedia Wireless Networks: Technologies, Standards and QoS, Prentice Hall, 2003.

NPTEL LINK:https://nptel.ac.in/courses/117/105/117105083/

COURSE CODE	COUSE TITLE	L	T	P	C
20EI903	ROBOTICS AND AUTOMATION	3	0	0	3

OBJECTIVES:

- To study the kinematics, drive systems and programming of robots.
- To study the basics of robot laws and transmission systems.
- To familiarize students with the concepts and techniques of robot manipulator, its kinematics.
- To familiarize students with the various Programming and Machine Vison application in robots.
- To build confidence among students to evaluate, choose and incorporate robots in engineering systems.

UNIT I FUNDAMENTALS OF ROBOT **9**

Overview of a robotic system, applications and significance of a robotic system, elements of a robotic system, future advances in robotics

UNIT II MODELING A ROBOTIC SYSTEM **9**

Introduction to common terms and nomenclature used in robotics- workspace, joint space, Euler angles, reference systems, robot manipulator – links and joints, DH- parameters, kinematics and dynamics of a two link robot manipulator

UNIT III ACTUATORS **9**

Electrical actuators-DC motor, stepper motor, drives, servo motor, relays and solenoids. Hydraulic and pneumatic devices- design. Gear trains, limit switches, power supply and hazards

UNIT IV CONTROL DESIGN **9**

Basics of a control system – closed loop and open loop, feedback and feedforward control, PID controller. PLC programming and ladder logic, analog input output, microprocessor applications in mechatronics, programming interfacing

UNIT V CASE STUDY OF ROBOTICS SYSTEM **9**

Control of a robotic manipulator and role of robots in inspection, assembly, material handling, underwater, space, medical fields, vehicle and drone

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this Course, the students will be able

CO1: Interpret the features of robots and technology involved in the control

CO2: Apply the basic engineering knowledge and laws for the design of robotics.

CO3: Explain the basic concepts like various configurations, classification and parts of end effectors compare various end effectors and grippers and tools and sensors used in robots.

CO4: Explain the concept of kinematics, degeneracy, dexterity and trajectory planning.

CO5: Demonstrate the image processing and image analysis techniques by machine vision system.

CO6: Understand the Robotic Manipulator for Inspection and assembly.

TEXT BOOKS:

1. Mikell Groover, Industrial Robotics: Technology, Programming, and Applications, Second Edition, Tata McGraw-Hill, 2017
2. Devdas Shetty & Richard Kolk, Mechatronics System Design, Third Edition. PWS Publishing, 2009.
3. Mark W. Spong, Seth Hutchinson, and M. Vidyasagar, Robot Dynamics and Control, Second Edition, 2004.
4. Ganesh.S.Hedge ,A textbook of Industrial Robotics, Lakshmi Publications, McGraw Hill Second Edition 2012.

REFERENCES:

1. Oussama Khatib, Handbook of Robotics, Springer, 2008
2. Mikell.P.Groover , Industrial Robotics Technology, Programming and applications
3. John. J.Craig, Introduction to Robotics: Mechanics and Control, Second Edition, 2002
4. Jazar, Theory of Applied Robotics: Kinematics, Dynamics and Control, Springer India reprint, 2010.
5. NPTEL video lecture on Robotics, IIT Bombay by Prof. B. Seth, Prof. C. Amarnath, Prof. K. Kurien Issac, Prof. P.S. Gandhi, Prof. P. Seshu

COURSE CODE	COURSE TITLE	L	T	P	C
20EE917	SYSTEM PROGRAMMING	4	0	0	4

COURSE OBJECTIVES

This course is meant to give them a broad exposure to the understanding of various concepts of System Programming.

The course will provide the students with

(i) the concept of advanced Embedded C Language,

(ii) the knowledge of microcontroller architecture,

(iii) the methodology to write Program for chosen microcontroller, and

(iv) the skill to use basic technique for debugging in Linux environment and

(v) basic understanding of system programming.

Experiments will run in synchronism with the lectures to support the methods and techniques taught in the lectures. Through the experiments, the students will

(i) learn how to use Linux commands and programming environment,

(ii) gain confidence to do system programming in Linux environment, and learn how to test and debug the developed programs.

Teaching and Learning Strategy

Teaching and Learning Strategy	Description of Work	Class Hours	Out-of-Class Hours
Lectures supported by tutorials, assignments and experiments	Practical in Debian or Ubuntu Linux Environment	15 hours	45 hours

UNIT 1 EMBEDDED C PROGRAMMING 9Hrs.

Essential C Programming Concepts, Variables and Constants, IO operation, Memory Layouts, Operators and Expression, Control Statements, Functions, Arrays, Pointer, Structure and Union, Debugging Methods.

Lab work

1. Programs to understand the various C memory layouts and variable storage locations.
2. Programs to understand the control and conditional statements extensively.
3. Programs to understand the passing of 1-D, 2-D arrays to functions as argument.
4. Programs to understand the pointer usage and passing argument by reference.
5. Programs to understand the structure, union, enum, typedef and bitwise logical operations.

Project

1. Projects based on the modular programming design.
2. Projects based on event handlers
3. Projects based on finite state machine

UNIT 2 EMBEDDED SYSTEM SOFTWARE 9Hrs.

Assembly and C Microcontroller Programming, IO Port Programming, Timer Programming, Handling Interrupts, Interfacing with external peripherals and memory, ADC Programming, LCD & Keypad Programming, Interfacing with Sensors.

Lab work

1. Programs to understand the GPIO input, output and alternate functionalities.
2. Programs to understand the timer functionalities in the microcontroller.
3. Programs to understand various interrupts and interrupt service handler and interrupt service routines.
4. Programs to understand the external interrupts and external peripheral interface with the microcontroller.
5. Programs to understand the ADC and DAC interfaces with the microcontroller.
6. Programs to understand the display and keypad interfaces with the microcontroller.
7. Programs to understand the external sensor signal handling in the microcontroller.

Project

1. Constructing the circuit in the breadboard to execute the lab work exercises in the actual hardware.
2. Developing programs for microcontroller with modular programming using state machines approaches.

UNIT 3 EMBEDDED LINUX SYSTEM PROGRAMMING 9Hrs.

System Programming Concepts, File Operation Programming, IO Operation Programming, Advance Process Management Programming and Thread Programming and Mutex.

Lab work

1. Programs to understand the file management in Linux C.
2. Programs to understand the process handling in Linux C.
3. Programs to understand the threads and mutex in Linux C.

Project

1. Developing multi processes project in Linux C.
2. Developing project using threads and mutex.

UNIT 4 EMBEDDED LINUX SYSTEM PROGRAMMING IPCs 9Hrs.

Essential Inter Process Communication and Synchronization, Pipes, Signals, Timers, Shared Memory, Message Queues and Semaphores.

1. Programs to understand the Pipes in Linux C.
2. Programs to understand the Signals and Timers in Linux C.
3. Programs to understand the Shared Memory and Semaphores in Linux C.
4. Programs to understand the Message Queues in Linux C.

Project

1. Developing event-based project using Linux IPC and synchronization mechanism.
2. Developing message queue-based project using message queue and synchronization mechanism.

UNIT 5 ADVANCE MICROCONTROLLER PROGRAMMING 9Hrs.

Introduction of Advanced Microcontroller Architectures, Buses, Memory, Clock Tree, Reset, Interrupts Management, IOs, Timers, and external interfaces.

Lab work

1. Programs to understand the various clock configurations.
2. Programs to understand the timer configurations and event handlers.
3. Programs to understand various interrupts and interrupt service handler and interrupt service routines.
4. Programs to understand the external interrupts and external peripheral interface with the microcontroller.
5. Programs to understand the handling of external signals.

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

(i) Perform advanced C programming using linked list, Function pointers, arrays, sorting, etc.,
(ii) Basic scripting in Linux environment
(iii) Demonstrate programming using Linux System calls
(iv) Demonstrate various debugging techniques when the program throws error
(v) Plan and execute projects simple system programming projects.

TEXT BOOK/ REFERENCE BOOKS

Text Books:

Advanced Embedded C Programming
The C Language Programming, Brian W. Kernighan • Dennis M. Ritchie, 1998.

Linux System Programming

Linux System Programming, Robert Love, 2013.

Advanced Microcontroller Programming
Discovering the STM32 Microcontroller, Geoffrey Brown, 2012.

Reference Books:

Advanced Embedded C Programming

1. THE FIRMWARE HANDBOOK, Jack Ganssle, 2004..
2. C Programming for Embedded Systems, Kirk Zurell, 2000.
3. Making Embedded Systems, Elecia White, 2011.

Linux System Programming

1. Beginning Linux Programming, Neil Matthew & Richard Stones, 2008.
2. Hands-On System Programming with Linux, Kaiwan N Billimoria, 2018.

Advanced Microcontroller Programming

1. Mastering STM32, Carmine Noviello, 2016.
2. ARM Cortex M4 Cookbook, Dr. Mark Fisher, 2016.
3. RM0090, Reference manual, STM32F405/415, STM32F407/417, STM32F427/437 and STM32F429/439 advanced Arm®-based 32-bit MCUs.
4. PM0214 Programming manual STM32 Cortex-M4 MCUs and MPUs programming manual.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3Hrs.**

Type of Assessment	Description	Percentage
Quiz (2 or 3)	1. Classroom attention 2. Adhoc Quizzes of approx. 40 mins each will be taken to evaluate the continuous progress	15 %
Mid Term (1)	One Mid Term of 1½ hour Practical Examination will be taken	25 %
Laboratory	Laboratory continuous monitoring and Exam	15%
Assignment	Two projects will be given, one before the mid-semester and one after the mid-semester	15%
End Term (1)	4-hour End Practical exam will be taken to evaluate the overall understanding	30 %
	Total	100%

COURSE CODE	COURSE TITLE	L	T	P	C
20EC701	RF AND MICROWAVE ENGINEERING	3	0	0	3

OBJECTIVES:

- To understand the basics required for circuit representation of RF networks.
- To deal with the issues in the design of RF amplifier.
- To instill knowledge on the properties of various microwave components.
- To understand the concept of microwave generation
- To learn the microwave measurement techniques

UNIT I TWO PORT NETWORK THEORY 9

Review of Low frequency parameters: Impedance, Admittance, Hybrid and ABCD parameters, Different types of interconnection of Two port networks, High Frequency parameters: Formulation of S parameters, Properties of S parameters, Transmission matrix, RF behavior of Wire, Resistor, Capacitor and Inductor.

UNIT II RF AMPLIFIERS AND MATCHING NETWORKS 9

Characteristics of Amplifiers, Amplifier power relations, Stability considerations, Gain Considerations, Impedance matching using discrete components: Two component Matching Networks, T and Pi Matching Networks, Microstrip Line Matching Networks.

UNIT III PASSIVE AND ACTIVE MICROWAVE DEVICES 9

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

Active Devices: Gunn diode, IMPATT diode, TRAPATT diode, PIN diode, Varactor diode and Schottkey diode, Transferred electron devices, Avalanche transistor devices.

UNIT IV MICROWAVE GENERATION 9

High frequency effects in vacuum tubes, Two Cavity Klystron Amplifier, Reflex Klystron Oscillator, Traveling Wave Tube Amplifier, Cylindrical Magnetron Oscillator.

UNIT V MICROWAVE MEASUREMENTS 9

Measuring Instruments: VSWR meter, Power meter, Spectrum analyzer, Network analyzer.Measurement of Impedance, Frequency, Power, VSWR, Attenuation, S-parameters

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Demonstrate the characteristics of multi- port RF networks.

CO2: Analyze a RF transceiver system for wireless communication.

CO3: Describe the characteristics of passive microwave components

CO4: Summarize the characteristics of active microwave devices

CO5: Explain the generation of microwave signals.

CO6 : Experiment the measurement of microwave signal and parameters.

TEXT BOOKS:

1. Reinhold Ludwig and Gene Bogdanov, RF Circuit Design: Theory and Applications, Pearson Education Inc., 2011
2. Robert E Colin, Foundations for Microwave Engineering, John Wiley & Sons Inc, 2005.

REFERENCES:

1. David M. Pozar, Microwave Engineering, Wiley India (P) Ltd, New Delhi, 2008.
2. Thomas H Lee, Planar Microwave Engineering: A Practical Guide to Theory, Measurements and Circuits, Cambridge University Press, 2004.
3. Mathew M Radmanesh, RF and Microwave Electronics, Prentice Hall, 2000.
4. Annapurna Das and Sisir K Das, Microwave Engineering, Tata Mc Graw Hill Publishing Company Ltd, New Delhi, 2005.
5. Frank Gustrau, Rf and Microwave Engineering Fundamentals of Wireless Communications, John Wiley & Sons, 2012.

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

COURSE CODE	COURSE TITLE	L	T	P	C
20EC702	OPTICAL COMMUNICATION AND NETWORKS	3	0	0	3

OBJECTIVES:

- Acquire the knowledge of optical fiber transmission mechanisms and various fiber types.
- Study the factors which produces signal degradation in fibers
- Learn the concept of sources and power coupling in optical communication.
- Explore the trends of optical fiber measurement systems.
- Enrich the idea of fiber optic networking.

9

UNIT-I INTRODUCTION TO OPTICAL FIBERS

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 wave guides- Overview of modes, Modes in Step-Index fibers, Linearly Polarized modes.

9

UNIT-II SIGNAL DEGRADATION IN OPTICAL FIBERS

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-RI profiles and cut-off wavelength.

9

UNITIII FIBER OPTICAL SOURCES AND COUPLING

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 and Tunable Laser. Power launching and coupling-Lensing schemes-Fiber -to-Fiber joints-Fiber splicing-Introduction to optical amplifiers.

9

UNIT-IV FIBER OPTIC RECEIVER AND MEASUREMENTS

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

9

UNIT-V OPTICAL NETWORKS AND SYSTEM TRANSMISSION

Basic networks – SONET / SDH – Broadcast and select WDM networks –Wavelength routed networks – Non- linear effects on Network performance –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

OUTCOMES:

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

CO1:Describe the various optical fiber modes and configurations
CO2: Illustrate various signal degradation factors associated with optical fiber.
CO3: Evaluate various optical sources and their use in the optical communication system to select the optimum transmitter.
CO4: Analyze the optical receiver performance and measure various fiber parameters for designing optical fiber.
CO5:Analyze the digital transmission and its associated parameters on system performance.
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: A Practical Perspective, Morgan Kaufmann, Third Edition, 2009.
2. J.Gower, Optical Communication System, Prentice Hall of India, 2001.
3. Svilen Dimitrov and Harald Haas, Principles of LED light Communications: Towards Networked Li-Fi , Cambridge University Press, 2015.
4. G.P Agrawal, Fiber Optic Communication Systems, Wiley, Second Edition,2011.
5. B.Mukerjee, Optical WDM Networks (Optical Networks), Springer edition, 2006.

NPTEL LINK: https://archive.nptel.ac.in/courses/117/104/117104127/

COURSE CODE	COURSE TITLE	L	T	P	C
20CE917	PROFESSIONAL ETHICS IN ENGINEERING	3	0	0	3

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 8

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 10

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.

UNIT V 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: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students 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. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2014.
2. Govindarajan M, Natarajan S, Senthil Kumar V. 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
20EC711	ADVANCED COMMUNICATION LABORATORY	0	0	4	2

OBJECTIVES:

- To Understand the working principle of optical sources, detector, fibers.
- To Develop understanding of simple optical communication link.
- To Understand the measurement of BER, Pulse broadening
- To Understand and capture an experimental approach to digital wireless communication
- To Understand actual communication waveforms that will be sent and received across wireless channel.

OPTICAL EXPERIMENTS

1. a) Measurement of connector losses
   (b) Bending losses
2. (a) Numerical aperture
   (b)Mode characteristics of fibers
3. DC characteristics of LED and PIN photo diode.
4. (a) Fiber optic analog and digital link characterization - frequency response (analog)
   (b) Eye diagram and BER (digital)

WIRELESS COMMUNICATION EXPERIMENTS

1. Wireless Channel Simulation including fading and Doppler effects
2. Simulation of Channel Estimation, Synchronization & Equalization techniques.
3. Analysing Impact of Pulse Shaping and Matched Filtering using Software Defined Radio.
4. OFDM Signal Transmission and Reception using Software Defined Radios.

MICROWAVE EXPERIMENTS

1. VSWR and Impedance Measurement and Impedance Matching
2. (a) Characterization of Directional Couplers
   (b) Isolators
   (c) Circulators
3. Gunn Diode Characteristics
4. Microwave Filter Characteristics

TOTAL:60 PERIODS

OUTCOMES:

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

CO1: Analyze the performance of simple optical link by measurement of losses

CO2: Analyze the mode characteristics of fiber

CO3: Analyze the Eye Pattern, Pulse broadening of optical fiber and the impact on BER.

CO4: Estimate the Wireless Channel Characteristics and

CO5: Analyze the performance of Wireless Communication System.

CO6: Understand the intricacies in Microwave System design.

COURSE CODE	COURSE TITLE	L	T	P	C
20EC712	PROJECT WORK - PHASE I AND INTERNSHIP	0	0	6	3

OBJECTIVES:

- To expose the students to industry environment and to take up onsite 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.

Course Evaluation

Phase I project	**Weight**
Project final report	30%
Presentation	30%
Internship Report	20%
Viva voce	20%

TOTAL:45 PERIODS

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
20EC713	DESIGN THINKING LABORATORY	0	0	2	1

OBJECTIVES

- To impart necessary knowledge of Design Thinking
- To impart practical knowledge of Design Thinking
- To learn concepts in Design Thinking
- To learn various software tools
- Develop skills required to build real-life products using Design Thinking

LIST OF EXPERIMENTS

1. Design a mind map of design thinking process
2. Construct empathy maps for a given case study-1
3. Develop customer journey map for a given case-1
4. Construct empathy maps for a given case study-2
5. Develop customer journey map for a given case -2
6. Ideation Technique Set 1 - Thirty circle Exercise and others
7. Ideation Technique Set 2 – Brainstorming and others
8. Prepare a prototype for the case-1, a toothpick bridge (mock-up model)
9. Test the prototype of the case-1, the toothpick bridge
10. Prepare a prototype for the case-2, a marble maze (mock up model)
11. Test the prototype of the case-2, the marble maze
12. Prepare a prototype for the case-3, an electronic system (mock up model)
13. Test the prototype of the case-3, the electronic system
14. Design thinking using sprintbase software - I
15. Design thinking using sprintbase software - II

TOTAL: 30 PERIODS

OUTCOMES

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

CO1: Develop a mind map for design thinking process

CO2: Prepare empathy maps and journey maps for problems.

CO3: Construct prototypes and mock-up models through ideation and innovation techniques

CO4: Test the prototypes using appropriate testing techniques

CO5: Use software tools for the design thinking process

CO6: Test the prototype

LIST OF SUGGESTED BOOKS AND RESOURCES

1. https://www.interaction-design.org/literature/article/5-stages-in-the-design-thinking-process
2. https://www.interaction-design.org/literature/article/design-thinking-getting-started-with-empathy
3. https://sprintbase.io/
4. https://www.innovationtraining.org/software-tools-for-design-thinking/
5. IdrisMootee, “Design Thinking for Strategic Innovation”, John Wiley & Sons (2013).
6. “Change by design”, Tim Brown, Harper Collins, 2009
7. “Design Thinking- The Guide Book” – Facilitated by the Royal Civil service Commission, Bhutan
8. Engineering design by George E Dieter
9. 101 Design Methods: A Structured Approach for Driving Innovation in Your Organization by Vijay Kumar
10. Human-Centered Design Toolkit: An Open-Source Toolkit to Inspire New Solutions in the Developing World by IDEO

SEMESTER VIII

COURSE CODE	COURSE TITLE	L	T	P	C
20EC811	PROJECT WORK - PHASE II	0	0	20	10

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 team work.
- 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 Final report	30%
Presentation	20%
Working Model Demonstration	30%
Viva voce	20%

OUTCOMES:

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 teamwork.

CO5: Able to understand advanced technology and research in engineering.

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

SEMESTERVII

ELECTIVE IV

COURSE CODE	COURSE TITLE	L	T	P	C
20EC911	PRINCIPLES OF SPEECH PROCESSING	3	0	0	3

OBJECTIVES:

- To learn the fundamentals of speech production mechanism and perception
- To understand time and frequency domain characteristics of speech signal and to model speech using digital systems
- To familiarize fundamentals of speech enhancement methods
- To identify various homomorphic signal processing techniques.
- To interpret linear predictive analysis techniques for speech processing.

UNIT I BASIC CONCEPTS **9**

Fundamentals of speech: articulatory phonetics - Production and Classification of Speech Sounds; Acoustic Phonetics – Acoustics of speech production; discrete time model of speech, Speech perception - human auditory system, critical bands, threshold of hearing, auditory masking - simultaneous and non-simultaneous masking.

UNIT II TIME AND FREQUENCY DOMAIN ANALYSIS **9**

Time-dependent processing of speech - short-time energy, short-time autocorrelation, short-time zero-crossing rate, speech vs. silence discrimination using time-domain processing. Frequency domain processing - Short-time Fourier analysis, time-frequency resolution, spectrogram - wideband and narrowband.

UNIT III HOMOMORPHIC SIGNAL PROCESSING **9**

Principles of homomorphic systems. Homomorphic systems for convolution. Complex cepstrum - sequences with rational z-transform and impulse train, homomorphic filtering, discrete complex cepstrum - phase unwrapping. Pitch and formant estimation using cepstrum.

UNIT IV LINEAR PREDICTIVE ANALYSIS **9**

Basics principles of linear predictive analysis, formulation of linear prediction analysis equation - the autocorrelation method and the Levinson Durbin recursive solution, the covariance method and Cholesky decomposition solution. Prediction error signal, frequency domain interpretation of prediction error. Applications of LPC parameters - pitch detection, formant estimation using LPC parameters.

UNIT V SPEECH ENHANCEMENT **9**

Sources of speech degradation, nature of interfering sounds. Speech enhancement techniques - short-term spectral amplitude techniques - spectral subtraction. Adaptive noise cancelling techniques - MMSE, log MMSE-based speech enhancement. Performance evaluation, Quality versus intelligibility, Subjective and objective measures of speech quality and intelligibility - PESQ, SEGSNR, STOI, CSII.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Understand the fundamentals of speech production and apply the same in building spoken language systems.
CO2: Apply time and frequency domain properties in speech-based applications.

CO3: Inferring the significance of non-parametric spectrum estimation technique.
CO4: Apply linear prediction in extracting speech features.

CO5: Articulate signal processing techniques for building robust speech-based systems.

CO6: Identifying optimal speech enhancement techniques and evaluate their performances.

TEXT BOOKS:

1. Thomas F Quatieri, Discrete-time speech signal processing - Principles and Practice, Pearson, 2012.
2.John R. Deller Jr, John H. L. Hansen, and John G. Proakis, Discrete-time processing of speech signals, IEEE Press, 2000.

REFERENCES:

1.Douglas O' Shaughnessy, Speech communications - human and machine, Universities Press, Second Edition, 2004.
2.Rabiner L. R and Schaffer R. W, Digital Processing of speech signals, Pearson Education, 2004.

3.John Makhoul, Linear Prediction - a tutorial review, Proceedings of the IEEE, 1975.

4.Ephraim Y, Statistical model -based speech enhancement techniques, Proceedings of the IEEE, 1992

5.Tokunbo Ogunfumi and Madihally Narasimha, Principles of Speech Coding, CRC Press Second Edition, 2007.

NPTEL LINK: https://nptel.ac.in/courses/117105145

COURSE CODE	COURSE TITLE	L	T	P	C
20EC912	COGNITIVE RADIO	3	0	0	3

OBJECTIVES:

- To understand the evolving of software defined radio
- To understand cognitive radio techniques and their essential functionalities
- To study the basic architecture and standard for cognitive radio
- To understand the physical, MAC and Network layer design of cognitive radio
- To expose the student to evolving applications and advanced features of cognitive radio

Unit I INTRODUCTION TO SOFTWARE-DEFINED RADIO AND COGNITIVE RADIO 9

Evolution of Software Defined Radio and Cognitive radio: goals, benefits, definitions, architectures, relations with other radios, issues, enabling technologies, radio frequency spectrum and regulations.

Unit II COGNITIVE RADIO ARCHITECTURE 9

Cognition cycle – orient, plan, decide and act phases, Organization, SDR as a platform for Cognitive Radio – Hardware and Software Architectures, Overview of IEEE 802.22 standard for broadband wireless access in TV bands.

Unit III SPECTRUM SENSING AND DYNAMIC SPECTRUM ACCESS 9

Introduction – Primary user detection techniques – energy detection, feature detection, matched filtering, cooperative detection and other approaches, Fundamental Tradeoffs in spectrum sensing, Spectrum Sharing Models of Dynamic Spectrum Access – Unlicensed and Licensed Spectrum Sharing, Fundamental Limits of Cognitive Radio.

Unit IV MAC AND NETWORK LAYER DESIGN FOR COGNITIVE RADIO 9

MAC for cognitive radios – Polling, ALOHA, slotted ALOHA, CSMA, CSMA / CA, Network layer design – routing in cognitive radios, flow control and error control techniques.

Unit V ADVANCED TOPICS IN COGNITIVE RADIO 9

Overview of security issues in cognitive radios, auction based spectrum markets in cognitive radio networks, public safety and cognitive radio, cognitive radio for Internet of Things.

TOTAL:45 PERIODS

OUTCOMES:

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

CO1: Gain knowledge on design principles of software defined radio and cognitive radio.

CO2: Gain knowledge on design principles of software defined radio and cognitive radio

CO3: Build experiments and projects with real time wireless applications.

CO4: Apply the knowledge of advanced features of cognitive radio for real world applications

CO5: Explain the needs for cognitive radio

CO6: Describe the recent trends used in cognitive radio

TEXT BOOKS:

1. Alexander M. Wyglinski, Maziar Nekovee, Thomas Hou, -Cognitive Radio Communications and Networks‖, Academic Press, Elsevier, 2010.
2. Huseyin Arslan (Ed.), -Cognitive Radio, Software Defined Radio, and Adaptive Wireless, Springer, 2007.

REFERENCES:

1. Bruce Fette, Cognitive Radio Technology, Newnes, 2006.
2. Kwang-Cheng Chen, Ramjee Prasad, Cognitive Radio Networks, John Wiley and Sons, 2009.
3. Ezio Biglieri, Professor Andrea J. Goldsmith, Dr Larry J. Greenstein, Narayan B. Mandayam, H. Vincent Poor, Principles of Cognitive Radio , Cambridge University Press, 2012.
4. Markus Dillinger, Kambiz Madani, Nancy Alonistioti, Software Defined Radio, John Wiley, 2003.
5. Hasari Celebi, Huseyin Arslan, Enabling Location and Environment Awareness in Cognitive Radios, Elsevier Computer Communications , Jan 2008

NPTEL LINK: **https://nptel.ac.in/courses/108107107**

COURSE CODE	COURSE TITLE	L	T	P	C
20IT913	WIRELESS ADHOC AND SENSOR NETWORKS	3	0	0	3

OBJECTIVES:

- To learn about the issues and challenges in the design of wireless ad hoc networks.
- To understand the working of MAC and Routing Protocols for ad hoc and sensor networks
- To learn about the Transport Layer protocols and their QoS for ad hoc and sensor networks.
- To understand various security issues in ad hoc and sensor networks and the corresponding solutions.

UNIT I MAC AND ROUTING IN AD HOC NETWORKS 9

Introduction – Issues and challenges in ad hoc networks – MAC Layer Protocols for wireless ad hoc networks – Contention-Based MAC protocols – MAC Protocols Using Directional Antennas – Multiple-Channel MAC Protocols – Power-Aware MAC Protocols – Routing in Ad hoc Networks – Design Issues – Proactive, Reactive and Hybrid Routing Protocols

UNIT II TRANSPORT AND QOS IN AD HOC NETWORKS 9

TCP‟s challenges and Design Issues in Ad Hoc Networks – Transport protocols for ad hoc networks – Issues and Challenges in providing QoS – MAC Layer QoS solutions – Network Layer QoS solutions – QoS Model

UNIT III MAC AND ROUTING IN WIRELESS SENSOR NETWORKS 9

Introduction – Applications – Challenges – Sensor network architecture – MAC Protocols for wireless sensor networks – Low duty cycle protocols and wakeup concepts – Contention-Based protocols – Schedule-Based protocols – IEEE 802.15.4 Zigbee – Topology Control – Routing Protocols

UNIT IV TRANSPORT AND QOS IN WIRELESS SENSOR NETWORKS 9

Data-Centric and Contention-Based Networking – Transport Layer and QoS in Wireless Sensor Networks – Congestion Control in network processing – Operating systems for wireless sensor networks – Examples

UNIT V SECURITY IN AD HOC AND SENSOR NETWORKS 9

Security Attacks – Key Distribution and Management – Intrusion Detection – Software based Anti-tamper techniques – Water marking techniques – Defense against routing attacks - Secure Ad hoc routing protocols – Broadcast authentication WSN protocols – TESLA – Biba – Sensor Network Security Protocols – SPINS

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Interpret the concept of MAC and routing in ad hoc networks

CO2: Identify different issues in wireless ad hoc and sensor networks.

CO3: Analyze protocols developed for ad hoc and sensor networks.

CO4: Demonstrate the concept of transport and QoS in wireless sensor networks.

CO5: Identify and understand security issues in ad hoc and sensor networks.

TEXTBOOKS:

1. C.Siva Ram Murthy and B.S.Manoj, Ad Hoc Wireless Networks – Architectures and Protocols, Pearson Education, First Edition 2006
2. Holger Karl, Andreas Willing, Protocols and Architectures for Wireless Sensor Networks, John Wiley & Sons, Inc., 2005.

REFERENCES

1. Subir Kumar Sarkar, T G Basavaraju, C Puttamadappa, Ad Hoc Mobile Wireless Networks, Auerbach Publications, 2008.
2. Carlos De Morais Cordeiro, Dharma Prakash Agrawal, Ad Hoc and Sensor Networks: Theory and Applications ,Second Edition, World Scientific Publishing, 2011.
3. Waltenegus Dargie, Christian Poellabauer, Fundamentals of Wireless Sensor Networks Theory and Practice, John Wiley and Sons, 2010
4. Xiang-Yang Li , Wireless Ad Hoc and Sensor Networks: Theory and Applications, Thousand Two Hundred and Twenty Seventh Edition, Cambridge university Press, 2008

COURSE CODE	COURSE TITLE	L	T	P	C
20EC913	ARM SYSTEM ARCHITECTURE	3	0	0	3

OBJECTIVES:

- To study the ARM architecture and programming
- To study the various instruction set used in ARM processor
- To learn the Thumb Instructions
- To understand the ARM processor core
- To know the various embedded applications using ARM processor

UNIT I ARM ARCHITECTURE **9**

RISC machine-ARM programmer's model-Development tools-ARM assembly language programming-ARM organization-ARM instruction execution-ARM implementation-ARM coprocessor interface

UNIT II ARM INSTRUCTION SET **9**

ARM instruction set. Floating point architecture-Expressions-Conditional statements- loops-Functions and procedures-Use of memory- Run time environment

UNIT III THUMB INSTRUCTION SET **9**

Thumb instruction set-Thumb programmer's model-Thumb branch instruction-Thumb data processing instruction-data transfer instruction-implementation. ARM memory interface-Advanced Microcontroller Bus Architecture (AMBA)-ARMulator -JTAG boundary scan test architecture-ARM Debug architecture. Embedded trace.

UNIT IV ARM PROCESSOR CORE **9**

Memory hierarchy-Architectural support for operating systems-Memory size and speed-Cache memory management-Operating systems-ARM processor chips.ARM7TDMI-ARM8-ARM9TDMI-ARM10TDMI

UNIT V EMBEDDED ARM APPLICATIONS **9**

ARM MMU architecture-The ARM710T.ARM740T.ARM810.The ARM920T and ARM940T-The ARM946E-S and ARM966E-S.ARM1020E-The VLSI ISDN Subscriber Processor. The Ericsson-VLSI Bluetooth Baseband Controller-The ARM7500-The ARM7100

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Describe the ARM processor architecture and its family.

CO2: Develop assembly language programs to perform specific tasks using ARM instructions.

CO3: Develop Thumb instruction for ARM microcontroller applications using Embedded C language.

CO4: Analyze operating system employed in ARM processor core.

CO5: Analyze the various applications of ARM Embedded System Architecture.

CO6: Design Embedded applications using ARM processor..

TEXT BOOKS:

1. S.Furber, ARM System-on-Chip Architecture, Pearson ,Third Impression,2010
2. ARM System Developer's Guide, Designing and optimizing Systems Software: Andrew N. Sloss, D. Symes, C.Wright, Elsevier Reprinted 2010.

REFERENCES:

1. ARM Architecture Reference Manual, Second Edition, Published, edited by David Seal, Addison-Wesley, 2001.
2. Wayne Wolf, Computers as Components: Principles of Embedded Computing System Design, Morgan Kaufman Publishers, 2001.
3. Shibu K V, Introduction to Embedded Systems, Second Edition, Tata McGraw Hill Education Private Limited, 2017.
4. Technical reference manual for ARM processor cores, including Cortex, ARM 11, ARM 9 & ARM 7 processor families.
5. User guides and reference manuals for ARM software development and modeling tools.

NPTEL LINK: https://onlinecourses.nptel.ac.in/noc20_cs15/preview

COURSE CODE	COURSE TITLE	L	T	P	C
20EC914	FPGA AND ASIC DESIGN	3	0	0	3

OBJECTIVES:

- To study the design flow of different types of ASIC.
- To learn the architecture of different types of FPGA.
- To gain knowledge about partitioning, floor planning, placement and routing including circuit extraction of ASIC.
- To analyse the synthesis, Simulation and testing of systems.
- To know about different high-performance algorithms and its applications in ASICs.

UNIT I OVERVIEW OF ASIC **9**

Types of ASICs - Design flow – CAD tools used in ASIC Design – Programming Technologies: Antifuse – static RAM – EPROM and EEPROM technology, Programmable Logic Devices: ROMs and EPROMs – PLA –PAL. Gate Arrays – CPLDs and FPGAs

UNIT II ASIC PHYSICAL DESIGN **9**

System partition -partitioning - partitioning methods – interconnect delay models and measurement of delay - floor planning - placement – Routing: global routing - detailed routing - special routing - circuit extraction – DRC

UNIT III LOGIC SYNTHESIS, SIMULATION AND TESTING **9**

Design systems - Logic Synthesis - Half gate ASIC -Schematic entry - Low level design language - PLA tools -EDIF- CFI design representation. Verilog and logic synthesis -VHDL and logic synthesis - types of simulation -boundary scan test - fault simulation - automatic test pattern generation.

UNIT IV FPGA **9**

Field Programmable gate arrays- Logic blocks, routing architecture, Design flow technology - mapping for FPGAs, Xilinx XC4000 - ALTERA's FLEX 8000/10000, ACTEL's ACT-1,2,3 and their speed performance Case studies: Altera MAX 5000 and 7000 - Altera MAX 9000 – Spartan II and Virtex II FPGAs - Apex and Cyclone FPGAs

UNIT V POWER DISSIPATION AND FAULT MODELING **9**

Introduction to testing – Faults in digital circuits – Fault modelling/Detection – Delay models. Power dissipation – Dynamic power and Static power – Power saving, low power design – Circuit gate level techniques for ASIC/FPGA ICs, Implementation challenges.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Analyze the synthesis and simulation of systems.

CO2: Apply partitioning methods and routing connections.

CO3: Apply HDL algorithms in ASIC/FPGAs.

CO4: Apply the testing of systems.

CO5: Analyze the types of memories usage.

CO6: Analyze the faults and implementation challenges in the systems.

TEXT BOOKS:

1. M.J.S. Smith, Application Specific Integrated Circuits, Pearson, 2003.
2. Wayne Wolf, FPGA-Based System Design, Prentice Hall PTR, 2004.

REFERENCES:

1. S. Trimberger, Field Programmable Gate Array Technology, Edr, Kluwer Academic Publications, 1994.
2. Parag.K.Lala, Digital System Design using Programmable Logic Devices , BSP, 2003.
3. F. Nekoogar. Timing Verification of Application-Specific Integrated Circuits (ASICs). Prentice Hall PTR, 1999.
4. P.K.Chan & S. Mourad, Digital Design Using Field Programmable Gate Array, Prentice Hall, 1994.
5. J. Old Field, R.Dorf, Field Programmable Gate Arrays, John Wiley & Sons, Newyork,1995.

NPTEL LINKS : https://nptel.ac.in/courses/117101004

SEMESTER VII
ELECTIVE – V

COURSE CODE	COURSE TITLE	L	T	P	C
20EC915	FUNDAMENTALS OF 4G/5G WIRELESS COMMUNICATION	3	0	0	3

OBJECTIVES:

- To know about technology and evolution of LTE networks.
- To gain knowledge on protocol architecture and network architecture.
- To introduce 5G massive MIMO and NOMA system technology.
- To enable students to understand various wireless protocols.
- To know the need for network security and application in 5G.

UNIT I INTRODUCTION **9**

Introduction to 1G/2G/3G/4G/5G Terminology - Evolution of Public Mobile Services - Motivation for IP Based Wireless Networks - Requirements and Targets for Long Term Evolution (LTE) - Technologies for LTE- 4G Advanced Features and Roadmap Evolutions from LTE to LTEA To 5G, Need for 5G, Performance Bottleneck of Universal Mobile Telecommunications System High-Speed Packet Access (UMTS/HSPA) and Long-Term Evolution (LTE) Networks.

UNIT II WIRELESS ARCHITECTURES **9**

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 - Open wireless Architecture for 5G - Network architecture changes FROM 3G TO 5G.

UNIT III WIRELESS TECHNOLOGIES **9**

Cellular wireless networks and systems principles - Antennas and radio propagation - Signal encoding and modulation techniques., advanced modulation and coding, medium access techniques, cognitive radio and dynamic spectrum access networks, Static and dynamic channel allocation techniques, Introduction to 5G Massive MIMO Systems Introduction to Non-Orthogonal Multiple Access (NOMA) Technology

UNIT IV WIRELESS PROTOCOLS **9**

MAC Protocols, The Mediation Device Protocol, Contention based protocols - PAMAS, Schedule based protocols – LEACH, IEEE 802.15.4 MAC protocol, Challenges and Issues in Transport layer protocol. Routing protocols - Subscription management / roaming / offloading, IP telephony .

UNIT V NEED FOR SECURITY AND APPLICATIONS OF 4G AND 5G 9

Network Security Requirements, 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, Tele-medicine, Tele-education, AR/VR, Real time interactive gaming, IoT and smart cities, Satellite Internet, SnapDragon – Case study .

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Explain the basic features of 4G/5G communication technology.

CO2: The students will able to work with cellular networks and wireless protocols.

CO3: The students will able to work the principle of MIMO AMD NOMA.

CO4: The students will able to familiar with wireless protocols.

CO5: The students know the network security issues and challenges.

C06: Implement satellite internet, IoT hole and 5G smart antennas.

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. Harri Holma, Antti Toskala, Takehiro Nakamura, “ 5G Technology :3GPP New Radio”, John Wiley & Sons, 2019

REFERENCES:

1. W. Stallings, "Wireless Communications and Networks", Second Edition, Pearson Education, 2013

2. Harri Holma, Antti Toskala ,” WCDMA for UMTS: HSPA Evolution and LTE “, Fifth Edition John Wiley & Sons, Inc. Publication, 2010.

3. Dharma Prakash Agrawal and Qing-An Zeng, “Introduction to Wireless and Mobile Systems”, Third Edition ,Tomson, , 2011.

4. T Theodore S. Rappaport, “Wireless Communications -Principles Practice”, Second Edition, Prentice Hall of India, New Delhi, 2010.

5. Jyh-Cheng Chen and Tao Zhang, “IP-Based Next-Generation Wireless Networks Systems, Architectures, and Protocols”, First Edition, John Wiley & Sons, Inc. Publication, 2010

NPTEL LINK: https://onlinecourses.nptel.ac.in/noc22_ee56/preview

COURSE CODE	COURSE TITLE	L	T	P	C
20EC916	SATELLITE COMMUNICATION	3	0	0	3

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 compare the characteristics and performance.
- 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 ACESS 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

OUTCOMES:

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

CO1: Acquire knowledge of communication via satellite system.

CO2: Analyse the significance of various types of subsystems that make up a satellite system.

CO3: Design and analyse link budget.

CO4: Design compare and analyse access techniques

CO5: Learn advanced techniques and regulatory aspects of satellite communication

CO6: Analyse the applications of satellite systems

TEXT BOOKS:

1. Dennis Roddy,Satellite Communication, Fourth Edition, Mc Graw Hill International, 2006.

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 Book Co., 1984.
5. M.Richharia, Satellite Communication Systems-Design Principles, Macmillan 2003

NPTEL LINK: https://nptel.ac.in/courses/117105131

COURSE CODE	COURSE TITLE	L	T	P	C
20CB404	INTRODUCTION TO INNOVATION, IP MANAGEMENT & ENTREPRENEURSHIP	3	0	0	3

OBJECTIVES:

The Course will enable learners to:

- 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 for 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.) Lifecycle of IP (creation,protection, assetization, commercialization), Balancing IP Risks and Rewards (Right Access and Right Use of Open Source and 3rd party products, technology transferand 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

OUTCOMES:

Upon completion of the course, the students 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

REFERENCES:

1. Identifying Entrepreneurial Opportunities: Cognition and Categorization in
Nascent Entrepreneurs, Matthew J. Karlesky
2. http://www.businessdictionary.com/definition/entrepreneurship.
3. https://www.infoentrepreneurs.org/en/guides/use-innovation-to-grow-yourbusiness/
4. http://sourcesofinsight.com/innovation-life-cycle/
5. https://www.investottawa.ca/
6. https://www.Lead-innovation.com

COURSE CODE	COURSE TITLE	L	T	P	C
20IT927	INDIAN CONSTITUTION	3	0	0	3

OBJECTIVES:

- To have some knowledge about Indian Constitution.
- To understand the concept of fundamental rights
- To learn about Lok Sabha and Rajya Sabha
- To have some knowledge about Legislative Assembly and Legislative Council
- To learn about Local Self Government

UNIT I INTRODUCTION 9

Meaning and Importance of Constitution - Preamble and Salient Features of theConstitution.

UNIT II FUNDAMENTAL RIGHTS 9

Fundamental Rights, Right to Equality, Right to Freedom, Right against exploitation, Right to freedom of religion, Cultural and Educational Rights, Right to Constitutional Remedies and Duties, Directive Principles of State Policy.

UNIT III LOK SABHA AND RAJYA SABHA 9

Union Government – Lok Sabha and Rajya Sabha Composition, Powers and functions: The President, The Prime Minister and Supreme Court: Role Position and Powers/ functions.

UNIT IV LEGISLATIVE ASSEMBLY AND LEGISLATIVE COUNCIL 9

State Government - Legislative Assembly and Legislative Council: Composition,Powers and functions: The Governor, Chief Minister and High Court: Role, Position and Powers/ functions.

UNIT V LOCAL SELF GOVERNMENT 9

Local Self-Government, Panchayat Raj System in India; Election Commission; PublicService Commissions, Role, powers and function

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Interpret the knowledge on Indian Constitution.

CO2: Demonstrate the knowledge gained through fundamental rights concept.

CO3: Relate the concept of Lok Sabha and Rajya Sabha.

CO4: Illustrate the concept of Legislative Assembly and LegislativeCouncil.

CO5: Analyze the concept of Local Self Government.

TEXTBOOK:

1. M V Pylee, An Introduction to The Constitution of India, Vikas Publishing House Pvt. Ltd., Fifth Edition.

REFERENCES:

1. Durga Das Basu, Introduction to the Constitution of India, Nineteeth Edition Reprint 2009.
2. Sharma, Brij Kishore, “Introduction to the Constitution of India”, Prentice Hall of India, Seventh Edition, 2015.

COURSE CODE	COURSE TITLE	L	T	P	C
20EE925	LINUX KERNEL & DEVICE DRIVER PROGRAMMING	4	0	0	4

COURSE OBJECTIVES

This course is meant to give them a broad exposure to the understanding of various concepts of Linux Kernel and Device Driver Programming.

The course will provide the students with

(vi) The core concepts of operating systems

(vii) the knowledge of Linux Kernel architecture and device driver framework,

(viii) the methodology to write Programs for chosen embedded devices, and

(ix) the skill to use basic techniques for debugging in Linux device drivers and

(x) basic understanding of Linux based embedded system design.

Experiments will run in synchronism with the lectures to support the methods and techniques taught in the lectures. Through the experiments, the students will

(iii) learn how to setup environment for developing and debugging device drivers,

(iv) gain confidence to write/customise Linux device drivers, debug and test them using a target platform.

Teaching and Learning Strategy

Teaching and Learning Strategy	Description of Work	Class Hours	Out-of-Class Hours
Lectures supported by tutorials, assignments and experiments	Practical in Debian or Ubuntu Linux Environment and an embedded evaluation kit	15 hours	45 hours

Pre-requisites

1. Advanced C Programming
2. Basic Linux utilities
3. Comfortable with Linux text editors (Vim, Gedit, etc.)
4. Experience with major Linux distribution (Ubuntu, Debian, etc.)
5. Free course from Linux Foundation: A Beginner's Guide to Linux Kernel Development (LFD103)
6. Free course from Linux Foundation: Introduction to Linux (LFS101)

UNIT 1 INTRODUCTION TO THE LINUX KERNEL 9Hrs.

Preliminaries - UNIX Vs Linux, Types of Kernels, Versions, Kernel repository, Object-Oriented approach in Linux Kernel, Important Kernel tasks, User-Space and Kernel-Space.

Programming Preview - Error numbers and Getting Kernel output, Task structure, Memory allocations, Kernel data structures, Jiffies

Kernel Architecture Preview - Processes Vs Threads Vs Tasks, Process address space and Process context, Process limits and capabilities, Kernel Preemption, Real Time Preemption Patch, Dynamic Kernel Patching, Porting to a New Platform

Kernel Initialization - System initialization, System boot, U-Boot

Kernel Configuration - Layout of the Kernel source, Kernel configuration files, Kernel Building and Makefiles, initrd and initramfs

Kernel style & general considerations - Coding style, kernel-doc, Using generic Kernel routines and methods, sparse, Using likely() and unlikely(), Writing portable code (CPU, 32/64-bit, Endianness), Writing for SMP, Writing for high memory systems, Power management, Keeping security in mind, Mixing user and Kernel space headers

Modules - What are modules? Compiling modules, modules vs built-in, Module utilities, Automatic loading/unloading of modules, Module usage count, the module struct, Module licensing, exporting symbols, Resolving symbols

Lab work

1. Browsing/searching the Kernel source code
2. Booting a target development board over ethernet
3. Add a new system call
4. Code walkthrough for system initialisation code in Kernel
5. Create your first module and send it for review

UNIT 2 DEVICE DRIVERS I 9Hrs.

Device Driver Overview - Types of devices, Mechanism vs. Policy, avoiding binary blobs, Power management, How applications use device drivers, Walking through a system call accessing a device, Error numbers, printk(), devres: Managed device resources, Device driver binding

Platform Drivers - Platform devices, I2C subsystem, Device trees, Pin-muxing, Memory management overview, I/O memory and ports

Character Drivers - Character devices, Interaction of user space applications with the kernel, ioctls

Memory addressing - Virtual memory management, Systems with and without MMU and the TLB, Memory addresses, High and low memory, Memory zones, Special device nodes, NUMA, Paging, Page tables, page structure, Kernel Samepage Merging (KSM), Huge page support, libhugetlbfs, Transparent huge pages

Memory allocation - Requesting and releasing pages, Buddy system, Slabs and cache allocations, Memory pools, kmalloc(), vmalloc(), Early allocations and bootmem(), Memory defragmentation

Lab work

1. Implement a module that registers as an I2C driver
2. Modify the Device Tree to list the I2C device
3. Get the driver called when the device is enumerated at boot time
4. Configure the pin-mux for the I2C bus to communicate with the driver
5. Extend the driver to communicate with a I2C device
6. Extend the driver to communicate with user space
7. Extend the driver to implement ioctls
8. Demonstrate driver binding using udev
9. Write a module to gather memory statistics
10. Write a module to create a private memory cache
11. Write a module to setup a memory pool
12. Write a module to check the memory allocation limits

UNIT 3 KERNEL FRAMEWORK I **9Hrs.**

Race conditions & synchronization - Concurrency and synchronization Methods, Atomic operations, Bit operations, Spinlocks, Seqlocks, Disabling preemption, Mutexes, Semaphores, Completion functions, RCU, Reference counts

SMP and Threads - SMP Kernels and modules, Processor affinity, CPUSETS, SMP algorithms (Scheduling, Locking, etc.), Per-CPU variable

Scheduling - Main scheduling tasks, SMP, Scheduling priorities, Scheduling system calls, the schedule() function, O(1) Scheduler, Time slices and priorities, Load balancing, Priority inversion and priority inheritance, The CFS scheduler, Calculating priorities and fair times, Scheduling classes, CFS Scheduler Details

Disk caches and swapping – Caches, Page cache basics, what is swapping, Swap areas, swapping pages In and Out, Controlling swappiness, The swap cache, Reverse mapping, OOM Killer

Signals - What are Signals? Available signals, System calls for signals, Sigaction, Signals and threads, How the Kernel installs signal handlers, How the Kernel sends signals, How the Kernel invokes signal handlers, Real time signals

Lab work

1. Write module to get the current CPU ID
2. Create threads in Kernel and run them in different CPUs
3. Write a Kernel module to launch a user process
4. Write a program to simulate CFS
5. Write a program to defragment memory
6. Write a module to manipulate signals installed from user process

UNIT 4 DEVICE DRIVERS II **9Hrs.**

Input Subsystem – Principles of Kernel Input subsystem, API offered to kernel drivers to expose input devices capabilities to user space applications, User space API offered by the input subsystem

the misc Subsystem - What the misc kernel subsystem is useful for? API of the misc kernel subsystem (both the kernel side and user space side)

GPIO Subsystem - API of the GPIO kernel subsystem (both the kernel side and user space side)

PCI Drivers - What is PCI? Locating PCI Devices, Accessing Configuration Space, Accessing I/O and Memory Spaces, PCI Express

Sleeping and Interrupts, Locking

Monitoring & debugging

Lab work

1. Create a module to handle input events
2. Create a platform driver and hook it to the misc subsystem
3. Write a program to communicate with the GPIO port
4. Create a module to register a simple interrupt handler
5. Make a process sleep and wake-up from a module
6. Handle a variable from 3 simple modules using mutex
7. Handle a variable from 3 simple modules using Semaphore
8. Compute the average time slices of a process
9. Write a program to examine and modify the scheduling policies and priority
10. Write a basic PCI driver
11. Write interrupt example programs from LDD3

UNIT 5 KERNEL FRAMEWORK II **9Hrs.**

DMA - What is DMA? DMA directly to user, DMA and Interrupts, DMA memory constraints, DMA masks, DMA API, DMA pools, Scatter/Gather mappings

Memory Technology Devices - What are MTD Devices? NAND vs. NOR vs. eMMC, Flash filesystems

Block Drivers - What are Block Drivers? Buffering, Registering a block driver, gendisk structure, Request handling

Power Management - ACPI and APM, System power states, Callback functions

Network Drivers - Network Layers and Data Encapsulation, Datalink Layer, Network Device Drivers, Loading/Unloading, Opening and Closing, net_device, sk_buff, Tx/Rx, iocts, NAPI

Overview of ARM support in Kernel

Lab work

1. Write a simple block driver
2. Code walkthrough for an example USB driver
3. Code walkthrough for an example Network driver
4. Write SNULL driver example from LDD3
5. Write DMA driver example from LDD3

COURSE OUTCOMES :

Learning Outcome of students are

CO1. Understanding of complex Linux Kernel framework and extending this knowledge to understand any type of operating system

CO2. Writing device drivers for simple embedded devices

CO3. Basic scripting to building the Linux Kernel and Device Drivers

CO4. Demonstrate end-end data flow from device to application

CO5. Demonstrate various debugging techniques when the system crashes due to a malfunctioning Kernel or Device Driver

CO6. Plan and execute simple device driver development projects.

TEXTBOOK/ REFERENCE BOOKS

Text Books:

Linux Device Drivers (LDD), Third Edition
Linux Kernel Development, Third Edition, Robert Love

Reference Books:

Linux System Programming, Second Edition, Robert Love
The Linux Programming Interface, Michael Kerrisk
Linux Kernel Documentation

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3Hrs.**

Type of Assessment	Description	Percentage
Quiz (2 or 3)	1. Classroom attention 2. Adhoc Quizzes of approx. 40 mins each will be taken to evaluate the continuous progress	15 %
Mid Term (1)	One Mid Term of 1½ hour Practical Examination will be taken	25 %
Laboratory	Laboratory continuous monitoring and Exam	15%
Assignment	Two projects will be given, one before the mid-semester and one after the mid-semester	15%
End Term (1)	4-hour End Practical exam will be taken to evaluate the overall understanding	30 %
	Total	100%

OPEN ELECTIVES

COURSE CODE	COURSE TITLE	L	T	P	C
20EC001	SENSORS AND TRANSDUCERS	3	0	0	3

OBJECTIVES:

- To understand the concepts of measurement technology.
- To learn about motion and proximity sensors.
- To interpret force, magnetic and heading sensors.
- To Enumerate the functionalities of optical pressure and temperature sensors.
- To learn the fundamentals of signal conditioning and data acquisition system.

UNIT I INTRODUCTION **9**

Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types.

UNIT II MOTION AND PROXIMITY SENSORS **9**

Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn,

UNIT III FORCE, MAGNETIC AND HEADING SENSORS **9**

Strain Gage, Load Cell, Magnetic Sensors –types, principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers.

UNIT IV 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 V SIGNAL CONDITIONING AND DAQ SYSTEMS **9**

Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multi-channel data acquisition – Data logging and types of data loggers.

TOTAL: 45 PERIODS

OUTCOMES:

The students will be able to

CO1: Analyze the problems related to sensors & transducers.

CO2: Expertise in various calibration techniques and signal types for sensors.

CO3. Study the basic characteristics of transducers and sensors.

CO4: Understand the properties and working of various transducers.

CO5: Select the right sensor/transducer for a given applications

CO6: Describe various signal conditioning and DAQ systems.

TEXT BOOKS:

1. Ernest O Doebelin, Measurement Systems – Applications and Design, Tata McGraw-Hill, 2009.

2. Sawney A K and Puneet Sawney, A Course in Mechanical Measurements and Instrumentation and Control, Twelfth Edition, Dhanpat Rai & Co, New Delhi, 2013.

REFERENCES

1. Patranabis D, Sensors and Transducers, Second Edition, PHI, New Delhi, 2010.

2. John Turner and Martyn Hill, Instrumentation for Engineers and Scientists, Oxford Science Publications, 1999.

3. Richard Zurawski, Industrial Communication Technology Handbook, Second Edition, CRC Press, 2015.

4. Doebelin E.O. and Manik D.N., Measurement Systems, Sixth Edition, McGraw-Hill Education Pvt. Ltd., 2011.

5.Ian Sinclair, Sensors and Transducers, Third Edition, Elsevier, 2012.

NPTEL LINK: https://nptel.ac.in/courses/108/105/108105064/

COURSE CODE	COURSE TITLE	L	T	P	C
20EC002	MATLAB PROGRAMMING	3	0	0	3

OBJECTIVES:

- To learn features of MATLAB as a programming tool
- 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 use MATLAB as a simulation tool
- To learn the MATLAB Library

UNIT I INTRODUCTION TO MATLAB **9**

The MATLAB Environment - MATLAB Basics – Variables, Numbers, Operators, Expressions, Input and output - Vectors, Arrays – Matrices

UNIT II MATLAB FUNCTIONS **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

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

CO6: Know about recent trends in MATLAB

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. Michael Paluszek, Stephanie Thomas,Practical MATLAB Deep Learning: A Project-Based Approach, Apress,Fourth Edition, 2016.
5. Brian Hahn and Daniel T. Valentine,Essential MATLAB for Engineers and Scientists, Seventh Edition, Apress, 2018.

NPTEL LINKS: **https://nptel.ac.in/courses/103/106/103106118/**

COURSE CODE	COURSE TITLE	L	T	P	C
20EC003	MEDICAL ELECTRONICS	3	0	0	3

OBJECTIVES:

- To gain knowledge about the various physiological parameters both electrical and non-electrical and the methods of recording and also the method of transmitting these parameters
- To study about the various assist devices used in the hospitals
- To gain knowledge about equipment used for physical medicine and the various recently developed diagnostic and therapeutic techniques
- To understand the physical medicine methods eg. ultrasonic, shortwave, microwave surgical diathermies , and bio-telemetry principles and methods
- To know about recent trends in medical instrumentation

UNIT I ELECTRO-PHYSIOLOGY AND BIO-POTENTIAL RECORDING 9

Sources of bio medical signals, Bio-potentials, Biopotential electrodes, ECG, EEG, EMG, PCG, typical waveforms and signal characteristics

UNIT II BIO-CHEMICAL AND NON ELECTRICAL PARAMETER MEASUREMENT 9

Colorimeter, Blood flow meter, Cardiac output, respiratory, blood pressure, temperature and pulse measurement

UNIT III ASSIST DEVICES 9

Cardiac pacemakers, DC Defibrillator, Dialyser, Ventilators

UNIT IV PHYSICAL MEDICINE AND BIOTELEMETRY 9

Diathermies- Shortwave, ultrasonic and microwave type and their applications, Surgical Diathermy, Biotelemetry.

UNIT V RECENT TRENDS IN MEDICAL INSTRUMENTATION 9

Telemedicine, Insulin Pumps, Radio pill, Endomicroscopy, Brain machine interface, Lab on a chip.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Know the human body electro- physiological parameters and recording of bio-potentials

CO2: Comprehend the non-electrical physiological parameters and their measurement – body temperature, blood pressure, pulse, blood cell count, blood flow meter etc.

CO3: Interpret the various assist devices used in the hospitals viz. pacemakers, defibrillators, dialyzers and ventilators

CO4: Understand physical medicine methods eg. ultrasonic, shortwave, microwave surgical diathermies

CO5: Understand about bio-telemetry principles and methods

CO6: Know about recent trends in medical instrumentation

TEXT BOOKS:

1. Leslie Cromwell, Biomedical Instrumentation and Measurement, Prentice Hall of India, New Delhi, 2007.

2.Alan S. Morris, Reza Langari, Measurement and Instrumentation Theory and Application, Elsevier, 2020.

REFERENCES:

1. Khandpur, R.S., Handbook of Biomedical Instrumentation, TATA Mc Graw-Hill, New Delhi, 2003.
2.John G.Webster, Medical Instrumentation Application and Design, Third Edition, Wiley India 2007.
3. Joseph J.Carr and John M.Brown, Introduction to Biomedical Equipment Technology, John Wiley and Sons, New York, 2004. ISO9001-2015 Standards.
4. J. G. Webster, Medical Instrumentation Application and Design Wiley Publication, 2015.

5.D. Jennings, B.C.H. Turton, Introduction to Medical Electronics Applications,Elsevier Ltd,1995.

NPTEL LINK: **https://nptel.ac.in/courses/108/105/108105101/**

COURSE CODE	COURSE TITLE	L	T	P	C
20EC004	Industrial IoT Applications	3	0	0	3

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 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 introduce the tools and techniques that enable IoT solution and Securityaspects.

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; 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

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

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,First 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

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, Second Edition,Wiley Publications
3. Internet of Things - From Research and Innovation to Market Deployment; by OvidiuVermesan & Peter Friess; 2014, River Publishers Series
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

COURSE CODE	COURSE TITLE	L	T	P	C
20EC005	INTRODUCTION TO IMAGE PROCESSING	3	0	0	3

OBJECTIVES:

• To understand the fundamentals of digital image processing

• To analyze the need for different types of image transforms and their properties

• To infer the different techniques employed for the enhancement of images.

• To learn different feature extraction techniques for image analysis and recognition.

• To interpret the need for image compression using the spatial and frequency domain techniques.

UNIT I FUNDAMENTALS OF IMAGE PROCESSING 9

Need for Digital Image Processing, Fundamental steps in Digital Image Processing, Elements of visual perception, Image sensing and Acquisition, Image Sampling and Quantization,Imaging geometry, Discrete image mathematical characterization.

UNIT II IMAGE TRANSFORMS 9

Two dimensional Fourier Transform: Properties, Fast Fourier Transform , Inverse FFT,Discrete cosine transform and KL transform, Discrete wavelet Transform and its application.

UNIT III IMAGE ENHANCEMENT AND IMAGE RESTORATION 9

Spatial Domain: Basic relationship between pixels, Basic Gray level Transformations, Histogram Processing, Smoothing and Sharpening spatial filters.

Frequency Domain: Smoothing and sharpening frequency domain filters, Homomorphic filtering, Overview of Degradation models - Unconstrained and constrained restorations, Inverse Filtering, Wiener Filter.

UNIT IV FEATURE EXTRACTION 9

Detection of discontinuities, Edge linking and Boundary detection,Thresholding,Edge based segmentation,Region based Segmentation, Advanced optimal border and surface detection,Use of motion in segmentation,Image Morphology ,Boundary descriptors, Regional descriptors.

UNIT V ERROR FREE COMPRESSION AND IMAGE RECONSTRUCTION 9

Variable length coding, LZW, Bit-plane coding, Lossless predictive coding, Lossy compression-Lossy predictive coding, transform coding, wavelet coding. Image compression standards:CCITT,

JPEG, JPEG 2000, Video compression standards. Need for Radon Transform ,Back projection operator,Projection Theorem,Inverse Radon Transform. **TOTAL:45 PERIODS**

OUTCOMES:

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

CO1: Understand the 2D system which is the extension of 1D system.

CO2: Enumerate the different types of image transforms and their properties.

CO3: Learn different techniques employed for the enhancement of images.

CO4: Apply image processing algorithms for practical object recognition applications.

CO5: Outline error free compression techniques and standards.

CO6: Annotate the fundamentals of digital image processing including filtering, transforms and morphology, compression and reconstruction.

TEXT BOOK:

1. Rafael C.Gonzalez & Richard E.Woods, Digital Image Processing, Fourth Edition, Pearson Education, 2018.

2. Anil.K.Jain, Fundamentals of Digital Image Processing, Pearson Education, 2015.

REFERENCES:

1. B.Chanda D.Dutta Majumder ,Digital Image Processing and Analysis ,Prentice Hall of India ,2002

2. William K. Pratt ,Digital Image Processing ,Second Edition, John Wiley & Sons, 2004

3. R.C.Gonzalez & R.E. Woods, Digital Image Processing with MATLAB, Prentice Hall, 2003

4. J.C. Russ, The Image Processing Handbook, Fifth Edition,CRC, 2006

5. Mark Nixon & Alberto Aguado, Feature Extraction, and Image Processing, Third Edition, Elsevier‟s Science & Technology Publications Woborn MA, Great Britain,2012.

NPTEL LINK: **https://nptel.ac.in/courses/117/105/117105135/**

COURSE CODE	COURSE TITLE	L	T	P	C
20EC006	ARDUINO FOR ENGINEERS	3	0	0	3

OBJECTIVES:

- Arduino microcontroller, its architecture and programming to design application systems
- The processor architecture and instruction set architecture as the underlying principles
- Study of Arduino Interfacing and its applications
- Develop program using Arduino
- Design methodology to build embedded system using Arduino

UNIT I INTRODUCTION TO ARDUINO MICROCONTROLLER 9

Features of Arduino Microcontroller, Architecture of Arduino, Different boards of Arduino, Overview of Arduino Interfacing and Applications, Anatomy of an Interactive Device like Sensors and Actuators, A to D converters and their comparison

UNIT II ARM PROCESSOR 9

Features of ARM processor, ARM Architecture, Instruction set architecture, ARM Programming, Interrupt Service Routines (ISR), Instruction level parallelism

UNIT III ARDUINO INTERFACING AND APPLICATIONS 9

Blinking an LED, LCD Display, driving a DC and stepper motor, Temperature sensors, Serial Communications, Sending Debug Information from Arduino to Your Computer, Sending Formatted Text and Numeric Data from Arduino, Receiving Serial Data in Arduino, Sending Multiple Text Fields from Arduino in a Single Message, Receiving Multiple Text Fields in a Single Message in Arduino. Light controlling with PWM.

UNIT IV PROGRAMMING IN ARDUINO 9

The Code designing step by step. Taking a Variety of Actions Based on a Single Variable, Comparing Character and Numeric Values, Comparing Strings, Performing Logical Comparisons, Performing Bitwise Operations, Combining Operations and Assignment, Using Embedded techniques to program Arduino microcontroller, Understanding the libraries of Arduino programming language and applying for circuit design.

UNIT V DESIGNING ARDUINO BASED EMBEDDED SYSTEM 9

Complex systems and microprocessors – Embedded system design process –Design example: Model train controller- Design methodologies- Design flows - Requirement Analysis – Specifications-System analysis and architecture design – Quality Assurance techniques - Designing with computing platforms – consumer electronics architecture – platform-level performance analysis.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Understand of features of Arduino board, analyze the internal Architecture of Arduino board.
CO2: Understand and analyse the ARM Processor architecture and instruction set architecture
CO3: Apply Arduino board programming concepts to build interfaces through sensors and actuators
CO4: Apply Arduino board programming concepts to build applications
CO5: Study of Embedded programming in Arduino
CO6: Design and implement Arduino based embedded systems

TEXT BOOKS:

1. Michael Margolis, Arduino Cookbook by, Second Edition , O'Reilly 2012.
2. Arduino for beginners : Essential Skills Every Maker Needs, John Baichtal, First Edition, Person Education, 2013.

REFERENCES:

1. Michael McRoberts, Beginning Arduino, Technology in action publications.
2. Alan G. Smith, Introduction to Arduino: a piece of cake, CreateSpace Independent Publishing Platform ,2011
3. John Boxall, Arduino Workshop - a Hands-On Introduction with 65 Projects, No Starch Press; First Edition ,2013
4. Beginning C for Arduino Second Edition: Learn C Programming for the Arduino, Jack Purdum, Springer Nature, 2015.
5. Programming Arduino: Getting Started with Sketches, Second Edition (ELECTRONICS), Simon Monk, Second Edition, McGraw Hill TAB, 2016.

NPTEL LINK: https://onlinecourses.swayam2.ac.in/aic20_sp04/preview

COURSE CODE	COURSE TITLE	L	T	P	C
20EC007	ELECTRONIC MATERIALS	3	0	0	3

OBJECTIVES:

- To understand the various materials and its properties towards the electrical and electronics field.
- To contrast the factors affecting the material conductivity.
- To infer the basics of semiconducting and magnetic materials
- To annotate the factors influencing dielectric strength and capacitor materials
- To learn about Opto Electronic and Nano electronic materials.

UNIT I INTRODUCTION 9

Structure: atomic structures and bonding , types of bonding, band formation. Defects and imperfections in solids: Point, line and Planer defects, Interfacial defects and volume defects. Classification of materials based on bonding: conductors, semiconductors and insulators.

UNIT II CONDUCTING MATERIALS 9

Introduction, factors affecting the conductivity of materials, classification based on conductivity of materials, temperature dependence of resistivity, Low resistivity materials (graphite, Al, Cu and Steel) and its applications, high resistivity materials (manganin, constantin, nichrome, tungsten) and their applications. Superconductors: Meissner effect, classification and applications.

UNIT III SEMICONDUCTING AND MAGNETIC MATERIALS 9

Semiconductors: Introduction, types of semiconductors, temperature dependence of semiconductors, compound semiconductors, basic ideas of amorphous and organic semiconductors.

Magnetic Materials: classification of magnetic materials, ferromagnetism-B-H curve (Qualitative), hard and soft magnetic materials, magneto materials, applications.

UNIT IV DIELECTRIC AND INSULATING MATERIALS 9

Dielectric Materials: Introduction, classification, temperature dependence on polarization, properties, dielectric loss, factors influencing dielectric strength and capacitor materials, applications.

Insulators: Introduction, thermal and mechanical properties required for insulators, Inorganic materials, organic materials, liquid insulators, gaseous insulators and ageing of insulators, applications.

UNIT V OPTOELECTRONIC AND NANO ELECTRONIC MATERIALS 9

Optoelectronic materials: Introduction, properties, factor affecting optical properties, role of optoelectronic materials in LEDs, LASERs, photodetectors, solar cells.

Nano electronic Materials: Introduction, advantage of nanoelectronic devices, materials, fabrication, challenges in Nano electronic materials, Smart materials- Overview **TOTAL: 45 PERIODS**

OUTCOMES:

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

CO1: Define the structure and classification of materials

CO2: Analyze the low and high resistivity materials and superconductors

CO3: Classify the magnetic materials and semiconductor materials

CO4: Infer the properties of insulators and dielectric materials

CO5: Annotate the challenges in fabricating opto and nano materials

CO6: Interpret clear concepts on electronic behavior of materials

TEXT BOOKS:

1. S.O. Kasap Principles of Electronic Materials and Devices, Third Edition, McGraw-Hill Education (India) Pvt. Ltd., 2007.

2. W D Callister, Materials Science & Engineering – An Introduction, Jr., Seventh Edition, John Willey & Sons, Inc, New York, 2007.

REFERENCES:

1. B.G. Streetman and S. Banerjee, Solid State Electronic Devices, Sixth Edition, PHI Learning, 2009.
2. Eugene A. Irene, Electronic Materials Science, Wiley, 2005
3. Wei Gao, Zhengwei Li, Nigel Sammes, An Introduction to Electronic Materials for Engineers, World Scientific Publishing Co. Pvt. Ltd., Second Edition, 2011.
4. William D. Callister, Jr., Fundamentals of Materials Science and Engineering, Fifth Edition,John Wiley & Sons, Inc,2001.
5. S.O. Kasap Optoelectronics and Photonics: Principles and Practices,Pearson Education,2009.

NPTEL LINK: https://nptel.ac.in/courses/113106065

COURSE CODE	COURSE TITLE	L	T	P	C
20EC008	INTRODUCTION TO EMBEDDED SYSTEM	3	0	0	3

OBJECTIVES:

- Be familiar with the embedded computing platform design and analysis.
- Learn the architecture and programming of ARM processor.
- Be exposed to the basic concepts of real time operating system and scheduling.
- Be familiar with different applications of embedded system
- To learn the applications of embedded systems in various domains.

UNIT I INTRODUCTION TO EMBEDDED SYSTEM DESIGN 9

Complex systems and microprocessors– Embedded system design process –Design example: Model train controller – **System Design Techniques:** Design methodologies - Design flows – Requirement Analysis – Specifications - System analysis and architecture design – Quality Assurance techniques – Safety oriented methodologies.

UNIT II INSTRUCTION SETS 9

Computer architecture taxonomy – Assembly languages – VLIW processors – ARM processor – PICmicro midrange family – TI C55x DSP – TI C64x.

UNIT III EMBEDDED PROGRAM DESIGN AND ANALYSIS 9

Components for embedded programs- Models of programs- Assembly, linking and loading – compilation techniques- Program level performance analysis – Software performance optimization – Program level energy and power analysis and optimization – Analysis and optimization of program size- Program validation and testing.

UNIT IV PROCESSES AND OPERATING SYSTEMS 9

Introduction – Multiple tasks and multiple processes – Multirate systems- Preemptive real time operating systems- Priority based scheduling- Interprocess communication mechanisms – Evaluating operating system performance – Example Real time operating systems - POSIX-Windows CE – Distributed embedded systems – MPSOCs and shared memory multiprocessors.

UNIT V APPLICATIONS OF EMBEDDED SYSTEMS 9

Data compressor - Alarm clock - Audio player - Software modem - Digital still camera - Telephone answering machine-Engine control unit – Video accelerator – Optical disk.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Acquire knowledge on basic components of embedded system design

CO2: Analyze the concepts of embedded systems.

CO3: Describe the architecture and programming of ARM processor.

CO4: Use the system design techniques to develop software for embedded systems.

CO5: Acquire knowledge on fundamentals of RTOS and its various scheduling policies

CO6: Model real-time consumer/industrial applications using embedded-system concepts

TEXT BOOKS:

1. Marilyn Wolf, Computers as Components - Principles of Embedded Computing System Design, Fourth Edition Morgan Kaufmann Publisher (An imprint from Elsevier), 2016.
2. Alexander G. Dean, Embedded Systems Fundamentals with Arm Cortex-M based Microcontrollers: A Practical Approach, ARM Education media, Paperback ,2017

REFERENCES:

1. Lyla B. Das,— Embedded Systems: An Integrated Approach – Pearson Education, 2013.
2. Jonathan W. Valvano, — Embedded Microcomputer Systems Real Time Interfacing, Third Edition Cengage Learning, 2012.
3. David. E. Simon, — An Embedded Software Primer‖, First Edition, Fifth Impression, Addison Wesley Professional, 2007
4. Raymond J.A. Buhr, Donald L. Bailey, — An Introduction to Real-Time Systems -From Design to Networking with C/C++‖, Prentice Hall, 1999.
5. Sriram V Iyer, Pankaj Gupta, Embedded Real Time Systems Programming, Tata McGraw Hill, 2017.

NPTEL LINK :https://nptel.ac.in/courses/106/105/106105193/