NATIONAL ENGINEERING COLLEGE

(An Autonomous Institution Affiliated to Anna University Chennai & Accredited by NAAC)

K.R.NAGAR, KOVILPATTI – 628 503
www.nec.edu.in

REGULATIONS – 2019

CURRICULUM & SYLLABUS

B. E. – ELECTRONICS AND COMMUNICATION ENGINEERING
Accredited by NBA

B. E. – ELECTRONICS AND COMMUNICATION ENGINEERING

CURRICULUM AND SYLLABUS

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

VISION

To produce Electronics and Communication Engineers capable of generating a knowledge economy with social responsibility

MISSION

- To impart high quality education with ethical behavior.
- To equip the students compatible with recent trends in Electronic industries.
- To develop leadership qualities with humanity, wisdom, creativity and team spirit.
- To provide a passionate environment for continual learning.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

1. Graduate will have successful technical career in core and related fields.
2. Graduates will pursue higher education and work in Research and Development for solving real world problems.
3. Graduates will have leadership qualities with social consciousness and ethics.

PROGRAMME OUTCOMES (POs)

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

2. **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.

3. **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.

4. **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.

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

6. **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.

7. **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.

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

9. **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **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.

11. **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.

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

PREAMBLE OF THE CURRICULUM & SYLLABI

The Curriculum and Syllabi under Regulations 2019 are implemented based on the recommendations of AICTE, New Delhi and UGC, New Delhi. The course content of each course shall be fixed in accordance with the Programme Educational Objectives (PEOs), Programme Outcomes (POs) and Course Outcomes (COs).

Further, The CBCS enables the students to earn credits across programmes and provides flexibility for slow and fast learners in registering the required number of credits in a semester. The CBCS facilitates the transfer of credits earned in different departments / Centers of other recognized / accredited universities or institutions of higher education in India and abroad either by studying directly or by online method.

The curriculum of **ECE programme** is designed with total number of credits ***168 (128*** for Lateral entry). The curriculum shall have the following category of courses with credits as given in Table-1.

TABLE – 1 CATEGORY OF COURSES

Sl. No	Coursework – Subject Area	The range of Total credits
1.	Humanities and Social Sciences including Management courses	13
2.	Basic Science courses	27
3.	Engineering Science courses	20
4.	Programme Core courses	66
5.	Programme Elective courses relevant to chosen specialization / branch	15
6.	Open Elective courses from other technical and /or emerging subject areas	12
7.	Skill Development Courses	15
8.	Mandatory courses	(non – credit)
	TOTAL	**168**

i. **Humanities and Social Sciences (HSMC)** include English, Communication Skill laboratory and Management courses

ii. **Basic Science Courses (BSC)** include Chemistry, Physics, Biology and Mathematics

iii. **Engineering Science Courses (ESC)** include Workshop, Drawing, Basics of Electrical / Electronics / Mechanical / Civil / Computer / Instrumentation Engineering

iv. **Programme Core Courses (PCC)** include the core courses relevant to the chosen programme of study.

v. **Programme Elective Courses (PEC)** include the elective courses relevant to the chosen programme of study.

vi. **Open Elective Courses (OEC)** include inter-disciplinary courses which are offered in other Engineering/Technology Programme of study.

vii. **Skill Development Courses (SDC)** include the courses such as Project, Seminar and Inplant training / Internship for improving Employability Skills.

viii. **Mandatory courses (MAC)** include Personality and Character development and the courses recommended by the regulatory bodies such as AICTE, UGC, etc.

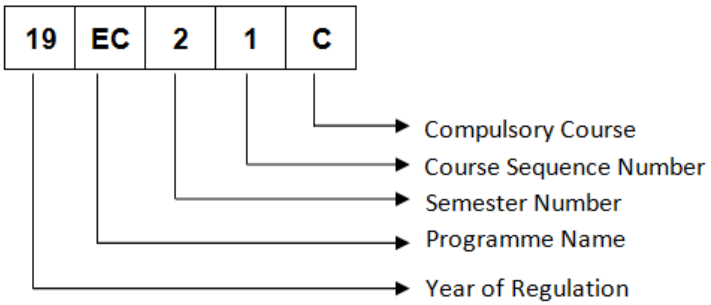
Performance in each course of study shall be evaluated based on Continuous Assessment throughout the semester and end semester examination at the end of the programme. Keeping in mind the content of the courses and delivery methods, different question paper patterns are suggested, as given in Table-2.

TABLE – 2 QP – QUESTION PATTERN

R-2019 REVISED Question Pattern Format

Subject Type	Question pattern	2 marks	4 marks	10 marks	11 marks	12 marks	16 marks	20 marks	Total
Theory (3 / 4 credit)	A	10	5	-	--	5 Qns (either or type)	--	--	100
Theory (2 credit)	B	10	-	-	5 Qns (either or type)	--	--	--	75
Theory (1 credit)	C	5	--	2 Qns (either or type)	--	--	--	--	30
Theory (Trans Disciplinary)	D	-	-	-	-	-	--	5 out of 8	100
Design Oriented / Theory	E	--	-	--	-	-	--	5 Qns (either or type)	100
Theory (3 / 4 credit)	F	10	--	--	--	--	5 Qns (either or type)	--	100

FORMAT FOR COURSE CODE



REGULATIONS – 2019 CURRICULUM AND SYLLABUS

SEMESTER – I

S. No	Course Category	Course Code	Course Title	L	T	P	C	Question pattern⊕
THEORY COURSES								
1.	HSMC	19SH11C	Technical English	2	0	0	2	B
2.	BSC	19SH12C	Mathematical Foundations For Engineers	3	1	0	4	A
3.	BSC	19SH13C	Engineering Physics	2	0	0	2	B
4.	BSC	19SH14C	Engineering Chemistry	2	0	0	2	B
5.	ESC	19EC11C	Basic Electrical Engineering	3	0	0	3	A
PRACTICAL COURSES								
6.	BSC	19SH16C	Engineering Physics and Engineering Chemistry Laboratory Part A – Engineering Physics Laboratory Part B – Engineering Chemistry Laboratory	0	0	3	1.5	-
7.	ESC	19SH17C	Engineering Practice Laboratory* Part A – Mechanical Laboratory Part B – Electrical and Electronics Laboratory	0	0	4	2	-
8.	ESC	19EC12C	Basic Electrical Engineering Laboratory	0	0	4	2	-
			TOTAL	**12**	**1**	**11**	**18.5**	

SEMESTER – II

S. No	Course Category	Course Code	Course Title	L	T	P	C	Question pattern⊕
THEORY COURSES								
1	HSMC	19EC21C	Professional English	2	0	0	2	B
2	BSC	19EC22C	Calculus and Laplace Transform	3	1	0	4	A
3	BSC	19EC23C	Electromagnetic Theory	2	0	0	2	B
4	BSC	19EC24C	Biology and Biomaterials	2	0	0	2	B
5	ESC	19EC25C	Problem Solving Techniques	3	0	0	3	A
6	ESC	19SH15C	Engineering Graphics	2	0	4	4	E
7.	HSMC	19GN02C	Heritage of Tamils (தமிழர் மரபு)	1	0	0	1	**C**
PRACTICAL COURSES								
8.	BSC	19EC26C	Electromagnetism and Biology Laboratory Part A – Electromagnetism Laboratory Part B – Biology Laboratory	0	0	3	1.5	-
9.	ESC	19EC27C	Problem Solving Techniques Laboratory	0	0	4	2	-
10.	SDC	19GN01C	Innovation through Design Thinking	1	0	2	2	
			TOTAL	**16**	**1**	**13**	**23.5**	

SEMESTER – III

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	Question pattern⊕
THEORY COURSES								
1.	PCC	19EC31C	Electronic Devices	3	0	0	3	A
2.	PCC	19EC32C	Digital System Design	3	0	0	3	A
3.	PCC	19EC33C	Signals and Systems	3	0	0	3	A
4.	PCC	19EC34C	Network Theory	3	0	0	3	A
5.	BSC	19EC35C	Fourier Series and Mathematical Transforms	3	1	0	4	A
6.	ESC	19EC36C	C++ and Data structures	3	0	0	3	A
7.	HSMC	19GN03C	Tamils and Technology (தமிழரும் தொழில் நுட்பமும்)	1	0	0	1	**C**
PRACTICAL COURSES								
8.	PCC	19EC37C	Electronic Devices Laboratory	0	0	3	1.5	-
9.	PCC	19EC38C	Digital System Design Laboratory	0	0	3	1.5	-
10.	ESC	19EC39C	C++ and Data structures Laboratory	0	0	2	1	-
			TOTAL	**18**	**1**	**8**	**23**	

SEMESTER – IV

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	Question pattern⊕
THEORY COURSES								
1.	PCC	19EC41C	Analog and Digital Communication	3	1	0	4	A
2.	PCC	19EC42C	Electronic Circuits	3	1	0	4	A
3.	PCC	19EC43C	Microprocessor & Microcontrollers	3	0	0	3	A
4.	BSC	19EC44C	Probability, Random Processes and Queuing Theory	3	1	0	4	A
5.	MAC	19MC02C	Constitution of India	3	0	0	0	D
PRACTICAL COURSES								
6.	PCC	19EC45C	Analog and Digital Communication Laboratory	0	0	3	1.5	-
7.	PCC	19EC46C	Electronic Circuits Laboratory	0	0	3	1.5	-
8.	PCC	19EC47C	Microprocessor and Microcontrollers Laboratory	0	0	3	1.5	-
9.	HSMC	19EC48C	Communication Skills Laboratory	0	0	2	1	-
			TOTAL	**15**	**3**	**11**	**20.5**	

SEMESTER – V

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	Question pattern⊕
THEORY COURSES								
1.	PCC	19EC51C	Electromagnetic Waves	3	0	0	3	A
2.	PCC	19EC52C	Computer Architecture	3	0	0	3	A
3.	PCC	19EC53C	Linear Integrated Circuits	3	0	0	3	A
4.	PCC	19EC54C	Digital Signal Processing	3	0	0	3	A
5.	PEC		Programme Elective-1	3	0	0	3	A
6.	OEC		Open Elective - 1	3	0	0	3	A
7.	MAC	19MC01C	Environmental Science and Engineering	3	0	0	0	D
PRACTICAL COURSES								
8.	PCC	19EC55C	Electromagnetic Waves Laboratory	0	0	3	1.5	-
9.	PCC	19EC56C	Digital Signal Processing Laboratory	0	0	3	1.5	-
10.	PCC	19EC57C	Linear IC and Measurements Laboratory	0	0	3	1.5	-
			TOTAL	**21**	**0**	**9**	**22.5**	

SEMESTER – VI

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	Question pattern⊕
THEORY COURSES								
1.	PCC	19EC61C	Wireless Communication	3	0	0	3	A
2.	PCC	19EC62C	Control Systems	3	0	0	3	A
3.	PCC	19EC63C	Computer Networks	3	0	0	3	A
4.	PCC	19EC64C	VLSI Design	3	0	0	3	A
5.	PCC	19EC65C	Antenna and wave propagation	3	0	0	3	A
6.	PEC		Programme Elective – 2	3	0	0	3	A
PRACTICAL								
7.	PCC	19EC66C	Computer Networks Laboratory	0	0	3	1.5	_
8.	PCC	19EC67C	VLSI Design Laboratory	0	0	3	1.5	_
9.	SDC	19EC68C	Product Development Laboratory	1	0	2	2	_
			TOTAL	**18**	**0**	**10**	**23**	

SEMESTER – VII

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	Question pattern⊕
THEORY								
1	HSMC	19EC71C	Project Management and Finance	3	0	0	3	A
2	HSMC	19EC72C	Professional Ethics and Human Values	3	0	0	3	A
3	PEC		Programme Elective – 3	3	0	0	3	A
4	PEC		Programme Elective – 4	3	0	0	3	A
5	PEC		Programme Elective – 5	3	0	0	3	A
6	OEC		Open Elective – 2	3	0	0	3	A
7	OEC		Open Elective – 3	3	0	0	3	A
PRACTICAL								
8	PCC	19EC73C	Comprehension	0	0	2	1	-
9	SDC	19EC74C	Project work - I	0	0	6	3	-
			TOTAL	**21**	**0**	**8**	**25**	

SEMESTER – VIII

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	Question pattern⊕
THEORY								
1	OEC		Open Elective – 4	3	0	0	3	A
PRACTICAL								
2	SDC	19EC81C	Project work – II	0	0	12	6	-
3	SDC	19EC82C	Internship / In-Plant Training	0	0	4	2	-
			TOTAL	**3**	**0**	**16**	**11**	

TOTAL CREDITS: 168

LIST OF ELECTIVES

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
SIGNAL and IMAGE PROCESSING								
1.	PEC	19EC01E	Speech and Audio Processing	3	0	0	3	A
2.	PEC	19EC02E	Digital image and video processing	3	0	0	3	A
3.	PEC	19EC03E	Mixed Signal Design	3	0	0	3	A
4.	PEC	19EC04E	Adaptive Signal Processing	3	0	0	3	A
5.	PEC	19EC05E	Wavelet Transforms	3	0	0	3	A
6.	PEC	19EC06E	Digital Signal Processors	3	0	0	3	A
7.	PEC	19EC07E	Bio-signal Processing	3	0	0	3	A
8.	PEC	19EC08E	Digital Image Processing	2	0	2	3	A
9.	PEC	19EC09E	Deep Learning	2	0	2	3	A
10.	PEC	19EC10E	Radar signal processing	3	0	0	3	A
11.	PEC	19EC11E	Digital signal processor Architecture and programming	3	0	0	3	A
12.	PEC	19EC12E	Remote sensing	3	0	0	3	A
13.	PEC	19EC13E	Computer vision	3	0	0	3	A
RF and COMMUNICATION ENGINEERING								
8.	PEC	19EC18E	Introduction to MEMS	3	0	0	3	A
9.	PEC	19EC19E	Information Theory and Coding	3	0	0	3	A
10.	PEC	19EC20E	Satellite Communication	3	0	0	3	A
11.	PEC	19EC21E	Radar and Navigational Aids	3	0	0	3	A
12.	PEC	19EC22E	Statistical Theory of Communication	3	0	0	3	A
13.	PEC	19EC23E	Multimedia Compression and Communication	3	0	0	3	A
14.	PEC	19EC24E	Global Navigation Satellite System	3	0	0	3	A
15.	PEC	19EC25E	Electromagnetic Interference and Compatibility	3	0	0	3	A
16.	PEC	19EC26E	Advanced Wireless Communication	3	0	0	3	A
17.	PEC	19EC27E	Error control codes	3	0	0	3	A
18.	PEC	19EC28E	Microwave Theory and Techniques	3	0	0	3	A
19.	PEC	19EC29E	Fiber Optic Communications	3	0	0	3	A
VLSI and EMBEDDED SYSTEM								
20.	PEC	19EC35E	Nanoelectronics	3	0	0	3	A

21.	PEC	19EC36E	Advanced Microprocessors	3	0	0	3	A
22.	PEC	19EC37E	Fundamentals of Semiconductor Chip Testing	3	0	0	3	A
23.	PEC	19EC38E	ARM Processor Architecture and Programming	3	0	0	3	A
24.	PEC	19EC39E	Embedded and Real Time Systems	3	0	0	3	A
25.	PEC	19EC40E	PLC and SCADA	3	0	0	3	A
26.	PEC	19EC41E	Embedded System Architecture	3	0	0	3	A
27.	PEC	19EC42E	Embedded System Analysis and Risk Management	3	0	0	3	A
28.	PEC	19EC43E	CMOS Fundamentals	3	0	0	3	A
29.	PEC	19EC44E	Digital VLSI Systems Design	3	0	0	3	A
30.	PEC	19EC75E	Hardware Modelling using Verilog HDL	2	0	2	3	A
31.	PEC	19EC76E	Design and Verification using System Verilog	3	0	0	3	A
32.	PEC	19EC77E	VLSI Physical Design	3	0	0	3	A
33.	PEC	19EC78E	Design for Testability (DFT)	3	0	0	3	A
34.	PEC	19EC79E	Analog IC Design	3	0	0	3	A
APPLIED ELECTRONICS								
35.	PEC	19EC45E	Bio-Medical Electronics	3	0	0	3	A
36.	PEC	19EC46E	Power Electronics	3	0	0	3	A
37.	PEC	19EC47E	High Speed Electronics	3	0	0	3	A
38.	PEC	19EC48E	Measurements and Instrumentation	3	0	0	3	A
39.	PEC	19EC49E	PCB Design and Fabrication	3	0	0	3	A
NETWORKS								
40.	PEC	19EC56E	Wireless Sensor Networks	3	0	0	3	A
41.	PEC	19EC57E	Mobile Adhoc Networks	3	0	0	3	A
42.	PEC	19EC58E	Cryptography and Network Security	3	0	0	3	A
43.	PEC	19EC59E	Fundamentals of Cyber Security	3	0	0	3	A
44.	PEC	19EC60E	Principles of Operating System	3	0	0	3	A
45.	PEC	19EC61E	Scientific Computing	3	0	0	3	A
46.	PEC	19EC62E	Edge Analytics and Internet of Things	3	0	0	3	A
47.	PEC	19EC63E	Machine Learning Techniques	3	0	0	3	A
48.	PEC	19EC64E	Introduction to Internet of Things	3	0	0	3	A
49.	PEC	19EC65E	Database Management System for IoT	3	0	0	3	A

50.	PEC	19EC66E	IoT: Architecture, Standards and Protocols	3	0	0	3	A
51.	PEC	19EC67E	Wireless Technologies for IoT	3	0	0	3	A
52.	PEC	19EC68E	IoT Big Data Analytics	3	0	0	3	A
53.	PEC	19EC69E	Blockchain and its applications	2	0	2	3	A
54.	PEC	19EC71E	Web Application development	1	0	2	2	B
55.	PEC	19EC80E	Theory and Applications of Blockchain	2	1	2	4	A
SKILL DEVELOPMENT COURSE								
55.	SDC	19EC70E	Professional Readiness for Innovation, Employability and Entrepreneurship	0	0	6	3	-
CYBER SECURITY								
56.	PEC	19EC72E	Cyber Crime investigations and Digital forensics	3	0	0	3	A
57.	PEC	19EC73E	Vulnerability Analysis	3	0	0	3	A
58.	PEC	19EC74E	Malware Analysis and Threat hunting	2	0	2	3	A

ONE CREDIT ELECTIVE COURSES (PEC)

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
1.	PEC	19EC01L	Basic Device Driver Programming Practice	0	0	2	1	-
2.	PEC	19EC02L	Image Processing Practice using OpenCV	0	0	2	1	-
3.	PEC	19EC03L	Introduction to OFDM	1	0	0	1	C
4.	PEC	19EC04L	Wireless Communication System design using SDR	0	0	2	1	-
5.	PEC	19EC05L	OFDM System Design using SDR	0	0	2	1	-
6.	PEC	19EC06L	Spreading codes in Spread Spectrum Modulation	1	0	0	1	C
7.	PEC	19EC07L	Memory Built in Self Test (MBIST)	1	0	0	1	C
8.	PEC	19EC08L	Joint Test Action Group (JTAG)	1	0	0	1	C
9.	PEC	19EC09L	Network Traffic Analysis using Wireshark Laboratory	0	0	2	1	-
10.	PEC	19EC10L	Intrusion detection system using Snort Laboratory	0	0	2	1	-
11.	PEC	19EC11L	Vulnerability Assessment and Penetration Testing Laboratory	0	0	2	1	-
12.	PEC	19EC12L	Malware Analysis and Reverse Engineering Laboratory	0	0	2	1	-
13.	PEC	19EC13L	Cyber Security: Governance, Risk and Compliance	1	0	0	1	C

14.	PEC	19EC14L	Programming in JAVA	0	0	2	1	-
15.	PEC	19EC15L	Programming in Python	0	0	2	1	-
16.	PEC	19EC16L	Consumer Electronics	1	0	0	1	C
17.	PEC	19EC17L	Computational Electromagnetics Laboratory	0	0	2	1	-
18.	PEC	19EC18L	Advanced Communication Systems Laboratory	0	0	2	1	-
19.	PEC	19EC19L	Machine Learning Techniques Laboratory	0	0	2	1	-
20.	PEC	19EC20L	Web of Things Laboratory	0	0	2	1	-
21.	PEC	19EC21L	Database Management System Laboratory	0	0	2	1	-
22.	PEC	19EC22L	Internet of Things Laboratory	0	0	2	1	-

OPEN ELECTIVE COURSES

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
1.	OEC	19EC01N	Basics of Communication Systems	3	0	0	3	A
2.	OEC	19EC02N	Overview of Communication systems	3	0	0	3	A
3.	OEC	19EC03N	CMOS technology and Chip Testing	3	0	0	3	A
4.	OEC	19EC04N	Automotive Electronics	3	0	0	3	A
5.	OEC	19EC05N	Electronics and Microprocessors	3	0	0	3	A
6.	OEC	19EC06N	ARM processor and programming	3	0	0	3	A
7.	OEC	19EC07N	Fundamentals of Digital Signal Processing	3	0	0	3	A
8.	OEC	19EC08N	Embedded and Real Time Systems	3	0	0	3	A

LIST OF COURSES UNDER VERTICALS

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
SIGNAL PROCESSING AND IT'S APPLICATIONS								
1	PEC	19EC08E	Digital Image Processing	2	0	2	3	A
2	PEC	19EC23E	Multimedia Compression and communication	3	0	0	3	A
3	PEC	19EC09E	Deep Learning	2	0	2	3	A
4	PEC	19EC10E	Radar signal processing	3	0	0	3	A
5	PEC	19EC01E	Speech and Audio Processing	3	0	0	3	A
6	PEC	19EC11E	Digital signal processor Architecture and programming	3	0	0	3	A
7	PEC	19EC07E	Biosignal processing	3	0	0	3	A
8	PEC	19EC12E	Remote sensing	3	0	0	3	A
9	PEC	19EC13E	Computer vision	3	0	0	3	A
CYBER SECURITY								
1.	PEC	19EC60E	Principles of Operating System	3	0	0	3	A
2.	PEC	19EC59E	Fundamentals of Cyber Security	3	0	0	3	A
3.	PEC	19EC72E	Cyber Crime investigations and Digital forensics	3	0	0	3	A
4.	PEC	19EC73E	Vulnerability Analysis	3	0	0	3	A
5.	PEC	19EC69E	Blockchain and its Applications	2	0	2	3	A
6.	PEC	19EC74E	Malware Analysis and Threat hunting	2	0	2	3	A
VLSI								
1	PEC	19EC43E	CMOS Fundamentals	3	0	0	3	A
2	PEC	19EC44E	Digital VLSI Systems Design	3	0	0	3	A
3	PEC	19EC75E	Hardware Modelling using Verilog HDL	2	0	2	3	A
4	PEC	19EC76E	Design and Verification using System Verilog	3	0	0	3	A
5	PEC	19EC77E	VLSI Physical Design	3	0	0	3	A
6	PEC	19EC78E	Design for Testability (DFT)	3	0	0	3	A
7.	PEC	19EC79E	Analog IC Design	3	0	0	3	A
8.	PEC	19EC37E	Fundamentals of Semiconductor Chip Testing	3	0	0	3	A

19SH11C **TECHNICAL ENGLISH** **L T P C**
(Common to all B.E. / B.Tech. Degree Programmes) **2 0 0 2**

COURSE OUTCOMES

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

CO1: apply the basic language skills to understand various aspects of communication skills (K3)
CO2: express their thoughts with correct usage of language in formal writings (K3)
CO3: understand various language components and develop the pronunciation skill. (K2)
CO4: make effective technical writings and interpret any pictorial representation. (K3)
CO5: frame sentences and write effective reports. (K3)

UNIT I **6**

Parts of Speech – Word formation using Prefixes and Suffixes - Informal writing - Diary writing, letter to Friend / Parent / Siblings - Greetings and Self Introduction – Situational Phrases - Tense (Present)

UNIT II **6**

Technical terms and extended definitions - Transformation of words into different grammatical forms – Tense (Past) –Letter writing (for Industrial visit and training) - Instruction Writing - Listening for general information.

UNIT III **6**

Personality Adjectives - Phonetics (Vowels - Consonants– Diphthongs - Transcriptions) – Kinds of Sentences (Statement, Interrogative, Imperative & Exclamatory) – Situational Conversation.

UNIT IV **6**

Commonly Misspelled words – Active and Passive Voices – E - mail writing - Picture Description – Checklists

UNIT V **6**

Homophones - Concord - Tense (Future) - Foreign Words and Phrases - Report writing (Types – Structure - Stages in Report writing- Model Report) – Reading Comprehension.

Suggested Activity: Book Review – Herein the students will be required to submit a review of a book (Literary or non-literary) of their choice. This will be followed by a presentation of the same in the class.

L: 30; TOTAL: 30 PERIODS

TEXT BOOKS

1. Anderson, Paul V. “Technical Communication: A Reader - Centered Approach”, 9th Edition, Cengage, New Delhi, 2018.
2. Jan Svartvik, et.al. “A Comprehensive Grammar of the English Language”, Longman Inc., Newyork, 2014.

REFERENCES

1. Murphy Raymond, “Basic Grammar Practice on Tense”, Cambridge University Press: New Delhi, 2018.

2. Kumar, Suresh. E., "Engineering English", Orient Blackswan: Hyderabad, 2015.

19SH12C MATHEMATICAL FOUNDATIONS FOR ENGINEERS L T P C
(Common to all B.E. / B.Tech. Degree Programmes) 3 1 0 4

COURSE OUTCOMES

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

CO1: make use of orthogonal transformation. (K3)
CO2: find the evolutes of various curves.(K2)
CO3: maxima and minima of real valued functions.(K3)
CO4: solve ordinary differential equations.(K2)
CO5: solve partial differential equations.(K2)

UNIT I MATRICES 12

Characteristic equation – Eigen values and Eigen vectors of a real matrix – Properties of Eigen values and Eigen vectors – Diagonalisation of a matrix by orthogonal transformation – Quadratic forms – Reduction of quadratic form to canonical form by orthogonal transformation and its nature; Cayley – Hamilton theorem (excluding proof)

UNIT II DIFFERENTIAL CALCULUS 12

Curvature in cartesian, parametric and polar forms – Centre of curvature, radius of curvature and circle of curvature – Evolutes – Envelopes – Evolute as envelope of normals.

UNIT III FUNCTIONS OF SEVERAL VARIABLES 12

Partial derivative – Total derivative – Euler's theorem on homogeneous functions – Taylor's Series – Jacobians – Maxima and Minima – Constrained Maxima and Minima by the method of Lagrange's multipliers.

UNIT IV ORDINARY DIFFERENTIAL EQUATIONS 12

Solutions of first order ordinary differential equations - Equations solvable for 'p', equations solvable for 'y', equations solvable for 'x' - Solutions of higher order linear differential equations with constant coefficients – Cauchy's and Legendre's linear equations - Method of variation of parameters – Solution of simultaneous linear differential equation.

UNIT V PARTIAL DIFFERENTIAL EQUATIONS 12

Formation of partial differential equations – Solutions of standard types of first order partial differential equations - Lagrange's linear equations - Solutions of homogeneous and Non homogeneous linear partial differential equations of second and higher order with constant coefficients.

L: 45; T: 15; TOTAL: 60 PERIODS

TEXT BOOKS

1. Grewal.B.S. "Higher Engineering Mathematics", 44th Edition, Khanna Publications, New Delhi, 2017.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India, 2014.

REFERENCES

1. Bali.N.P. and Manish Goyal, "A Text book of Engineering Mathematics", 9th Edition, Laxmi Publications Private Limited, 2017.

2. George B.Thomas, Jr. Ross L.Finney, "Calculus and Analytic Geometry", 9th Edition, Dorling Kindersley Private Limited, 2010.

19SH13C **ENGINEERING PHYSICS** **L T P C**
(Common to all B.E. / B.Tech. Degree Programmes) **2 0 0 2**

COURSE OUTCOMES

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

CO1: summarize the properties and structures of crystal solids. (K2)
CO2: understand the principle and propagation of different types of waves (K2)
CO3: choose the appropriate Laser technique for industrial and medical applications (K2)
CO4: describe the different types, fabrication, losses of optical fibers and their applications in communication and instrumentation. (K2)
CO5: explain the physical properties of photons & electrons and their applications in different electron microscopes. (K2)

UNIT I CRYSTALLOGRAPHY 6

Lattice, Unit cell, Bravais lattice, Lattice planes - Crystal system - Miller indices – d spacing - Characteristics of SC, BCC, FCC and HCP structures- Crystal defects.

UNIT II WAVES 6

Simple harmonic oscillators - Damped harmonic oscillator - Forced mechanical and electrical oscillators - Transverse wave on a string - Wave equation on a string - Longitudinal waves and wave equation - Acoustics waves

UNIT III LASER 6

Principle of spontaneous emission and stimulated emission, Population inversion, Pumping, Einstein's A and B coefficients – Different types of lasers: gas lasers (CO_2), solid-state lasers (Nd-YAG) - Applications of lasers in science, engineering and medicine.

UNIT IV FIBRE OPTICS 6

Principle – Total internal reflection - Acceptance angle and Numerical aperture - Types of optical fibers - Double crucible technique – Splicing - Losses in optical fibers - Fiber optic communication system - Applications - Fiber optic sensors – Medical Endoscope.

UNIT V QUANTUM PHYSICS 6

Black Body Radiation - Matter Waves - Heisenberg's uncertainty principle - Schrodinger's wave equation - Particle in one dimensional box - Electron microscope - Scanning electron microscope - Transmission electron microscope.

L: 30; TOTAL: 30 PERIODS

TEXT BOOKS

1. David Halliday, Robert Resnick, Jearl Walker, "Fundamentals of Physics", 11th Edition, John Wiley & Sons Inc.USA, 2018.
2. Arthur Beiser, "Concepts of Modern Physics", 7th Edition, Mc-Graw Hill Publications Private Limited, 2017.
3. D. J. Griffiths, "Quantum mechanics", 2nd Edition, Cambridge University Press, 2014.

REFERENCES

1. Renk, Karl.F "Basics of laser physics", 2nd Edition, Springer International publishing, 2017.
2. H. J. Pain,Patricia Rankin "Introduction to vibration and waves", 1st Edition, Wiley, 2015

3. K.S.Mathur, “Fundamentals of Fiber Optics”, 1st Edition, Zorba books, 2018.

19SH14C ENGINEERING CHEMISTRY L T P C
(Common to all B.E. / B.Tech. Degree Programmes) 2 0 0 2

COURSE OUTCOMES

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

CO1: identify the various water treatment technique for domestic and industrial purpose. (K2)
CO2: understand the various isotherms, kinetics in surface chemistry and catalysis. (K2)
CO3: acquire the knowledge of electrochemistry and corrosion and its control. (K2)
CO4: familiar with the various novel organic material used in electronics industry. (K2)
CO5: understand the principle, components and working of various analytical instruments. (K2)

UNIT I WATER TREATMENT 6

Hardness - Estimation of hardness of water – Specifications for drinking water (BIS and WHO standards) - Softening of water: External and Internal treatments of water – Desalination - Methods of treatment of municipal water - Waste water treatments: primary, secondary and tertiary

UNIT II SURFACE CHEMISTRY AND CATALYSIS 6

Adsorption – Types - Freundlich’s adsorption isotherm – Langmuir’s adsorption isotherm – contact theory – Kinetics of surface reactions - Unimolecular reactions - Applications of adsorption on pollution abatement.
Catalysis: Catalyst – Types of catalysis – Criteria – Autocatalysis – Acid base catalysis – applications - Catalytic convertor – Enzyme catalysis – Michaelis – Menten equation.

UNIT III ELECTROCHEMISTRY AND CORROSION 6

Electrode potential-Nernst Equation-reference electrode - glass electrode - measurement of pH – electrochemical series – significance – Conductometric titrations (strong acid vs strong base and weak acid vs strong base)
Corrosion: Types of corrosion - Factors influencing corrosion – Corrosion control – Sacrificial anode and impressed current cathodic methods – Corrosion inhibitors

UNIT IV ELECTRONIC MATERIALS 6

Organic semiconducting materials: advantages- p-type and n-type semiconducting materials – pentacene – fullerens-C-60; organic light emitting polymer: polyvinylidene fluoride - OLED material – polyphenylene vinylene - micro and nano sensors - fundamentals of sensors, biosensor - chemical sensors

UNIT V ANALYTICAL TECHNIQUES 6

Spectroscopy:Principle, instrumentation and applications of UV-Visible and IR spectroscopy. chromatography: - HPLC (Principle, instrumentation and applications of HPLC and gas chromatography - Flame photometry – Estimation of sodium and potassium by Flame photometry.

L: 30; TOTAL: 30 PERIODS

TEXT BOOKS

1. Jain P.C. and Jain. M., “Engineering Chemistry”, Dhanpat Rai Publishing Company, 16th Edition, New Delhi, 2016.

2. S.S Dara and S.S Umare, A Text Book of Engineering Chemistry, S.Chand & Company Limited, 20th Edition, 2018.

REFERENCES

1. P. Brezonik, W. Arnold, Water Chemistry: An Introduction to the Chemistry of Natural and Engineered Aquatic Systems, Oxford Press, 6th Edition, 2017.
2. B.R. Puri, L.R. Sharma, M.S. Pathania, Vishal, Principles of Physical Chemistry, Vishal Publishing Co., Punjab, 47th Edition, 2017.
3. S. Crouch, D. Skoog, F Holler, Principles of Instrumental Analysis Hardcover, 2017.
4. H. Klauk, "Organic Electronics: Materials, manufacturing and applications", Wiley - VCH, 2016

19EC11C BASIC ELECTRICAL ENGINEERING L T P C
3 0 0 3

COURSE OUTCOMES

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

CO1: explain the basic concepts of DC electrical circuits (K2)
CO2: infer the electrical quantities of AC electrical circuits (K2)
CO3: describe the working principles of DC electrical machines and transformers (K2)
CO4: recall the working characteristics of AC electrical machines (K2)
CO5: outline the functions of the instruments and component of low voltage electrical installations (K2)

UNIT I DC CIRCUITS 9

Electrical Circuit Elements – Ideal and Practical Sources – Charge – Electrical Quantities: Voltage, Current, Power and Energy – Ohms Law – Kirchoff Laws – Series and Parallel Circuit Connection – Star and Delta Circuit.

UNIT II AC CIRCUITS 9

AC Fundamentals: Impedance – Description of AC using Magnitude, Frequency and Phase – Peak, Average and RMS Values of AC Signal – Power and Power Factor – Single Phase Circuits and Three Phase Circuits – Voltage and Current in Star and Delta connection.

UNIT III DC ELECTRICAL MACHINES AND TRANSFORMERS 9

DC Machines: General Construction – Working Principles – DC Motor Starters – Speed Control of DC Motors with Power Converters.

Transformers: Construction and Working Principles, Types – Losses, Regulation and Efficiency - Three Phase Transformers Connections – Auto Transformers.

UNIT IV AC ELECTRICAL MACHINES 9

Three Phase Synchronous Generators: Principle of Operation, Types and Constructional Features.

AC Motors: Construction and Working of Single Phase and Three Phase Induction Motor – Torque- Slip Characteristics - Starting and Speed Control of Induction Motors - Inverters.

UNIT V INSTRUMENTS AND ELECTRICAL INSTALLATION 9

Instruments: Functional Elements – Principles of Measurements of Electrical Quantities: Voltage, Current, Power and Energy – Multifunction meter.

Electrical Installation: Components of LT Switchgear – Switch Fuse – MCB – ELCB – MCCB – Types of Wires and Cables – Earthing – Energy Storage devices - Elementary Calculations for Energy Consumptions and Battery Backup.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. D.P. Kothari and I.J. Kothari, "Basic Electrical Engineering", Tata McGraw Hill, 3rd Edition, 2010.
2. P.S. Bimbhra, "Electrical Machinery", Khanna Publishes, 7th Edition, 2011.
3. A.K.Sawhney, "A Course in Electrical & Electronic Measurements & Instrumentation", Dhanpat Rai and Co, 2004.

REFERENCES

1. D.C. Kulshreshtha, "Basic Electrical Engineering", Tata McGraw Hill, Revised 1st Edition, 2011.
2. L.S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
3. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
4. V.D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.
5. E.O. Doebelin, "Measurement Systems – Application and Design", Tata McGraw Hill, 2003.

19SH16C	ENGINEERING PHYSICS AND ENGINEERING CHEMISTRY LABORATORY (Common to all B.E. / B.Tech. Degree Programmes)	L T P C 0 0 3 1.5

PART A – ENGINEERING PHYSICS LABORATORY

COURSE OUTCOMES

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

CO1: demonstrate the different phenomenon exhibited by the waves. (K2)

CO2: interpret the production of ultrasounds and the variation of velocity of ultrasounds with respect to different medium.(K2)

CO3: illustrate the electrical properties of materials. (K2)

LIST OF EXPERIMENTS

1. Determination of thickness of a thin wire – Air wedge method.
2. Determination of velocity of sound and compressibility of the liquid – Ultrasonic Interferometer.
3. Determination of Dispersive power of a prism using Spectrometer.
4. Determination of angle of divergence of laser beam and acceptance angle, numerical aperture of optical fibre.
5. Determination of acceleration due to gravity using compound pendulum.
6. Determination of (a) spring Constant (b) Value of g and (c) Modulus of Rigidity of a spring by studying motion of a spring.
7. Determination of specific resistance of the coil using Carey-Foster's bridge.

- A minimum of FIVE experiments shall be offered.

REFERENCES

1. David Loyal, " Physics laboratory" 4th Edition, Cengage learning, 2013
2. Sesha Sai Kumar Vemula, "Engineering Physics lab manual" 1st Edition, LAP LAMBERT Academic Publishing, 2017

PART B - ENGINEERING CHEMISTRY LABORATORY

COURSE OUTCOMES

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

CO 1: determine various water quality parameters. (K2)
CO 2: quantify different ions by different analytical techniques. (K2)
CO3: determine the rate of corrosion of mild steel plate. (K2)
CO4: verify the freundlich adsorption isotherm. (K2)

LIST OF EXPERIMENTS

1. Estimation of hardness of water sample by EDTA method.
2. Estimation of iron (Fe^{2+}) by dichrometric method.
3. Determination of rate of corrosion of mild steel plate by weight loss method.
4. Estimation of hydrochloric acid by conductometric method.
5. Estimation of mixture of acids by conductometric method.
6. Determination of purity of simple organic compounds using HPLC- (Demo).
7. Estimation of iron (Fe^{2+}) by spectrophotometric method.
8. Verification of Freundlich adsorption isotherm by using oxalic acid in activated charcoal.

P: 45; TOTAL: 45 PERIODS

- A minimum of FIVE experiments shall be offered.
- Laboratory classes on alternate weeks for Physics and Chemistry.

REFERENCES

1. D.C. Harris "Quantitative Chemical Analysis: International Edition", W.H.Freeman, 9th Edition, 2016.
2. A.I. Vogel, A.R. Tatchell, B.S. Furnis, A.J. Hannaford , P.W.G.Smith, Vogel's Textbook of Practical Organic Chemistry, Pearson Education Limited, England, 8th Edition, 2015.
3. M. Nath, Inorganic Chemistry: A Laboratory Manual, Alpha Science, New Delhi, 2016.

19SH17C	**ENGINEERING PRACTICE LABORATORY**	**L T P C**
	(Common to all B.E. / B.Tech. Degree Programmes)	**0 0 4 2**

PART A - MECHANICAL LABORATORY

COURSE OUTCOMES

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

CO1: prepare different carpentry joints. (K3)
CO2: prepare pipe connections with different joints for domestic applications. (K3)
CO3: make simple components using sheet metal (K3)
CO4: make components using machining operations (K3)
CO5: explain the types of welding processes (K2)
CO6: discuss the applications of 3D printing and injection moulding processes (K2)

LIST OF EXPERIMENTS

I. CARPENTRY PRACTICES **5**

1. Study of the joints in roofs, doors, windows and furniture.
2. Hands on exercise with application

II. PLUMBING PRACTICES **5**

1. Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
2. Study of pipe connections requirements for pumps and turbines.
3. Preparation of plumbing line sketches for water supply and sewage works.
4. Hands on exercise with application

III. SHEET METAL PRACTICES **5**

1. Forming and Bending
2. Model making: Tray, Conical Funnel etc.

IV. MACHINING PRACTICES **5**

1. Simple Turning
2. Drilling Practice
3. Model making: Shaft, stiffener plate, square flange, etc.
4. Demonstration of machining process in Vertical Machining Centre (VMC)

V. METAL JOINING PROCESS **5**

1. Demonstration of Gas, Arc and TIG Welding

VI. ADDITIVE MANUFACTURING AND INJECTION MOULDING PROCESSES

1. Demonstration of Injection Moulding process

P: 30; TOTAL: 30 PERIODS

TEXT BOOKS

1. Bawa H.S, "Workshop Practice", Tata McGraw Hill Publishing Company Limited, 2007

REFERENCES

1. Ramesh Babu V, "Engineering Practices Laboratory Manual", Revised Edition, VRB Publishers Private Limited, Chennai, 2014.
2. Jeyachandran K, Natarajan S. and Balasubramanian S, "A Primer on Engineering Practices Laboratory", Anuradha Publications, 2007.
3. Jeyapoovan T, Saravanapandian M. and Pranitha S, "Engineering Practices Lab Manual", Vikas Publishing House Private Limited, 2006.
4. Rajendra Prasad A and Sarma PMMS, "Workshop Practice", Sree Sai Publication, 2002
5. Kannaiah P and Narayana KL, "Manual on Workshop Practice", Scitech Publications, 1999.

PART B – ELECTRICAL AND ELECTRONICS LABORATORY

COURSE OUTCOMES

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

CO1: perform residential house wiring (K2)
CO2: identify faults in any electrical appliances (K2)
CO3: measure energy and resistance to earth of electrical equipment (K2)
CO4: measure AC signal parameters using CRO (K2)
CO5: apply soldering for electronic circuit formation in PCB (K2)

LIST OF EXPERIMENTS

ELECTRICAL

1. Residential House Wiring using Switches, Fuse, Indicator, Lamp and Energy Meter.

2. Stair Case Wiring Connections
3. Measurement of Energy using Energy Meter for Single Phase System.
4. Measurement of Earth Resistance using Electrical Equipment.
5. Study of Emergency Lamp, Choke, Starter, Fan and Iron Box
6. Coil Rewinding for Transformer and Fan using Rewinding Machine.
7. Connection of protective devices

ELECTRONICS

8. Study of Resistor, capacitor and inductor
9. Study and Operation of Digital Multimeter, Function/Signal Generator and Regulated Power Supply.
10. Measurement of AC signal parameter (Peak-Peak, RMS, Period and Frequency) using CRO and DSO.
11. Soldering Practice
12. Study of logic gates AND, OR, NOT, NAND, NOR and EXOR.
13. Half Wave Rectifier and Full Wave Rectifier.

P: 30; TOTAL: 30PERIODS

REFERENCES

1. Jeyachandran K, Natarajan S and Balasubramanian S, “A Primer on Engineering Practices Laboratory”, Anuradha Publications, 2007.
2. Jeyapoovan T, Saravanapandian M and Pranitha S, “Engineering Practices Lab Manual”, Vikas Publishing House Pvt. Ltd, 2006.
3. Bawa H.S., “Workshop Practice”, Tata McGraw – Hill Publishing Company Limited, 2007.
4. Rajendra Prasad A and Sarma P.M.M.S., “Workshop Practice”, Sree Sai Publication, 2002.
5. Kannaiah P and Narayana K.L., “Manual on Workshop Practice”, Scitech Publications, 1999.

19EC12C BASIC ELECTRICAL ENGINEERING LABORATORY L T P C
0 0 4 2

COURSE OUTCOMES

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

CO1: demonstrate the common components with different rating and use the instruments (K2)
CO2: analyze the basic electrical circuits (K2)
CO3: infer the characteristics of electrical machines (K2)

LIST OF EXPERIMENTS

1. Basic Safety Precautions, Practical Circuit Elements and Measuring Instruments – Voltmeter, Ammeter, Wattmeter and Energy Meter
2. Verification of Ohms Law and Kirchoff Laws
3. Star and Delta Configuration in electrical circuits.
4. Load test on DC shunt Motor
5. Load test on DC series Motor
6. Speed Control of DC shunt Motor.
7. Load test of single Phase Transformer
8. Load test on Single Phase Induction Motor
9. Load test on Three Phase Induction Motor
10. Measurement of Power and Power Factor with resistive and inductive Loads

11. Speed Control of Three Phase Induction Motor.

P:30; TOTAL: 30 PERIODS

19EC21C **PROFESSIONAL ENGLISH** **L T P C**
(Common to all B.E. / B.Tech. Degree Programmes) **2 0 0 2**

COURSE OUTCOMES

Upon completion of this course, the student will be able to

CO 1: integrate and apply the acquired skills in real life situation. (K3)
CO 2: write effectively in any professional contexts. (K3)
CO 3: enhance the vital sub-functions of communication in any formal situation. (K3)
CO 4: participate actively in any informal and formal discussion. (K3)
CO 5: recall the acquired skills and apply them in their work place. (K2)

UNIT I **6**

Standard Abbreviations - If Conditionals - Presenting articles based on newspaper reading - Listening for specific information - Argumentative essay.

UNIT II **6**

One word substitution - Rearranging the jumbled phrases of sentences – Chart Description - Business Letters for Quotations and Clarification.

UNIT III **6**

Idioms and Phrases - Direct & Indirect Speech - Business Letters for Placing orders and Making Complaints - Process Description.

UNIT IV **6**

Synonyms **-** Group Discussion (Uses – Structure – Strategies – Team Work – Positive & Negative Body Languages – Samples - Demo) - Proposal Writing.

UNIT V **6**

Error Spotting (Based on Concord, Pronouns, Articles & Adverb Placement) - Job Application Letter & Resume Preparation - Circular and Minutes of the meeting - Reading Comprehension.

Suggested Activity: Career Analysis – Herein the students will be required to submit a report about their dream career / company of their choice. This will be followed by a presentation of the same in the class.

L: 30; TOTAL: 30 PERIODS

TEXT BOOKS

1. Board of editors. “Fluency in English A Course book for Engineering and Technology”, Orient Blackswan, Hyderabad, 2016.
2. Bovee, Courtland, L., John V.Thill. “Business Communication Today”, 13th Edition, Pearson Education, New Delhi, 2018.

REFERENCES

1. Lester Mark and Larry Beason, “Hand book of English Grammar and Usage”, McGraw Hill Education, 1st Edition, 2017.
2. Raman, Meenakshi and Sharma, Sangeetha, “Technical Communication Principles and Practice”, Oxford University Press, New Delhi, 2014.

19EC22C CALCULUS AND LAPLACE TRANSFORM L T P C
3 1 0 4

COURSE OUTCOMES

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

CO1: evaluate area and volume using double and triple integrals.(K3)
CO2:analyze the concepts related to vector calculus.(K3)
CO3: grasp Analytic functions and their properties.(K2)
CO4: evaluate complex integration over contour. (K3)
CO5: perform the ideas of Laplace transform. (K3)

UNIT I MULTIPLE INTEGRALS 12

Double integration – Cartesian and polar coordinates - Change of order of integration - Change of variables between Cartesian and polar coordinates - Triple integration in Cartesian coordinates - Area as double integral - Beta and Gamma functions and their properties.

UNIT II VECTOR CALCULUS 12

Gradient, Divergence and Curl –Directional derivatives – Irrotational and solenoidal vector fields -Vector integration–Green's theorem in a plane, Gauss divergence theorem and Stoke's theorem (excluding proofs)–Simple applications involving cubes and rectangular parallelopipeds.

UNIT III ANALYTIC FUNCTIONS 12

Functions of a complex variable – Analytic functions – Necessary and Sufficient conditions (excluding proofs) – Harmonic and orthogonal properties of analytic functions – Harmonic conjugate – Construction of analytic functions – Conformal mapping: w = z+c, cz, 1/z and bilinear transformation.

UNIT IV COMPLEX INTEGRATION 12

Cauchy's integral theorem and Cauchy"s integral formula – Taylor's and Laurent's expansions – Singular points – Residues – Residue theorem – Application of residue theorem to evaluate real integrals – Unit circle and semi- circular contour excluding poles on boundaries.

UNIT V LAPLACE TRANSFORM 12

Existence conditions -– Transforms of elementary functions – Properties – Transform of Derivatives and Integrals - Transforms of periodic functions - Inverse transforms – Initial and final value theorems – Convolution theorem.

L: 45; T:15; TOTAL: 60 PERIODS

TEXT BOOKS

1. Grewal.B.S., "Higher Engineering Mathematics", Khanna Publications, 44th Edition, New Delhi, 2017.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India, 10th Edition, 2011.

REFERENCES

1. Bali.N.P. and Manish Goyal, "A Text book of Engineering Mathematics", Laxmi Publications Private Limited, 9th Edition, 2017.
2. Ramana.B.V., "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 6th Edition , 2008.
3. Jain RK and Iyengar SRK, "Advanced Engineering Mathematics", Narosa Publishing House Pvt. Ltd, 4th Edition, 2014.

19EC23C **ELECTROMAGNETIC THEORY** **L T P C**
2 0 0 2

COURSE OUTCOMES

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

CO1: know the basic mathematical concepts related to electromagnetic vector fields (K2)
CO2: understand the perception of electrostatics and its applications.(K2)
CO3: explain the concepts of electrostatics in dielectric medium (K2)
CO4: summarize the concepts of magnetostatics and its applications.(K2)
CO5: acquire knowledge on the laws in electrodynamics and apply them to electrical engineering problems (K2)

UNIT I VECTOR ANALYSIS 6

Scalar and vector fields - operator Del(∇) - gradient, divergence and curl of electrostatic field - Gauss Divergence theorem – Stoke's theorem – coordinate systems – cartesian – cylindrical – spherical coordinate systems – vector identities.

UNIT II ELECTROSTATICS 6

Electric flux – displacement density – Gauss law – Coulomb's law – electric field- electric potential – charged disc – charged ring – charged wire – Poisson's and Laplace equations for electrostatic potential – uniqueness of solution – steady state diffusion and thermal conduction – Faraday's cage – coffee- ring effect

UNIT III ELECTROSTATICS IN DIELECTRIC MEDIUM 6

Electrostatic potential and field due to dipole- Gauss law for dielectrics – electric polarization – displacement – dielectric boundary conditions (1^{st} and 2^{nd})- electrostatic problems in presence of dielectric – point charge at the centre of sphere – capacitance – parallel plate capacitor – cylindrical capacitor – energy stored in capacitor – force of attraction between plates

UNIT IV MAGNETOSTATICS 6

Magnetic field – flux density – magneto motive force – Biot-Savart law – magnetic field due to finite conductor – circular loop – Ampere's law – magnetic field due to lay wire – solenoid – magnetic boundary condition – inductance – Types and properties of magnetic materials –Dia, para and ferro magnetisation – hysteresis loss.

UNIT V ELECTRODYNAMICS AND ELECTROMAGNETIC WAVES 6

Faraday's laws of electromagnetic induction – dynamically induced emf – lenz law – Faraday's disc generator – emf equation of single loop generator (electromagnetic generator) – Electromagnetic breaking and its applications – Electromagnetic waves – Properties and Applications.

L:30;TOTAL:30PERIODS

TEXTBOOKS

1. David Griffiths,"Introduction to Electrodynamics" Cambridge University Press, 4^{th} Edition, 2017
2. Mathew N. O. Sadiku, "Principles of Electromagnetics", Oxford University Press, 6^{th} Edition, 2015.
3. Ashutosh Pramanik, 'Electromagnetism–Theory and Applications', PHI Learning Private Limited, New Delhi, 2^{nd} Edition,2008.

REFERENCES

1. David Halliday, Robert Resnick,Jearl Walker, " Fundamentals of Physics", John Wiley & Sons Inc.USA, 10th Edition, 2014
2. Joseph. A.Edminister, "Schaum's Outline of Electromagnetics", 3rd Edition (Schaum's Outline Series), Tata McGraw Hill, 2010
3. William H. Hayt and John A. Buck, "Engineering Electromagnetics", 8th Revised edition Tata McGraw Hill, 2011.
4. Kraus and Fleish, "Electromagnetics with Applications", 5th Edition, McGraw Hill International Editions, 2010.

19EC24C BIOLOGY AND BIOMATERIALS L T P C
2 0 0 2

COURSE OUTCOMES

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

CO1: describe and comprehend the fundamental concepts of cell biology. (K2)
CO2: understand the various bimolecular interactions in living organisms. (K2)
CO3: familiar with various metabolic reactions in living organisms. (K2)
CO4: know the various biomaterials and its testing procedure. (K2)
CO5: understand the working methodology of various biosensors. (K2)

UNIT I CELL BIOLOGY 6

Cell: organization of prokaryotic and eukaryotic cells - structural and functional capitalization of cell: Mitochondria, Chloroplast, Lysosomes, Golgi bodies, Plasma membrane, Cytoskeleton, Cell wall and Nucleus - cell division: mitosis and meiosis.

UNIT II BIO-MOLECULAR INTERACTIONS 6

DNA and RNA - hydrophobicity and hydrophilicity - Molecular interactions: covalent and non covalent interaction- partition coefficient: (Log p) octanol -water system -Lipinski's rule

UNIT III METABOLISM 6 Cell metabolism - regulation of blood glucose and homeostasis - glycogenesis and glycogenolysis and their regulation - measurement of blood glucose level.

UNIT IV BIOMATERIALS AND TESTING 6

Degradable biomaterials: PGA and PLA-Composite Biomaterials: Properties-classification-Applications: fabrication of biodevices and implants.
Testing: physiochemical test, mechanical test, Invitro and Invivo.

UNIT V BIOSENSORS 6

Biosensor – requirements – classification: amperometric enzyme electrodes and Potentiometric enzyme electrodes - construction and function – application: determination of enzyme activity and immunoassay – advantages.

L: 30; TOTAL: 30 PERIODS

TEXT BOOKS

1. Y. Nelson, L. David, Lehninger,"Principles of Biochemistry", International Edition. New York: W. H. Freeman, Macmillan Learning, 7thEdition,2017.
2. Nagata, Kazuhiro, Real-Time Analysis of Biological Interactions, Springer, Japan, 3rd Edition, 2015.
3. I. Bertini, H.B Gray, Bioinorganic Chemistry, Viva Books Private Limited, 4thEdition, 2014.

REFERENCES

1. P.N.Bartlett, Bioelectrochemistry: Fundamentals, Experimental Techniques and Applications, 2nd Edition, John Wiley & Sons, 2014.

2. Ratner and Hoffmann, Biomaterial Science: An Introduction to Materials in Medicine, 2nd Edition, 2015.
3. D. V. Vranken, G.A. Weiss, Introduction to Bioorganic Chemistry and Chemical Biology, CRC, Taylor & Francis, 1st Edition, 2012.

19EC25C PROBLEM SOLVING TECHNIQUES L T P C
3 0 0 3

COURSE OUTCOMES

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

CO 1: develop algorithmic solutions to simple computational problems. (K3)
CO 2: make appropriate decisions and solve problems using looping techniques.(K2)
CO 3: solve problems using array and functions. (K3)
CO 4: implement various sorting techniques. (K3)
CO 5: implement various searching techniques. (K3)

UNIT I BASICS OF PROBLEM SOLVING 9

Overview of programming: Problem Solving in Everyday Life, Types of Problem, Computer-based problem solving, Difficulties in problem solving, Program design, implementation issues, programming environment, Data Storage and Communication with Computer, Organizing the Problem.Algorithms for problem solving:Algorithms and flow charts, flowchart symbols, design of algorithms for simple and scientific problems, divide and conquer strategy.

UNIT II BASIC TECHNIQUES 9

Sequential Logic Structure, Decision Making, Looping Techniques, Multi-Way decision Making, Solving With Modules.

UNIT III ARRAYS AND FUNCTIONS 9

Arrays: one dimensional array – Two dimensional arrays – Multi dimensional arrays. Character arrays and Strings: Declaring and initializing String Variables – Comparison of two strings – String handling functions. User defined Functions: Definition – Declaration – Function calls – Category of Functions – Recursion - Storage Classes.

UNIT IV SORTING TECHNIQUES 9

Sorting: Bubble Sort, Selection Sort, Insertion Sort, Postman Sort, Quick Sort, Merge Sort, Radix Sort, Applications

UNIT V SEARCHING TECHNIQUES 9

Searching algorithms: Linear search, Binary search, Fibonacci search, Golden-ratio selection, Golden section search method, Applications

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Maureen Sprankle and Jim Hubbard, “Problem Solving and Programming Concepts”, Prentice Hall, 9th Edition, 2012.
2. Harsha Priya, R. Ranjeet, — Programming and Problem Solving Through C Language, Firewall/Laxmi Publications (P) Ltd., New Delhi, 2015.

REFERENCES

1. Pradip Dey, Manas Ghosh, Fundamentals of Computing and Programming in C, Oxford University Press, 2nd Edition, 2013.

2. M.G.Venkateshmurthy, Programming Techniques through C: A Beginner's Companion, Pearson Education, Canada, 2009.
3. Ashok.N.Kamthane, Computer Programming, Pearson Education, India, 2011.

19SH15C ENGINEERING GRAPHICS L T P C
(Common to all B.E. / B.Tech. Degree Programmes) 2 0 4 4

COURSE OUTCOMES

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

CO1: familiarize with the fundamentals of Engineering graphics and construct the engineering curves. (K2)
CO2: construct the orthographic projections of points, straight lines and lamina (K2)
CO3: draw the projections of simple solids in different positions. (K3)
CO4: visualize the sectional views and surface areas of various solids. (K3)
CO5: perform freehand sketching and prepare elementary 2-D and 3D sketches of simple solids. (K3)

INTRODUCTION 5

Principles of Engineering Graphics – significance. Usage of Drawing Instruments. Lettering and dimensioning exercise. First angle projection should be followed for all the topics except projection of points.

UNIT I ENGINEERING CURVES 17

Construction of ellipse, parabola and hyperbola using eccentricity method– Construction of cycloids, Epi and Hypo-cycloids - construction of involutes for square and circle –Tangent and Normal to the above curves.

UNIT II ORTHOGRAPHIC PROJECTIONS 17

Principle of orthographic projections – Conventions - First angle and third angle projections. Projections of points placed in all quadrants – projections of straight lines – inclined to both reference planes - determination of true length and inclinations. Projections of regular polygonal surfaces and circular lamina inclined to both reference planes.

UNIT III PROJECTIONS OF SOLIDS 17

Projections of simple solids like prisms, pyramids, cylinder and cone - axis inclined to one reference plane - change of position method.

UNIT IV SECTIONS OF SOLIDS AND DEVELOPMENT OF SURFACES 17

Sectioning of simple solids – Axis perpendicular to horizontal plane- Drawing sectional views with true shape of the section.
Development of lateral surfaces of truncated solids – Prisms, pyramids, cylinder and cone.

UNIT V ISOMETRIC PROJECTIONS AND FREE HAND SKETCHING 17

Principles of isometric projection – isometric scale – isometric projections of simple solids like prism, pyramid, cone and cylinder – Combination of solids.Orthographic views of simple components by Free hand drawing - Transferring measurement from the given object to the free hand sketches.

L:30; P:60; TOTAL: 90 PERIODS

TEXT BOOKS

1. Bhatt N.D, "Engineering Drawing", 53rd Edition, Charotar Publishing House, 2014.

2. Shah M.B and Rana B.C, “Engineering Drawing”, Pearson Education, 2nd Edition, 2009.

REFERENCES

1. Agrawal B. & Agrawal C.M., Engineering Graphics, TMH Publication, 2nd Edition, 2013
2. Narayana K.L. & Kannaiah P, Text book on Engineering Drawing, Scitech Publishers, 2010.
3. Gopalakrishna K.R, “Engineering Drawing”, Subhas Publications, 32nd Edition, 2017.

19GN02C HERITAGE OF TAMILS (தமிழர் மரபு) L T P C
1 0 0 1

UNIT I LANGUAGE AND LITERATURE 3

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

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

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

UNIT III FOLK AND MARTIAL ARTS 3

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

UNIT IV THINAI CONCEPT OF TAMILS 3

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

UNIT V CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE 3

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

L: 15; TOTAL: 15 PERIODS

REFERENCE BOOKS

1. தமிழக வரலாறு – மக்களும் பண்பாடும் - கே.கே.பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கணினித் தமிழ் - முனைவர். இல.சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரீகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரீகம். (தொல்லியல் துறை வெளியீடு)

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

19GN02C HERITAGE OF TAMILS (தமிழர் மரபு) LT P C
1 0 0 1

அலகு I மொழி மற்றும் இலக்கியம் 3

இந்திய மொழிக்குடும்பங்கள் - திராவிட மொழிகள் - தமிழ் ஒரு செம்மொழி – தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை – சங்க இலக்கியத்தில் பகிர்தல் அறம் - திருக்குறளில் மேலாண்மைக் கருத்துக்கள் - தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் - சிற்றிலக்கியங்கள் - தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி - தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு II மரபு பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக்கலை 3

நடுகல் முதல் நவீன சிற்பங்கள் வரை – ஐம்பொன் சிலைகள் - பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் - தேர் செய்யும் கலை – சுடுமண் சிற்பங்கள் - நாட்டுப்புறத் தெய்வங்கள் - குமரிமுனையில் திருவள்ளுவர் சிலை - இசைக் கருவிகள் - மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் - தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு III நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள் 3

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

அலகு IV தமிழர்களின் திணைக் கோட்பாடுகள் 3

தமிழகத்தின் தாவரங்களும், விலங்குகளும் - தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் - தமிழர்கள் போற்றிய அறக்கோட்பாடு – சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் - சங்ககால நகரங்களும் துறை முகங்களும் - சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு V இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு 3

இந்திய விடுதலைப் போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் - சுயமரியாதை இயக்கம் - இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப் படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

L: 15; TOTAL: 15 PERIODS

REFERENCE BOOKS

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

19EC26C	**ELECTROMAGNETISM AND BIOLOGY LABORATORY**	**L T P C** **0 0 3 1.5**

PARTAELECTROMAGNETISM LABORATORY

COURSE OUTCOMES

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

CO1: demonstrate the magnetic properties of the materials (K2)

CO2: interpret the operation and the effects of series / parallel resonance circuit (K2)

CO3: illustrate the properties of electromagnetic waves (K2)

LIST OF EXPERIMENTS

1. Determination of Hysteresis loss in ferromagnetic material

2. Determination of magnetic flux density and Hall coefficient of a semiconductor crystal
3. Series LCR Resonance circuit
4. Parallel LCR Resonance circuit
5. Determination of wavelength of mercury spectrum using spectrometer & grating.
6. Determination of Radius of curvature of a Plano convex lens using Newton‟s rings Method
7. Determination of horizontal intensity of earth's magnetic field and moment of bar magnet –Deflection magnetometer

- A minimum of FIVE experiments shall be offered.

REFERENCES

1. R.K.Shukla, Anchal Srivastava, "Practical Physics-Electricity and magnetism" New Age Pvt Ltd, 2014
2. David Loyal, " Physics laboratory", Cengage learning, 4th Edition,2013
3. Sesha Sai Kumar Vemula, "Engineering Physics lab manual", LAP LAMBERT Academic Publishing, 1st Edition,2017

PART B BIOLOGY LABORATORY

COURSE OUTCOMES

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

CO 1: identify the various biomolecule by suitable chemical analysis. (K3)
CO 2: quantify the amount of acid, sodium and antioxidant by different analytical techniques. (K2)
CO3: estimate the retention factor and log Pvalue of paracetamol and aspirin. (K2)
CO4: identify the molecular interactions of amino acid with biomolecule. (K3)

LIST OF EXPERIMENTS

1. Qualitative analysis of biomolecule.
2. Calculation of retention factor of paracetamol and aspirin.
3. Estimation of acid by pH metric method.
4. Study of interaction of amino acids with DNA by gel electrophoresis.
5. Study of interaction of amino acids with proteins by fluorescence spectrophotometer.
6. Determination of partition coefficient (log P) value for paracetamol and aspirin.
7. Determination of antioxidant activity by invitro method.
8. Estimation of sodium in bio-fluids by flame photometry.

P: 45; TOTAL: 45 PERIODS

- A minimum of FIVE experiments shall be offered.
- Laboratory classes on alternate weeks for Physics and Biology.

REFERENCES

1. P.Worsfold, A.Townshend, C.Poole, M.Miro, Encylopedia of Analytical science, Elsevier, 3rd Edition, 2018

19EC27C PROBLEM SOLVING TECHNIQUES LABORATORY L T P C
0 0 4 2

COURSE OUTCOMES

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

CO 1: solve simple and Complex problems. (K3)

CO 2: solve sorting and searching problems. (K3)

LIST OF EXERCISES

Programs using simple logics and switch cases

1. Solve problems such as temperature conversion, student grading, interest calculation.
2. Find the roots of a quadratic equation
3. Design a simple arithmetic calculator. (Use switch statement)
4. Design a traffic light controller (Use switch statement)

Programs using Control Structures

5. Perform the following operations:
   a. Generate Pascal‘s triangle.
   b. Construct a Pyramid of numbers.
6. Generate of the first n terms of the Fibonacci sequence and prime sequence.
7. Compute Sine series and Cosine series.
8. Find the 2‘s complement of a binary number.

Programs using Arrays

9. Perform the following operations:
   a. Matrix addition.
   b. Transpose of a matrix.
   c. Matrix multiplication by checking compatibility

Programs to manipulate Strings

10. Perform the following operations on a string:
    a. Insert a sub-string into main string at a given position.
    b. Delete n characters from a given position in a string.
    c. Check whether the given string is palindrome or not.
    d. Replace a character of string either from beginning or ending or at a specified location.

Programs using Functions

11. Perform the following operations: (Use recursive functions)
    a. Find the factorial of a given integer.
    b. Find the GCD (Greatest Common Divisor) of two given integers.
    c. Solve the Towers of Hanoi problem.

Programs using sorting and searching techniques

12. Implement Insertion Sort, Merge Sort
13. Implement Linear search, Binary search

P: 60; TOTAL: 60 PERIODS

Software Requirement: Turbo C / Python

19GN01C	**INNOVATION THROUGH DESIGN THINKING**	**L T P C**
		1 0 2 2

COURSE OUTCOMES

Upon Successful completion of this course, the students will be able to

CO1: To discuss the design thinking process and innovation. (K2)

CO2: Practice design thinking process through a multidisciplinary task. (K3)

UNIT I BASICS OF DESIGN THINKING PROCESS 15

Design thinking process basics-Ideation tools-case studies.

UNIT II PRACTICING DESIGN THINKING PROCESS 30

Real world problem selection-Practicing the preliminary stages of Design Thinking Process-work presentation.

L: 15; P: 30; TOTAL: 45 PERIODS

REFERENCES

1. Falk Uebernickel, Li Jiang, Walter Brenner, Britta Pukall, Therese Naef, “Design Thinking: The Handbook”, WS Professional,2020
2. Pavan Soni, “Design Your Thinking: The Mindsets, Toolsets and Skill Sets for Creative Problem solving”, Penguin Random House, 2020
3. D.M. Arvind Mallik, “Design Thinking for Educators”, Notion Press,2019
4. Michael Lewrick, “The Design Thinking Playbook”, Wiley,2019
5. Kathryn Christopher, “Design Thinking in Engineering”, Kendall Hunt Publishing Company,2019
6. Robert Curedale, “Design Thinking Process & Methods” 5th Edition, Design Community College Inc, 2019
7. David Lee, “Design Thinking in the Classroom”, Ulysses Press,2018
8. Jimmy Jain, “Design Thinking for Startups”, Notion Press,2018
9. Monika Hestad Silvia Rigoni Anders Grnli, “The Little Booklet on Design Thinking: An Introduction”, 2nd Edition, Zaccheus Entertainment,2017
10. Scott Swan, Michael G. Luchs and Abbie Griffin, “Design Thinking: New Product Development Essentials”, Wiley-Blackwell,2016
11. Thomas Lockwood, “Design Thinking: Integrating Innovation, Customer Experience, and Brand Value”, Allworth Press,2009

MENTOR ACTIVITIES:

Educating the design thinking process: basics, Ideation tools and empathy map through case studies - presentation	10 Hours
Forming multidisciplinary batches among the students- Guide the batches to select a real-world task- Apply and practice the different stages of Design thinking process to bring out innovative solutions	20 Hours
Evaluating the students‘ activities through their presentations	--

End semester Assessments can be made through:

- Design Thinking presentation(PowerPointformat)
- Design Thinking poster preparation and presentation (PDF format, in color and monochrome, printable in A3size)

Other points:

This course is for all department students

- A class/section should be with all departmentstudents
- A course instructor will be responsible for the academicprocess.
- In a project batch, maximum number of students should be four and no two students fromsame disciplinepossibly.
- The course has no pre-requisite and may be offered to second/fourth semester students.

19EC31C ELECTRONIC DEVICES L T P C QP
3 0 0 3 A

COURSE OUTCOMES

Upon completion of this course, the students will be able to
CO1: Explain the principles of semiconductor Physics (K2)
CO2: Analyze the diode characteristics and its applications (K3)
CO3: Describe the operation and characteristics of BJT and MOS transistors (K2)
CO4: Describe the operation and characteristics of special semiconductor devices (K2)
CO5: Describe the operation and characteristics of advanced MOS devices (K2)

UNIT I INTRODUCTION TO SEMICONDUCTOR PHYSICS 9

Classification of semiconductors, Energy bands in intrinsic and extrinsic silicon; Carrier transport: diffusion current, drift current, mobility and resistivity, Generation and recombination of carriers; Poisson and continuity equation

UNIT II PN JUNCTION DIODE AND ITS APPLICATIONS 9

P-N junction characteristics, I-V characteristics, and small signal switching models; Avalanche breakdown, Characteristics of Zener diode, Schottky diode, Applications of diodes

UNIT III TRANSISTORS 9

Bipolar Junction Transistor- I-V characteristics, Ebers-Moll Model, JFET, MOS capacitor-C-V characteristics, MOSFET, I-V characteristics, and small signal models of MOS transistor

UNIT IV SPECIAL SEMICONDUCTOR DEVICES 9

Characteristics of LED, photodiode, SCR, DIAC, TRIAC, UJT

UNIT V ADVANCED MOS DEVICES 9

Advanced MOS devices Double Gate MOSFET, Tri Gate MOSFET, Gate All AroundMOSFET, FinFet.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. G.Streetman and S.K.Banerjee, “Solid State Electronic Devices,” 7th Edition, Pearson, 2014.
2. D.Neamen, D.Biswas "Semiconductor Physics and Devices," McGraw-Hill Education.

REFERENCES

1. S.M.Sze and K.N.Kwok, “Physics of Semiconductor Devices,” 3rd Edition, John Wiley & Sons, 2006.
2. C.T.Sah, “Fundamentals of solid state electronics,” World Scientific Publishing Co.Inc,1991
3. Y.Tsividis and M.Colin, “Operation and Modeling of the MOS Transistor,” Oxford Univ. Press, 2011.
4. J.-P. Colinge, FinFETs and Other Multi-Gate Transistors, Springer 2008.

19EC32C DIGITAL SYSTEM DESIGN L T P C QP
3 0 0 3 A

COURSE OUTCOMES

Upon completion of this course, the students will be able to
CO1: Explain and represent Logic function and simplify it. (K2)
CO2: Design and analyze combinational logic circuits. (K3)
CO3: Design and analyze sequential logic circuits. (K3)

CO4: Describe the operation of Logic families, Memory architecture and Programmable Logic devices. (K2)
CO5: Write HDL code for digital logic circuits. (K3)

UNIT I DIGITAL LOGIC AND ITS SIMPLIFICATION 9

Boolean algebra, Number systems, De Morgan's theorem, Binary arithmetic, SOP, POS, Universal gates, Canonical forms, Duality, Binary codes, Code conversions, Boolean expression simplification using Karnaugh Maps

UNIT II COMBINATIONAL LOGIC 9

Adder, Subtractor, BCD Adder, Decoder, Encoder, Multiplexer, Function realization using Multiplexer & Decoder, Comparator, Parity generator & checker, Barrel shifter, ALU, Driver and Multiplexed display, Parallel adder

UNIT III SEQUENTIAL LOGIC 9

SR, JK, Master-slave, Edge triggered FFs, Ripple & Synchronous counter, Shift register, Design of synchronous sequential circuits- Moore, Mealy, Serial Adder Design, Generation of Pulse train, Pseudo random sequence and clock signals, Asynchronous sequential design- Hazards, Races

UNIT IV LOGIC FAMILIES, MEMORY ELEMENTS AND PLDs 9

TTL specifications, TTL, ECL, CMOS Logic Family and its Interfacing, Characteristics, Memory Elements – static RAM, dynamic RAM, ROM, EPROM, FPGA, Programmable Logic devices – PLA, PAL, PLD

UNIT V HDL PROGRAMMING 9

HDL, Verilog data types and objects, Modeling – Gate level, Data flow and behavioral, Programming for Adder, Multiplexer, Flipflops, Registers and Counters.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. M. Morris Mano, Michael D. Ciletti, "Digital Design with an introduction to VerilogHDL", PHI, 6th Edition, 2018
2. Charles Roth, L.K.John, B.K.Lee, "Digital System Design using Verilog", Cengage, 1st Edition, 2016.

REFERENCES

1. R.P. Jain, "Modern digital Electronics", Tata Mc-Graw Hill, 4th Edition, 2010.
2. Donald P.Leach, A.P.Malvino, GoutamSaha, "Digital Principles and Applications", Tata Mc-Graw Hill, 8th Edition, 2014
3. James E. Palmer, David E. Perlman, "Schuams Outlines-Introduction to Digital Systems", Tata McGraw Hill, 2nd Edition, 2003
4. Thomas L.Floyd, "Digital Fundamentals", PHI, 11th Edition, 2017.

19EC33C SIGNALS AND SYSTEMS L T P C QP
3 0 0 3 A

COURSE OUTCOMES

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

CO1: Classify and analyze the types of signals, their responses and properties. (K2)

CO2: Analyze the continuous time signals using Fourier series, Fourier transform and Laplace transform and also understand their properties (K3)
CO3: Analyze the continuous time systems using Fourier transform and Laplace transform and to solve the frequency response of LTI-CT systems. (K3)
CO4: Explore the sampling concepts and the effects of aliasing. (K2)
CO5: Analyze the discrete time signals using Fourier transform and Z transform and to understand their properties. (K3)
CO6: Analyze the discrete time systems using Fourier transform and Z- transform in order to solve the frequency response of LTI-DT systems. (K3)

UNIT I CLASSIFICATION OF SIGNALS AND SYSTEMS 9

Continuous time signals (CT signals), Discrete time signals (DT signals), Step, Ramp, Pulse, Impulse, Exponential, Classification of CT and DT signals, periodic and aperiodic, random signals, CT systems and DT systems, Basic properties of systems, Linear Time Invariant systems and properties.

UNIT II ANALYSIS OF CONTINUOUS TIME SIGNALS 9

Fourier series analysis- trigonometric, cosine and Exponential Fourier series, Spectrum of CT signals, Fourier Transform properties, Fourier transform signal analysis, Laplace Transform properties, Laplace transform Signal Analysis.

UNIT III LINEAR TIME INVARIANT - CONTINUOUS TIME SYSTEMS 9

Differential equation, Block diagram representation, Impulse response, Convolution integral, frequency response, LTI systems analysis using Fourier and Laplace transforms, State space representation.

UNIT IV ANALYSIS OF DISCRETE TIME SIGNALS 9

Sampling of CT signals and aliasing, DTFT properties, DTFT signal analysis, Z transform properties, Z transform signal analysis, Inverse Z transform.

UNIT V LINEAR TIME INVARIANT - DISCRETE TIME SYSTEMS 9

Difference equation, Block diagram representation, Impulse response, Convolution sum, LTI systems analysis using DTFT and Z-transforms, State space representation.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Alan V.Oppenheim, Alan S.Willsky and S.H.Nawab, “Signals and Systems”, Pearson Education, 2nd Edition, 2015.
2. Edward W Kamen and Bonnie S. Heck, “Fundamentals of Signals and Systems using the Web and MATLAB”, Pearson Education, 3rdEdition, 2013.

REFERENCES

1. Rodger E.Ziemer, William H.Tranter and D.Ronald Fannin, “Signals & Systems-continuous and discrete”, Pearson Education, 4th Edition, 2014.
2. Simon Haykin and Barry Van Veen, “Signals and Systems”, 2nd Edition, Willey Publication, 2010.
3. Hwei P. Hsu, “Signals and Systems- Schaum's Outline Series”, Tata McGraw Hill, 3rd Edition, 2013.

4. M.J.Roberts, “Signals and systems- Analysis using transform methods and MATLAB”, Tata McGraw Hill, 2nd Edition, 2011.

19EC34C NETWORK THEORY L T P C QP
3 0 0 3 A

COURSE OUTCOMES

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

CO1: Analyze DC and steady state AC networks using various techniques and network theorems (K3)
CO2: Apply and determine the time domain response of series RL,RC and RLC circuits for DC and AC excitation (K3)
CO3: Apply and determine the frequency domain response of resonant circuits and to design passive filters (K3)
CO4: Apply Laplace transform for analysis and synthesis of two port networks (K3)
CO5: Synthesis two port networks and derive its parameters (K3)

UNIT I STEADY STATE DC & AC CIRCUIT ANALYSIS 9

Mesh current method, Node voltage method, Source Transformation, Superposition theorem, Thevenin’s theorem, Norton’s Theorem, Maximum Power Transfer theorem.

UNIT II TRANSIENT RESPONSE ANALYSIS 9

Transient Analysis: Step response and sinusoidal response of first order (series RL and series RC) and second order circuits (Series RLC), sinusoidal steady state analysis

UNIT III RESONANCE CIRCUITS 9

Series resonance, Parallel resonance, Bandwidth, Quality factor, Selectivity, Passive filters

UNIT IV CIRCUIT ANALYSIS & SYNTHESIS USING S-DOMAIN 9

Application of Laplace transforms – Circuit Element models, circuit analysis, transfer function, state variables, Applications - network stability, and network synthesis.

UNIT V LINEAR TWO PORT NETWORKS 9

Impedance parameters, Admittance parameters, Hybrid parameters, Transmission parameters, Relationships between parameters, Interconnection of two port networks

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Robert L. Boylestad, “Introductory circuit analysis”, 13th Edition, Pearson, 2016
2. Charles K. Alexander, Mathew N.O. Sadiku, “Fundamentals of Electric Circuits”, 5th Edition, McGraw Hill, 2012.

REFERENCES

1. John Bird, “Electrical Circuit Theory and Technology”, 5th Edition, Newness Publication, 2014.
2. William H. Hayt, Jack, E.Kemmerly and Steven M. Durbin, “Engineering Circuit Analysis”, 8th Edition, Tata Mc-Graw Hill, 2012.
3. Joseph A. Edminister, Mahmood, Nahvi, “Electric Circuits”, Schaum's Series, 5th Edition, Tata Mc-Graw Hill, 2010.

19EC35C FOURIER SERIES AND MATHEMATICAL TRANSFORMS L T P C QP
3 1 0 4 A

COURSE OUTCOMES

Upon completion of this course, the students should be able to

CO1 : perform Fourier series analysis of the functions(K2)
CO2: compute the Fourier transforms of various functions (K2)
CO3: calculate the Fourier series solution of Wave and Heat equations (K3)
CO4: solve difference equations using Z–Transforms (K2)
CO5: solve the differential equations using Transforms (K3)

UNITI FOURIER SERIES 12

Dirichlet's conditions–General Fourier series–Half range series–Complex form of Fourier series–Parseval"s identity–Harmonic analysis.

UNIT II APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 12

Classification of second order partial differential equations–Fourier series solutions of one dimensional wave equation–One dimensional equation of heat conduction–Steady state solution of two dimensional equation of heat conduction excluding Insulated edges.

UNITIII FOURIER TRANSFORMS 12

Fourier Integral theorem (without proof)–Fourier transform pair–Fourier Sine and Cosine transforms–Properties–Transforms of simple functions–Convolution theorem–Parseval's identity.

UNITIV Z–TRANSFORMS 12

Z-transform – Transform of Elementary functions- properties –Initial and Final value theorem – InverseZ-transform– Partial fraction method – Residue method – Convolutiontheorem– Formationofdifferenceequations.

UNIT V APPLICATIONS OF TRANSFORMS 12

Introduction to Laplace Transform – Solutions of Integro-differential equations – Solutions of linear ordinary differential equations of second order with constant coefficients-Solutions of simultaneous differential equations of first order with constant coefficients – Solutions of difference equations using Z-transform- Solving partial differential equation Fourier Transform.

L: 45; T: 15; TOTAL: 60 PERIODS

TEXT BOOKS

1. Grewal.B.S "Higher Engineering Mathematics", 44th Edition, Khanna Publications, New Delhi, 2017.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India, 2011.
3. K.Sankara Rao, "Introduction to Partial Differential Equations", PHI Learning Pvt.Ltd, 3rd Edition, New Delhi, 2011

REFERENCES

1. Bali.N.P. and Manish Goyal, "A Textbook of Engineering Mathematics", 9th Edition, Laxmi Publications Private Ltd., 2014.
2. Ramana B.V, "Higher Engineering Mathematics", Tata Mc-Graw Hill Publishing Company, New Delhi, 2007.
3. Jain.R.K. and Iyengar.S.R.K., "Advanced Engineering Mathematics", 5th Edition, Narosa Publishing House Private Limited, 2016.

19EC36C C++ AND DATA STRUCTURES L T P C QP
3 0 0 3 A

COURSE OUTCOMES

Upon completion of this course, the student will be able to
CO1: Explain the fundamentals of object-oriented programming (K2)
CO2: Explore the concepts of inheritance and polymorphism (K2)
CO3: Apply the principles of linear data structures for various applications. (K3)
CO4: Implement the non linear data structure concepts (K3)
CO5: Design and develop sorting and searching techniques. (K4)

UNIT I CLASS, OBJECT AND DATA ABSTRACTION 9

Overview of C++ – Concepts – Class Scope and accessing Class Members – Reference Variables – Initialization – Constructors – Destructors – Member Functions and Classes – Friend Function – Static Class Members – Container Classes and Integrators – Proxy Classes – This Pointer–String Manipulation-Dynamic Memory Allocation

UNIT II INHERITANCE AND POLYMORPHISM 9

Base Classes and Derived Classes – Protected Members – Casting Class pointers and Member Functions – Overloading: Function overloading and Operator Overloading-Class Object to Base – Class Object Conversion – Composition Vs. Inheritance – Virtual functions – Abstract Base Classes and Concrete Classes –Templates-Exception handling.

UNIT III LINEAR DATA STRUCTURES 9

Abstract Data Types (ADTs) – List ADT – array-based implementation – linked list implementation –– singly linked list –Polynomial Manipulation - Stack –Applications of Stack-infix to post fix conversion-Evaluation of postfix expression-Queue - Case study: Music Player Implementation Using Linear Data Structures

UNIT IV NON-LINEAR DATA STRUCTURES 9

Trees – Binary tree – Binary tree Representation and traversals – Binary Search tree - Application of tree: Set representation and Union-Find operations – Graph and its representations – Dijkstra's shortest path Algorithm - Prim's and Kruskal's Algorithms. Case study: Usage of Non-Linear Data structure for social network like Facebook

UNIT V SORTING AND SEARCHING 9

Sorting algorithms: Insertion sort - Quick sort - Merge sort - Searching: Linear search – Binary Search-Hashing techniques. Case study: Rabin-Karp Algorithm for Pattern Searching

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Bjarne Stroustrup, "The C++ Programming Language", 4th Edition, Pearson Education, 2013.
2. E.Balagurusamy, "Object Oriented Programming with C++", 7th Edition, McGraw Hill Company Limited, 2013.

3. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", 4th Edition, Addison Wesley, 2013.

REFERENCES

1. V.Aho, J.E.Hopcroft, and J.D.Ullman, "Data Structures and Algorithms", 3rdEdition, Pearson Education, Reprint 2009.
2. Thomas H.Cormen, Charles E.Leiserson, Ronald L.Rivest, Clifford Stein, "Introduction to Algorithms", 3rd Edition The MIT Press,2013
3. https://www.tutorialspoint.com/cplusplus/
4. https://www.javatpoint.com/cpp-tutorial
5. https://www.geeksforgeeks.org/c-plus-plus/
6. http://www.cs.bu.edu/teaching/c/tree/binary/
7. https://www.geeksforgeeks.org/design-data-structures-for-a-very-large-social-network like-facebook-or-linkedln/
8. https://www.geeksforgeeks.org/rabin-karp-algorithm-for-pattern-searching
9. https://www.cs.usfca.edu/~galles/visualization/Algorithms.html
10. https://visualgo.net/en/mst
11. https://nptel.ac.in/courses/106106127/41

19GN03C TAMILS AND TECHNOLOGY (தமிழரும் தொழில்நுட்பமும்) L T P C 1 0 0 1

UNIT I WEAVING AND CERAMIC TECHNOLOGY 3

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

UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY 3

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

UNIT III MANUFACTURING TECHNOLOGY 3

Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and goldCoins as source of history - Minting of Coins – Beads making-industries Stone beads - Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.

UNIT IV AGRICULTURE AND IRRIGATION TECHNOLOGY 3

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

UNIT V SCIENTIFIC TAMIL & TAMIL COMPUTING 3

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

L: 15; TOTAL: 15 PERIODS

REFERENCE BOOKS

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

19GN03C TAMILS AND TECHNOLOGY (தமிழரும் தொழில்நுட்பமும்) LT P C
1 0 0 1

அலகு I நெசவு மற்றும் பானைத் தொழில்நுட்பம் 3

சங்க காலத்தில் நெசவுத் தொழில் - பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் - பாண்டங்களில் கீறல் குறியீடுகள்.

அலகு II வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம் 3

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு - சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் - சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும், கோவில்களும் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் - செட்டிநாட்டு வீடுகள் - பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ-சாரோசெனிக் கட்டிடக்கலை.

அலகு III உற்பத்தித் தொழில்நுட்பம் 3

கப்பல் கட்டும் கலை – உலோகவியல் - இரும்புத் தொழிற்சாலை - இரும்பை உருக்குதல், எ.ஃ.கு – வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் - நாணயங்கள் அச்சடித்தல் - மணி உருவாக்கும் தொழிற்சாலைகள் - கல்மணிகள், கண்ணாடி மணிகள் - சுடுமண் மணிகள் - சங்கு மணிகள் - எலும்புத் துண்டுகள் - தொல்லியல் சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு IV வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம் 3

அணை, ஏரி, குளங்கள், மதகு – சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு – கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் - வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு – மீன்வளம் - முத்து மற்றும் முத்துக்குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு – அறிவுசார் சமூகம்.

அலகு V அறிவியல் தமிழ் மற்றும் கணினித்தமிழ் 3

அறிவியல் தமிழின் வளர்ச்சி - கணினித்தமிழ் வளர்ச்சி – தமிழ் நூல்களை மின்பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம் - தமிழ் இணையக் கல்விக் கழகம் - தமிழ் மின் நூலகம் - இணையத்தில் தமிழ் அகராதிகள் - சொற்குவைத் திட்டம்.

L: 15; TOTAL: 15 PERIODS

REFERENCE BOOKS

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

19EC37C ELECTRONIC DEVICES LABORATORY L T P C
0 0 3 1.5

COURSE OUTCOMES

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

CO1: Analyze the characteristics of LED, LDR, Photo diode and Photo transistor. (K3)

CO2: Analyze the characteristics of PN junction diode, Zener diode, BJTs, MOSFETs. (K3)

CO3: Design and analyze the rectifier and voltage regulator circuits. (K3)
CO4: Write PSPICE/Multisim code for simple analog circuits and simulate it. (K3)

LIST OF RECOMMENDED EXPERIMENTS

1. Characteristics of PN junction and Zener diode.
2. Input, Output and Transfer characteristics of CE and CC Amplifier.
3. Characteristics of LDR, Photo-diode and Photo transistor.
4. Transfer characteristics of JFET.
5. Transfer characteristics of MOSFET (with depletion and enhancement mode)
6. Characteristics of LED with three different wavelengths.
7. Half wave rectifier.
8. Full wave rectifier with 2 diodes.
9. Full wave rectifier with 4 diodes (Bridge rectifier).
10. Series voltage Regulator.
11. Shunt voltage Regulator.
12. Simulation experiments using PSPICE or Multisim.

P: 45; TOTAL: 45 PERIODS

19EC38C DIGITAL SYSTEM DESIGN LABORATORY L T P C
0 0 3 1.5

COURSE OUTCOMES

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

CO1: Design and demonstrate the combinational and sequential logic circuits using digital ICs. (K3)
CO2: Write HDL code for simple digital circuits. (K3)

LIST OF EXPERIMENTS

1. Design and implementation of Adder and Subtractor using logic gates.
2. Design and implementation of code converters using logic gates.
3. Perform binary Addition/ subtraction and BCD addition.
4. Design and implementation of Multiplexer and De-multiplexer using logic gates.
5. Design and implementation of encoder and decoder using logic gates.
6. Construction and verification of ripple counter and Decade counters.
7. Implementation of shift registers using Flip- flops.
8. Design and simulation of Adder, Subtractor, Multiplexer, Demultiplexer using Verilog Hardware Description Language.
9. Design and simulation of ripple counter, Mod-10 ripple counter and Shift registers using Verilog Hardware Description Language.

P: 45; TOTAL: 45 PERIODS

19EC39C C++ AND DATA STRUCTURES LABORATORY LTPC
0 0 2 1

COURSE OUTCOMES

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

CO 1: Implement basic concepts of OOP (K3)
CO 2: Solve real world problems using advanced concepts of OOP. (K3)
CO 3: Develop programs using dynamic memory allocation and linked list ADT. (K3)
CO 4: Apply Stack ADT and Queue ADT to solve problems. (K3)

CO 5: Implement Programs for various trees ADT and Sorting and Searching techniques. (K3)

LIST OF EXPERIMENTS

1. A) Design simple C++ classes using static members, methods, default arguments and friend functions.
   B) Design matrix and vector classes with static allocation and use friend function to do matrix vector multiplication
2. Implement Matrix class with dynamic memory allocation and necessary methods. Give proper constructor, destructor, copy constructor and overloading of assignment operator to copy a matrix into another variable.
3. Assume a bank maintaining two kinds of accounts savings account and current account. The savings account provides compound interest and withdrawal facilities but no cheque book facility. The current account provides compound interest and withdrawal facilities but no cheque book facility and no interest. Current account holders should also maintain a minimum balance and if the balance falls below this level, a service charge is imposed. Create a class account that stores customer name, account number and type of account. From this derive the classes current_acct and saving_acct to makethem more specific to their requirements. Design a C++ class for the above scenario
   1) Include necessary member functions in order to achieve the following tasks: (Don't use constructors to initialize)
      a. Accept deposit from a customer and update the balance
      b. Display the balance
      c. Compute and deposit interest
      d. Permit withdrawal and update the balance
      e. Check for the minimum balance, impose penalty, necessary and update the balance
   2) Use constructors to initialize members for the three classes account, cur_acct and sav_acct
4. Create a base class shape. Use this class to store two double type values that could beused to compute the area of figures. Derive two specific classes called triangle andrectangle from the base shape. The member function get_data() of the base class is usedto initialize base class data members and another member function display_area() to compute and display the area of figures. Make display_area() as a virtual function and redefine this function in the derived classes to suit their requirements. Design a C++program that will accept dimensions of a triangle or a rectangle interactively and display the area. Note: The two values given as input will be treated as lengths and breadth in the case of rectangles and as base and height in case of triangles.
5. Design stack and queue classes with necessary exception handling
6. A) Create a list. While creating, the new nodes should be added in the front of the list by default.
      i. Delete the specified node
      ii. Find the specified node and return its position
      iii. Display the list and the number of nodes after each operation
   B) Create a list with n nodes. Each node contains data and time tick information.
      i. Insert the node based on the sorted order of time tick.
      ii. Display the list in the reverse order and number of nodes in the list.
      iii. Delete the specified node from the list and display the resultant list.
7. Represent a polynomial as a linked list and write functions to add the polynomials and display the resultant polynomial.

8. Develop a program to convert infix expression into postfix expression using Stack ADT.
9. Develop functions to perform the following:
   a) Create a binary search tree of integers.
   b) Traverse the above Binary search tree:Produce its pre-order, in-order, and post-order traversals.
10. Implement the following sorting methods to arrange a list of integers in ascending order:
   a) Insertion sort
   b) Merge sort
11. Implement the following sorting methods to arrange a list of integers in ascending order:
   a) Quick sort
   b) Selection sort
12. Implement the program for Knuth-Morris- Pratt pattern matching algorithm by using hashing technique.

P: 30; TOTAL: 30 PERIODS

19EC41C ANALOG AND DIGITAL COMMUNICATION L T P C QP
3 1 0 4 A

COURSE OUTCOMES

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

CO1: Analyze the performance of analog communication system. (K3)
CO2: Explain waveform coding, compression and limits of information theory (K2)
CO3: Design channel encoder and decoder. (K3)
CO4: Analyze the performance of digital pass band modulation techniques. (K3)
CO5: Comprehend the various components of digital communication systems. (K2)

UNIT I ANALOG COMMUNICATION SYSTEM 12

Need for modulation, Amplitude Modulation (DSBFC, DSBSC, SSBSC) – Modulation index, spectral analysis, power relations, bandwidth, Envelope detector, Frequency modulation –Modulation index, Transmission Bandwidth, PLL FM demodulator, Superheterodyne receiver.

Noise sources, Thermal noise model, AWGN – Noise figure, noise temperature and noise bandwidth –– Noise performance analysis in AM & FM systems – qualitative analysis – FM Threshold, Pre-emphasis and de-emphasis for FM

UNIT II WAVEFORM & SOURCE CODING 12

Block diagram of digital communication system, Sampling, aliasing, quantization, encoding, line coding, pulse code modulation, bandwidth of PCM, Differential PCM, linear prediction coding, Audio compression Information, entropy, discrete memoryless channels, Mutual information, channel capacity, Information capacity theorem, Source coding - Shannon-Fano coding, Huffman coding, LZW coding

UNIT III CHANNEL CODING 12

Block Codes (linear block code & cyclic Code) – error detection and correction capability, convolutional encoding and decoding.

UNIT IV SIGNAL SPACE ANALYSIS AND PASSBAND MODULATION 12

Geometric representation of signals, Gram Schmidt orthogonalization procedure. Digital modulation techniques (BPSK, QPSK, QAM, FSK) – mathematical modeling, signal constellation, generation, detection, bit error rate analysis

UNIT V DIGITAL COMMUNICATION SYSTEM DESIGN 12

Inter symbol interference, eye pattern, Nyquist criterion, pulse shaping filters, matched filters, ML detector, Channel estimation and equalization.

Synchronization – ML based carrier phase and timing estimation, PLL, Carrier recovery for M-PSK using decision feedback PLL.

L: 45; T: 15; TOTAL: 60 PERIODS

TEXT BOOKS

1. Simon Haykin, Communication Systems, 4th Edition, Wiley, 2014
2. J.G.Proakis, M.Salehi, Fundamentals of Communication System, 2nd Edition, Pearson Education, 2014.
3. Bernard Sklar, "Digital Communications: Fundamentals and Applications", Pearson Education, 2013.

REFERENCES

1. Leon W. Couch, II, "Digital & analog communication systems", 8th Edition, Pearson Education, 2013.
2. Rodzer E. Ziemer and William H. Tranter, “Principles of Communications – Systems, Modulation and Noise”, 7th Edition, Wiley, 2015.
3. Krzysztof Wesołowski, “Introduction to Digital Communication Systems", Wiley,2009.

19EC42C ELECTRONIC CIRCUITS L T P C QP
3 1 0 4 A

COURSE OUTCOMES

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

CO1 :Analyze the various biasing circuits for a transistor amplifier. (K3)
CO2 : Analyze the small signal amplifiers using BJT and FET. (K3)
CO3 :Apply and determine the high frequency response of amplifier circuits. (K3)
CO4 : Design the large signal amplifiers. (K3)
CO5 : Design sinusoidal oscillator for audio and radio frequencies. (K3)

UNIT I TRANSISTOR BIASING AND STABILITY ANALYSIS 12

BJT biasing – DC Load line and AC Load line, Quiescent point – Different Types of biasing circuits: Fixed Bias Circuit, Collector to base bias, Voltage divider bias (Self Bias) – Stability Factors – Bias compensation: Diode, Thermistor and Sensistor compensations – Biasing circuits for JFET and MOSFET.

UNIT II SMALL SIGNAL AMPLIFIERS 12

Small signal model and operation of BJT, FET and MOSFET amplifiers – Analysis of BJT amplifier, FET, MOSFET amplifiers – Increase in input impedance of BJT amplifiers – Feedback topologies – Effects of feedback on gain, bandwidth, input impedance, output impedance etc – Analysis of negative feedback amplifiers.

UNIT III FREQUENCY RESPONSE OF AMPLIFIERS 12

High frequency equivalent circuits of single stage CE (Hybrid - Π model) and MOSFET CS amplifier – Determination of short circuit current gain, cutoff frequency and bandwidth – Bandwidth calculation of multistage amplifiers – Amplifier rise time, sag and their relation to cutoff frequencies. Tuned amplifiers – single tuned, double tuned and Stagger tuned amplifiers. (qualitative analysis only). Frequency response of tuned amplifiers.

UNIT IV LARGE SIGNAL AMPLIFIERS 12

Classification of amplifiers – Conversion efficiency of class A transformer coupled class A, class B and distortion in power amplifier – Classification of tuned amplifier – Class C large signal tuned amplifier and its efficiency – Stability of tuned amplifiers and neutralization technique.

UNIT V OSCILLATORS 12

Classification - Barkhausen Criterion - General form of an Oscillator - Analysis of LC oscillators - Hartley, Colpitts, Clapp, Tuned collector oscillators. RC oscillators - phase shift, Wien bridge, Twin-T Oscillators. Quartz Crystal Construction, Electrical equivalent circuit of Crystal, Miller and Pierce Crystal oscillators, frequency stability of oscillators.

L: 45; T: 15; TOTAL: 60 PERIODS

TEXT BOOKS

1. Donald.A. Neamen, “Electronic Circuit Analysis and Design”, 2nd Edition, Tata Mc-Graw Hill, 2009.
2. Millman.J and Halkias.C, “Electronic Devices and Circuits”, TMH, 2008.
3. Millman.J and Halkias.C., “Integrated Electronics”, Tata McGraw-Hill, 2010 (Re-print).
4. Schilling and Belove, “Electronic Circuits”, TMH, 3rd Edition, 2002.

REFERENCES

1. Robert L. Boylestad and Louis Nashelsky, “Electronic Devices and Circuit Theory”, 10th Edition, Prentice Hall, 2009.
2. Thomas L. Floyd and David M.Buchla, “Electronics Fundamentals: Circuits, Devices and Applications”, 8th Edition, Pearson College Div, 2010.
3. David A. Bell, “Fundamentals of Electronic Devices and Circuits”, Oxford University Press, 2009.
4. Chenming Hu, “Modern Semiconductor Devices for Integrated Circuits”, Prentice Hall, 2009

19EC43C MICROPROCESSOR AND MICROCONTROLLERS L T P C QP
3 0 0 3 A

COURSE OUTCOMES

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

CO1: Explain the internal architecture and organization of 8085 Microprocessor (K1)
CO2: Develop assembly language programming using microprocessor (K2)
CO3: Explain the internal architecture and organization of 8051 Microcontroller (K1)
CO4: Design microcontroller based system (K3)
CO5: Explain the basics of RISC processor (K1)

UNIT I 8085 PROCESSOR 9

Hardware Architecture, pinouts – Functional Building Blocks of Processor – Memory organization – I/O ports and data transfer concepts– Timing Diagram – Interrupts.

UNIT II PROGRAMMING OF 8085 PROCESSOR 12

Instruction -format and addressing modes – Assembly language format – Programming: Loop structure with counting & Indexing – Look up table – Subroutine instructions – stack. Memory Interfacing and I/O interfacing – Parallel communication interface – Serial communication interface – D/A and A/D Interface – Timer Programming and applications Case studies: Traffic Light control, LED display, LCD display

UNIT III MICROCONTROLLER 8

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

UNIT IV INTERFACING MICROCONTROLLER 10

Interrupts, Timer/Counter and Serial Communication, Programming Timer Interrupts, Programming External H/W interrupts, Programming the serial communication interrupts, Interrupt Priority in the 8051,Programming 8051 Timers and Counters. Applications of Micro Controllers, Interfacing 8051 to LED's, Push button, Relay's and Latch Connections

UNIT V HIGH PERFORMANCE RISC ARCHITECTURE-INTRODUCTION6

ARM organization and implementation, The ARM instruction set-The thumb instruction set (Elementary treatment only) Basic ARM ALP -32-bit addition, subtraction, multiplication, binary sorting.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. R. S. Gaonkar, Microprocessor Architecture: Programming and Applications with the 8085/8080A, 5th Edition, Penram International Publishing, 2002
2. K.Uma Rao, Andhe Pallav, The 8051 Microcontrollers, Architecture and Programming and Applications, 3rd Edition, Pearson, 2014.

REFERENCES

1. Muhammed Ali Mazidi, Janice Gillisple Maidi, Rolin.D. McKinlay, "The 8051 Microcontroller and Embedded Systems, Using Assembly and C", 2nd Edition, Pearson Prentice Hall, 2015.
2. Kenneth J Ayala, "The 8051 Microcontroller", 3rd Edition, Cengage Learning, Reprint 2014.
3. A.K.Ray and K.M. Bhurchandi, "Advanced Microprocessor and Peripherals", Tata McGraw Hill, 3rd Edition, 2013.
4. Andrew N. Sloss, Dominic Symes, Chris Wright and John Rayfield, "ARM System Developer's Guide, Designing and Optimizing System Software", Elsevier, 2009

19EC44C PROBABILITY, RANDOM PROCESSES AND QUEUEING THEORY

L T P C QP
3 1 0 4 A

COURSE OUTCOMES

Upon completion of this course, the students should be able to

CO 1: Grasp basic probability concepts and standard distributions.(K2)
CO 2: Perform the ideas related to two dimensional random variables.(K2)
CO 3: Understand various Random processes. (K3)
CO 4: Evaluate spectral densities of functions.(K3)
CO 5: Interpret the basic characteristic features of Markovian queues.(K3)

UNIT I RANDOM VARIABLES 12

Discrete and continuous random variables–Moments-Moment generating function and their properties. Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

UNITII TWO DIMENSIONAL RANDOM V ARIABLE 12

Joint distributions-Marginal and conditional distributions – Covariance - Correlation and Regression–Transformation of random variables.

UNITIII CLASSIFICATIONOFRANDOMPROCESSES 12

Classification of Random Processes – First order, second order, strictly stationary, wide-sense stationary and ergodic processes–Markov process –Poisson processes.

UNITIV CORRELATION AND SPECTRAL DENSITIES 12

Auto correlation-Cross correlation – Power spectral density–Cross spectral density-Properties–Wiener – Khintchine theorem (without proof)–Relationship between cross power spectrum and cross correlation function.

UNIT V QUEUEING THEORY 12

Markovian models – Birth and Death Queuing models- Steady state results: Single and multiple server queuing models- queues with finite waiting rooms- Finite source models-Little's Formula

L: 45; T: 15; TOTAL: 60 PERIODS

TEXT BOOKS

1. Oliver C.Ibe,"Fundamentals of Applied Probability and Random processes",Elsevier, 2nd Edition, 2014.
2. PeeblesJr.P.Z.,"Probability Random Variables and Random Signal Principles", 4th Edition,TataMcGraw-HillPublishers,NewDelhi,2002.
3. D. Gross and C.M. Harris, "Fundamentals of Queueing Theory", Wiley and Sons Publication Limited, 5th Edition, 2018.

REFERENCES

1. Miller.S.Land Childers, S.L, "Probability and Random Processes with applications to Signal Processing and Communications", Elsevier Inc., 2nd Edition,2012.
2. Hwei Hsu, "Schaum"s Outline of Theory and Problems of Probability, Random Variables and Random Processes",Tata McGraw-Hill, 3rd Edition, New Delhi, 2017.
3. Yates and D.J.Goodman,"Probability and Stochastic Processes", 3rd Edition, John Wiley and Sons,2014.

19MC02C CONSTITUTION OF INDIA L T P C
3 0 0 0

COURSE OUTCOMES

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

CO1: describe the salient features of the Indian Constitution. (K2)
CO2: discuss the structure and functions of parliament. (K2)
CO3: elaborate the structure and functions of state legislature. (K2)
CO4: explain the fundamentals of organization and working of the Judiciary. (K2)
CO5: discuss the foreign policy of India. (K2)

UNIT I INDIAN CONSTITUTION 9

Salient Features – Preamble-Pillars of constitution - Fundamental Rights – Directive Principles of State Policy - Fundamental Duties.

UNIT II PARLIAMENTARY SYSTEM 9

Powers and Functions of President and Prime Minister - Council of Ministers - The Legislature Structure and Functions of Lok Sabha and Rajya Sabha – Speaker.

UNIT III FEDERAL SYSTEM 9

Features of Federal System - Administrative Relationship between Union and States - Powers and Functions of Governor and Chief Minister – Council of Ministers - State Legislature.

UNIT IV THE JUDICIARY 9

Organization and Composition of Judiciary - Powers and Functions of the Supreme Court - Judicial Review – High Courts.

UNIT V INTERNATIONAL POLITICS 9

Foreign Policy of India – VISA Application Process- International Institutions like UNO, WTO, SAARC and Environmentalism.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Basu D.D," Introduction to Indian Constitution", Prentice Hall of India, New Delhi, 2015.
2. Gupta D.C, "Indian Government and Politics", Vikas Publishing House, New Delhi, 2010.

REFERENCES

1. Pylee M.V, "Introduction to the Constitution of India", Vikas Publishing House, New Delhi, 2011.
2. Kashyap S, "Our Constitution", National Book Trust, New Delhi, 2010.
3. Shukla V N, "Constitution of India", Eastern Book Company Ltd., New Delhi, 2011.

19EC45C ANALOG AND DIGITAL COMMUNICATION LABORATORY L T P C

0 0 3 1.5

COURSE OUTCOMES

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

CO1: Demonstrate various analog and digital modulation techniques using LabVIEW. (K3)

CO2: Demonstrate the analog to digital conversion process and encoding techniques. (K3)

CO3: Analyze the error performance of various digital modulation techniques using MATLAB. (K3)

LIST OF EXPERIMENTS Using Lab VIEW

1. Introduction to Lab VIEW
2. Amplitude Modulation
3. Frequency Modulation
4. Sampling and Quantization
5. Pulse Code Modulation
6. Digital Modulation – I
7. Digital Modulation – II

Using MATLAB

8. Demodulation and Performance Evaluation of digital modulation schemes.
9. Digital Link simulation: Error introduction & error estimation in a digital link using MATLAB.

P: 45; TOTAL: 45 PERIODS

19EC46C ELECTRONIC CIRCUITS LABORATORY L T P C

0 0 3 1.5

COURSE OUTCOMES

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

CO1: Design and demonstrate various biasing circuits for an amplifier (K3)

CO2: Design and construct BJT and MOSFET amplifier for the desired specification. (K3)

CO3: Design and construct audio and radio frequency oscillators. (K3)

LIST OF EXPERIMENTS

1. Design the biasing circuit for the desired specification for BJT amplifier.
2. Design and construction of BJT amplifier for audio frequency applications
   (i) To plot the frequency response.
   (ii) Measure input and output impedance
3. Design and Construction of negative feedback amplifiers with and without feedback.
   (i) To plot the frequency response.
   (ii) To determine the input and output impedance.
4. Design and Construct MOSFET amplifiers for the desired specification.
5. Design and construction of Class A and class B power amplifier and study its performance
6. Design and construction of audio frequency oscillator.
7. Design and construction of radio frequency oscillator.

P: 45; TOTAL: 45 PERIODS

19EC47C MICROPROCESSOR AND MICROCONTROLLERS LABORATORY L T P C
0 0 3 1.5

COURSE OUTCOMES

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

CO1: Write Assembly Language programs for simple application using 8085 and 8051 instruction set. (K3).

CO2: Interface Microprocessor / Microcontroller with various peripherals. (K3)

LIST OF EXPERIMENTS

1. Programs for Arithmetic and Logical Operations using 8085 & 8051processor / controller
2. Programs for Sorting and searching using 8085& 8051 processor/controller
3. Interfacing of 8255, 8253, 8279 with 8085 Microprocessor
4. Interfacing of LED and LCD with 8085 & 8051 Microcontroller.
5. Interfacing of ADC and DAC with 8085 & 8051 Microcontroller
6. Demonstration of Timer, Interrupts operations in 8051 Microcontroller
7. Serial Communication between Microcontroller kit and PC

P: 45; TOTAL: 45 PERIODS

19EC48C COMMUNICATION SKILLS LABORATORY L T P C
(Common to all B.E. / B.Tech., Degree Programmes) **0 0 2 1**

COURSE OUTCOMES

Upon completion of this course, the student will be able to

CO1: Listen and respond effectively to interact at different situations fluently (K2)
CO2: Excel appropriately in professional contexts. (K3)
CO3: Acquire the sub-skills required for paper presentations and group discussions which will help them to excel in their workplace.(K3)

UNIT I **10**

Lab session: Listening and responding to audio files
Practice session: Mini Presentation related to Business English & Picture description.

UNIT II **10**

Lab session: Role Play – News Reader
Practice session: Resume Preparation

UNIT III **10**

Lab session: Listening to audio files related to soft skills.
Practice session: Practicing Power point presentation, Group discussion.

P:30; TOTAL: 30 PERIODS

REFERENCES

1. Dutt P. Kiranmai and RajeevanGeeta, “Basic Communication Skills”, Foundation Books, 2013.
2. Comfort, Jeremy, et al. “Speaking Effectively, Developing Speaking Skills for Business English”, Cambridge University Press, Cambridge: Reprint 2011.
3. Rizvi.M.Ashraf, “Effective Technical Communication”, The MC-Graw Hill Education Private Limited Companies, New Delhi, 2010.

19EC51C ELECTROMAGNETIC WAVES **L T P C QP**
3 0 0 3 A

COURSE OUTCOMES

Upon completion of this course, the student will be able to
CO1: Explain the static field and magnetic field concepts. (K2)
CO2: Describe the Maxwell’s equation and transmission of waves between boundaries. (K2)
CO3: Analyze the characteristics and wave propagation on high frequency transmission lines. (K3)
CO4: Analyze the characteristic of uniform plane wave. (K3)
CO5: Describe different waveguide system. (K2)

UNITI STATIC ELECTRIC AND MAGNETIC FIELDS **9**

Coulomb's Law in Vector Form, Definition of Electric Field Intensity, Principle of Superposition, Electric field due to continuous charge distribution, Electric Field due to charges distributed uniformly on an infinite and finite line, Electric Field on the axis of a uniformly charged circular disc and charged circular ring, Electric Field due to an infinite uniformly charged sheet.
The Biot-Savart Law in vector form, Magnetic Field intensity due to a finite and infinite wire carrying a current I, Magnetic field intensity on the axis of a circular and rectangular loop carrying a current I.

UNIT II BOUNDARY CONDITIONS AND MAXWELLS EQUATION **9**

Boundary conditions for electric fields between dielectric and conductor, and between two different dielectrics, Magnetic field boundary condition, Faraday's law, Maxwell's Second Equation in integral form from Faraday's Law, Equation expressed in point form. Displacement current, Ampere's circuital law in integral form, Modified form of Ampere's

circuital law as Maxwell's first equation in integral form, Equation expressed in point form. Poynting Vector and the flow of power, Power flow in a co-axial cable.

UNIT III UNIFORM PLANE WAVES 9

Derivation of Wave Equation, Uniform Plane Waves, Wave equation in Phasor form, Plane waves in free space and in a homogenous material. Wave equation for a conducting medium, Plane waves in lossy dielectrics, Propagation in good conductors, Skin effect, Wave polarization.

UNIT IV TRANSMISSION LINES 9

Transmission Lines- Equations of Voltage and Current on TX line, Propagation constant and characteristic impedance, and reflection coefficient and VSWR, Impedance Transformation on Loss-less and Low loss Transmission line, Power transfer on TX line, Smith Chart, Admittance Smith Chart, Applications of transmission lines: Impedance Matching, use transmission line sections as circuit elements.

UNIT V WAVEGUIDES 9

Wave propagation in parallel plane waveguide, Analysis of waveguide general approach, Rectangular waveguide, Modal propagation in rectangular waveguide, Surface currents on the Waveguide walls, Field visualization, Attenuation in waveguide.

L: 45; TOTAL: 45 PERIODS

REFERENCES

1. R.K. Shevgaonkar, Electromagnetic Waves, Tata McGraw Hill India, 2005
2. E.C. Jordan & K.G. Balmain, Electromagnetic waves & Radiating Systems, Prentice Hall, India
3. Narayana Rao, N: Engineering Electromagnetics, 3rd Edition, Prentice Hall, 1997.
4. David Cheng, Electromagnetics, Prentice Hall

19EC52C COMPUTER ARCHITECTURE L T P C QP
3 0 0 3 A

COURSE OUTCOMES

Upon completion of this course, the student will be able to

CO1: Explain the basic organization of computer system. (K2)
CO2: Analyze the representation and manipulation of data on the computer. (K3)
CO3: Design the implementation schemes of control unit and to study the pipeline performance. (K3)
CO4: Describe the various types of parallelism architectures. (K2)
CO5: Explain the memory hierarchy and I/O systems interfacing. (K2)

UNIT I INTRODUCTION TO COMPUTER ORGANIZATION 9

Architecture and function of general computer system - Basic Operational Concepts, Bus Structures, Software Performance – Memory locations & addresses – Memory operations – Instruction and instruction sequencing – addressing modes – assembly language - System buses, Multi-bus organization

UNIT II DATA REPRESENTATION 9

Signed number representation, fixed and floating point representations, character representation. Computer arithmetic - integer addition and subtraction, ripple carry adder, carry look-ahead adder - multiplication - shift-and-add, Booth multiplier, carry save multiplier - Division - non-restoring and restoring techniques, floating point arithmetic.

UNIT III PROCESSOR ARCHITECTURE AND CONTROL UNIT 9

A Basic MIPS implementation – Building a Datapath – Control Implementation Scheme – Hardwired control – micro programmed control - Pipelining – Pipelined datapath and control – Handling Data Hazards & Control Hazards – Exceptions.

Processor Architecture: Very Long Instruction Word (VLIW) Architecture, Digital Signal Processor Architecture, System on Chip (SoC) architecture, MIPS Processor and programming

UNIT IV PARALLEL PROCESSING 9

Parallel processing challenges – Flynn's classification – Single Instruction Single Data (SISD), Multiple Instruction Multiple Data (MIMD), Single Instruction Multiple Data (SIMD), Single Program Multiple Data (SPMD), and Vector Architectures - Hardware multithreading – Multi-core processors and other Shared Memory Multiprocessors - Introduction to Graphics Processing Units, Clusters, Warehouse Scale Computers and other Message-Passing Multiprocessors.

UNIT V MEMORY & I/O SYSTEMS 9

Memory Hierarchy – memory technologies – cache memory – measuring and improving cache performance – virtual memory, Translation Lookaside Buffer's – Accessing I/O Devices – Interrupts – Direct Memory Access – Bus structure – Bus operation – Arbitration – Interface circuits – Universal Serial Bus.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. David A. Patterson and John L. Hennessy, "Computer Organization and Design: The Hardware/Software Interface", Morgan Kaufmann / Elsevier, 5th Edition, 2014.
2. Carl Hamacher, ZvonkoVranesic, SafwatZaky and NaraigManjikian, "Computer Organization and Embedded Systems", Tata McGraw Hill, 6th Edition, 2012.

REFERENCES

1. William Stallings, "Computer Organization and Architecture – Designing for Performance", Pearson Education, 8th Edition, 2010.
2. John P. Hayes, "Computer Architecture and Organization", Tata McGraw Hill, 3rd Edition, 2012.
3. John L. Hennessey and David A. Patterson, "Computer Architecture – A Quantitative Approach", Morgan Kaufmann / Elsevier Publishers, 5th Edition, 2012.

19EC53C LINEAR INTEGRATED CIRCUITS L T P C QP
3 0 0 3 A

COURSE OUTCOMES

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

CO1 Explain the fabrication of ICs and differential amplifier characteristic. (K2)
CO2 Analyze the various OP AMP application circuits. (K3)
CO3 Explain the operation of analog multipliers, PLL and its application. (K2)
CO4 Analyze the different types of digital to analog converters and Analog to Digital converters. (K3)
CO5 Describe the various operating modes of timer IC & Different types of voltage regulator. (K2)

UNIT I OVERVIEW OF LINEAR ICs 9

Advantages of IC over discrete components, manufacturing process of monolithic IC, Construction of Monolithic Bipolar transistor, Monolithic diodes, Integrated Resistors,

Monolithic Capacitors, Inductors. General operational amplifier stages, Current mirror and current sources, Current sources as active loads, BJT Differential amplifier with active loads, DC and AC performance characteristics, slew rate, Open and closed loop configurations.

UNIT II APPLICATIONS OF OPERATIONAL AMPLIFIERS 9

Sign Changer, Scale Changer, Phase Shift Circuits, Voltage Follower, V-to-I and I-to-V converters, Adder, Subtractor, Instrumentation amplifier, Integrator, Differentiator, Logarithmic amplifier, Antilogarithmic amplifier, Comparators, Schmitt trigger, Precision rectifier, Peak detector, Clipper and Clamper, Low-pass, High-pass and Band-pass Butterworth filters, Sine-wave generators, Triangular wave generator, Saw-tooth wavegenerator, Astable and MonostableMultivibrators.

UNIT III ANALOG MULTIPLIER AND PHASE LOCKED LOOP 9

Analog Multiplier using Emitter Coupled Transistor Pair, Gilbert Multiplier cell, Variable transconductance technique, Analog multiplier ICs and their applications, Operation of the basic PLL, Closed loop analysis, Voltage controlled oscillator, Monolithic PLL IC 565, PLL phase noise, application of PLL for AM detection, FM detection, FSK modulation and demodulation and Frequency synthesizing.

UNIT IV 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, Counter type, Servo tracking type, Successive Approximation type, Dual Slope type, A/D converter, Figure of merit, Static Parameters: DNL, INL.

UNIT V TIMER AND VOLTAGE REGULATOR 9

Timer IC 555 - Description and Functional Diagram, Monostable operation, Astable operation, Linear Regulators, IC Voltage regulators, Three terminal fixed and adjustable voltage regulators, IC 723 General purpose regulator, SMPS.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Sergio Franco, “Design with operational amplifiers and analog integrated circuits”, 3rd Edition, Tata McGraw Hill, 2007.
2. D.Roy Choudhry, Shail Jain, “Linear Integrated Circuits”, New Age International Private Limited, 4th Edition, 2010.

REFERENCES

1. Paul R. Gray, Paul J. Hurst, Stephen H. Lewis and Robert G. Meyer, “Analysis and Design of Analog Integrated Circuits”, John Wiley & Sons Inc, 5th Edition, 2009.
2. S.Salivahanan & V.S.Kanchana Bhaskaran,“Linear Integrated Circuits”, TMH, 1st Edition, 2008.
3. Ramakant A. Gayakwad, “Op-amps and Linear Integrated Circuits”, Prentice Hall, 4th Edition, 2000.

19EC54C DIGITAL SIGNAL PROCESSING L T P C QP
3 0 0 3 A

COURSE OUTCOMES

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

CO1: Correlate the relationship between DTFT, DFT and FFT and compute DFT (K2)
CO2: Design analog and digital IIR filters and realize them (K2)
CO3: Design digital FIR filters and realize them (K2)

CO4: Analyze the finite word length effects in signal processing (K2)
CO5: Explain the concepts of Multi rate signal processing (K3)

UNIT I DISCRETE FOURIER TRANSFORM 9

DFT and its properties, Relation between DTFT, DFT and Z-transform, DFT computations using Decimation in time and Decimation in frequency algorithms, Inverse DFT using FFT algorithms, Use of FFT in linear filtering, Sectionalized convolution-overlap add and save procedure.

UNIT II INFINITE IMPULSE RESPONSE DIGITAL FILTERS 9

Review of design of analog Butterworth and Chebyshev Filters, Frequency transformation in analog domain - Design of IIR digital filters using impulse invariance technique - Design of digital filters using bilinear transform – pre warping - Realization using direct, cascade and parallel forms

UNIT III FINITE IMPULSE RESPONSE DIGITAL FILTERS 9

Symmetric and Antisymmetric FIR filters - Linear phase FIR filters – Design using Hamming, Hanning, Blackman and Kaiser Windows – Frequency sampling method– Realization of FIR filters - Transversal, Linear phase and Polyphase structures

UNIT IV FINITE WORD LENGTH EFFECTS 9

Fixed point and floating point number representations - Comparison - Truncation and Rounding errors - Quantization noise - derivation for quantization noise power - coefficient quantization error – Product quantization error - Overflow error, Saturation arithmetic – Round-off noise power - limit cycle oscillations due to product round off and overflow errors - signal scaling

UNIT V MULTIRATE SIGNAL PROCESSING 9

Introduction to Multi-rate signal processing-Decimation-Interpolation- Polyphase implementation of FIR filters for interpolator and decimator - Multistage implementation of sampling rate conversion- Design of narrow band filters – Applications: Sub band coding, Quadrature Mirror filter bank.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. John G Proakis and Manolakis, “Digital Signal Processing Principles, Algorithms and Applications”, Pearson Education, 4th Edition, 2014.
2. Alan. V. Oppenheim, R. Schafer, “Digital Signal Processing”, Pearson Education, 1st Edition, 2015.

REFERENCES

1. E.C.Ifeachor and B.W.Jervis, “Digital signal processing - A practical approach”, Pearson, 2nd Edition, 2002.
2. S.K. Mitra, “Digital Signal Processing- A Computer Based approach”, Tata McGraw-Hill, 4th Edition, 2013.
3. Johny R.Johnson, “Introduction to Digital Signal Processing”, PHI, 2006.
4. Lonnie C.Ludeman, “Fundamentals of Digital Signal Processing”, Wiley, 1st Edition, 2009

19MC01C ENVIRONMENTAL SCIENCE AND ENGINEERING L T P C QP
3 0 0 0 D

COURSE OUTCOMES

Upon completion of this course, the student will be able to

CO 1: explain the structure and function of ecosystem. (K2)
CO 2: recognize the values of biodiversity and natural resources and the ways to protect the biodiversity of his /her locality. (K2)
CO 3: explain the causes and effects of pollution. (K2)
CO 4: describe social issues related to the environment and the environment act. (K2)
CO 5: identify the nutrients in food and impact of metals on human health. (K2)

UNIT I ENVIRONMENT AND ECOSYSTEMS 9

Scope and importance of environment – need for public awareness – ecosystem – structure and function of an ecosystem – energy flow in the ecosystem – forest and aquatic ecosystems – Field study of simple ecosystems – pond and forest.

UNIT II BIODIVERSITY AND NATURAL RESOURCES 9

Biodiversity: genetic, species and ecosystem diversity – threats to biodiversity – endangered and endemic species in India – conservation of biodiversity; forest resources: use and over - exploitation – deforestation – water resources: use and overutilization of surface and ground water – role of an individual in conservation of natural resources.

UNIT III ENVIRONMENTAL POLLUTION 9

Causes, effects and control measures of air pollution, water pollution, noise pollution and nuclear hazards – e-waste – toxic substances in e-waste – risks related to toxic substances – role of an individual in prevention of pollution.

UNIT IV SOCIAL ISSUES, HUMAN POPULATION AND ENVIRONMENTAL LAW 9

Water conservation – rain water harvesting – climate change – global warming, acid rain, ozone layer depletion – population growth – population explosion – family welfare programme; Environment laws: environmental (protection) act 1986-the wild life (protection) act 1972.

UNIT V FOOD AND HUMAN HEALTH 9

Carbohydrates, lipids and vitamins in balanced diet food; disease caused by deficiency of carbohydrates, amino acids, proteins, lipids and vitamins - food adulteration - simple test for food adulterants; environmental toxicology: metals in environment- impacts of lead, cadmium, mercury and chromium on human health.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Miller G. and Spoolman S, “Environmental Science”, 14th Edition, Brooks/Cole Publishing Co., 2014.
2. Maczulak A.E., “Environmental Engineering”, Facts on file Inc., 2009.
3. Han D, “Concise Environmental Engineering”, Ph.D & Ventus Publishing ApS, 2012.

REFERENCES

1. Weller K. “Environmental Science and Biological Engineering”, 1st Edition, WIT Press, 2015
2. Strange C., “Environmental Science and production”, Nason Trest Publisher, 2014.

19EC55C ELECTROMAGNETIC WAVES LABORATORY L T P C
0 0 3 1.5

COURSE OUTCOMES

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

CO1: Analyze the surface current distribution of coaxial, Rectangular, micro strip and coplanar waveguides using HFSS simulator. (K3)
CO2: Study and analyze the excitation of various boundaries using HFSS simulator. (K3)
CO3: Analyze the impedance matching of an antenna using smith chart. (K3)

LIST OF EXPERIMENTS

1. Design of a coaxial waveguide using ANSYS HFSS and analysis of surface current distribution.
2. Design of a rectangular waveguide using ANSYS HFSS and analysis of surface current distribution.
3. Study of various boundary conditions and excitations using ANSYS HFSS.
4. Impedance matching of an antenna and analysis using smith chart.
5. Design of microstrip transmission line using ANSYS HFSS and analysis of surface current distribution.
6. Design of Substrate Integrated Waveguide (SIW) using ANSYS HFSS.
7. Design of Coplanar waveguide using ANSYS HFSS and analysis of surface current distribution.
8. Design of scattered wave of metal sphere due to incident EM field using ANSYS HFSS

P: 30; TOTAL: 30 PERIODS

19EC56C DIGITAL SIGNAL PROCESSING LABORATORY L T P C
0 0 3 1.5

COURSE OUTCOMES

Upon completion of this course, the students will be able to
CO1: Simulate continuous-time and discrete-time signals. (K2)
CO2: Analyze signals and systems. (K2)
CO3: Compute convolution and correlation of a signal. (K2)
CO4: Analyze sampling rate and its effects.(K2)
CO5: Design and simulate digital IIR and FIR filters. (K3))

LIST OF EXPERIMENTS

1. Generation of Signals.
2. Convolutionand correlation
3. FFT and its properties
4. LTI system response of system
5. Single-rate and multi-rate sampling and analysis of the effects of aliasing
6. Design of IIR and FIR filters
7. Analysis of finite word length effects in filter design
8. Waveform generation using TMS320C6x Processor.
9. Convolution using TMS320C6x Processor
10. DFT computation of a signalusing TMS320C6x Processor
11. Image analysis using TMS320C6x Processor

P: 30; TOTAL: 30 PERIODS

19EC57C LINEAR IC AND MEASUREMENTS LABORATORY L T P C
0 0 3 1.5

COURSE OUTCOMES

Upon completion of this course, the students will be able to
CO1: Design and Construct the Operational Amplifier (OPAMP) – based application circuits for given Specifications. (K3-K4)

CO2: Measure the various parameters of application circuits. (K2)
CO3: Handle Computer Aided Design (CAD) tool for analyzing the performance of application circuits. (K3)

LIST OF EXPERIMENTS

1. Inverting and Non-inverting amplifiers using OPAMP.
2. Input Impedance and Loading effect of OPAMP.
3. Integrator and Differentiator using OPAMP.
4. Differential amplifier and Instrumentation amplifier using OPAMP.
5. Active low pass, High pass and band pass filters using OPAMP.
6. Waveform Generation using OPAMP and 555 Timer
7. Characteristic Measurements of OPAMP
8. Parametric Measurements of regulated DC Power supply.
9. Parametric Measurements of Analog to Digital Converter.
10. Designing bridge Circuit for Resistance Measurement
11. Designing bridge Circuit for capacitance measurement
12. Designing signal Conditioning circuit for Temperature Measurement
13. Designing signal Conditioning circuit for Strain Measurement

P: 30; TOTAL:30 PERIODS

19EC61C WIRELESS COMMUNICATION L T P C QP
3 0 0 3 A

COURSE OUTCOMES

Upon completion of this course, the students will be able to
CO1: Illustrate the cellular concept and identify the suitable Multiple access techniques (K2)
CO2: Explain the large scale propagation model for determining path loss (K2)
CO3: Analyze the various types of fading. (K3)
CO4: Comprehend the techniques to improve the signal quality (K3)
CO5: Understand the principles of a OFDM wireless system (K2)

UNIT I INTRODUCTION TO WIRELESS COMMUNICATION SYSTEMS 9

Introduction, Frequency Reuse, Channel Assignment Strategies, Handoff Strategies, Interference and System Capacity, Trunking and Grade of Service, Improving Coverage & Capacity in Cellular Systems, Multiple Access in cellular System- TDMA- FDMA-CDMA SDMA.

UNIT II MOBILE RADIO WAVE PROPAGATION - LARGE SCALE FADING 9

Radio wave Propagation – Transmit and receive Signal Models – Free Space pathloss – Ground ray propagation model – Shadow fading – Combine path loss and Shadowing – Outage Probability underpath loss & shadowing – Cell coverage area.

UNIT III MOBILE RADIO WAVE PROPAGATION - SMALL SCALE FADING AND MULTIPATH 9

Small Scale Multipath Propagation – Impulse response model of a Multipath Channel Small Scale Multipath Measurements – Parameters of Mobile Multipath Channels – Types of fading (fading effects due to Multipath Time Delay Spread &Doppler spread) – Rayleigh and Ricean Distribution**.**

UNIT IV DIVERSITY AND EQUALIZATION IN WIRELESS SYSTEM 9

Capacity in AWGN – Capacity of Flat Fading and frequency selective Channels. Diversity Technique – Selection combining – Equal Gain Combining – Maximum Ratio Combining – Feedback – Time – Frequency – Rake Receiver – Interleaving. Equalization – Linear Equalization – Non linear (DFE & MLSE) – Algorithm of Adaptive Equalization – Zero Frequency algorithm – LMS algorithm – Recursive Least Square algorithm.

UNIT V PRINCIPLES OF MIMO AND OFDM WIRELESS COMMUNICATION 9

Multiple Input Multiple Output system – MIMO Receivers – capacity of MIMO wireless system. Orthogonal Frequency Division Multiplexing – Transmission in Multicarrier systems – FFT – Cyclic Prefix in OFDM system – Schematic representation of OFDM Transmitter and Receiver. BER Performance of OFDM system.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Rappaport T.S, "Wireless Communications: Principles and Practice", Pearson Education, 2nd Edition, 2010.
2. William Stallings, "Wireless Communication Network and Systems", Pearson Education Asia, 2016.

REFERENCES

1. Andrea Goldsmith, "Wireless Communications", Cambridge UniversityPress, Aug 2005.
2. Lee W.C.Y., "Mobile Communications Engineering: Theory &Applications", McGraw Hill, New York 2nd Edition, 1998
3. Jochen Schiller, "Mobile Communication", Pearson Education Asia Ltd, 2nd Edition, 2008.
4. Rakhesh Singh Kshetrimayum, "Fundamentals of MIMO WirelessCommunication", Cambridge University press, 2017.

19EC62C CONTROL SYSTEMS L T P C QP
3 0 0 3 A

COURSE OUTCOMES

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

CO1: Explain the mathematical model of electrical systems and describe the transfer function for a given control system using block diagram reduction techniques and signal flow graph method (K2)
CO2: Determine the time domain specifications for first and second order systems (K2)
CO3: Determine the stability of a system in the frequency domain using various plots (K2)
CO4: Determine the stability of a system in the time domain using Routh Hurwitz criterion and Root-locus technique. (K2)
CO5: Develop a control system model in continuous and discrete time using state variable techniques (K3)

UNIT I SYSTEM COMPONENTS AND THEIR REPRESENTATION 9

Introduction to Control Systems: Types of Control Systems, Effect of Feedback Systems, Differential equation of Physical Systems- Electrical Systems. Block diagrams and signal flow graphs: Transfer functions, Block diagram algebra and Signal Flow graphs.

UNIT II TIME DOMAIN ANALYSIS 9

Standard test signals, Unit step response of First and second order Systems. Time response specifications of second order systems, steady state errors and error constants. Introduction to PI, PD and PID Controllers.

UNIT III FREQUENCY DOMAIN ANALYSIS 9

Polar plots, Bode plot, stability, Nyquist plots. Performance specifications in frequency-domain. Frequency-domain methods of design, Compensation & their realization in time & frequency domain. Lead and Lag compensation.

UNIT IV STABILITY ANALYSIS 9

Concept of stability-Bounded – Input Bounded – Output stability-Routh stability criterion-Relative stability-Root locus concept-Guidelines for sketching root locus-Nyquist stability criterion.

UNIT V STATE VARIABLE METHODS 9

State variable representation-Conversion of state variable models to transfer functions-Conversion of transfer functions to state variable models-Solution of state equations-Concepts of Controllability and Observability.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Nagarath and M.Gopal, “Control Systems Engineering”, New Age International (P) Limited, Publishers, 8th Edition, 2018.
2. M.Gopal, “Control System – Principles and Design”, Tata McGraw Hill, 2nd Edition, 2002.

REFERENCES

1. Charles L. Phillips and John Parr, “Feedback Control Systems”, Prentice Hall, 5th Edition, 2010.
2. Farid Golnaraghi and Benjamin C.Kuo, “Automatic Control Systems”, Wiley Publications, 9th Edition, 2009.
3. Richard C. Dorf and Robert H. Bishop, “Modern Control Systems”, Prentice Hall, 12th Edition, 2010.
4. K.Ogata, “Modern Control Engineering”, Pearson Education Asia/PHI, 4th Edition, 2002.

19EC63C COMPUTER NETWORKS L T P C QP

3 0 0 3 A

COURSE OUTCOMES

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

CO1: Describe the network model and physical layer concepts (K2)
CO2: Recognize error free transmission of data and analyze data collision with various protocols. (K3)
CO 3: Describe the various network layer protocols. (K2)
CO 4: Select the addressing entities of a network with implementation of TCP, UDP Protocols. (K2)
CO 5: Illustrate the real time applications of networks and explain the fundamentals of SDN & its operation. (K2)

UNIT I FUNDAMENTALS AND PHYSICAL LAYER 9

Data Communications – Networks - Networks models – OSI model – Layers in OSI model – Addressing – Types of Transmission Media, Line Coding, Switching in networks:

Classification and requirements of switches, a generic switch, Crossbar switch and evaluation of blocking probability, Circuit switched networks – Packet switched networks.

UNIT II DATA LINK LAYER 9

Data link control: Framing – Flow and error control –Protocols for Noiseless and Noisy Channels. Error Detection: Parity, LRC, VRC, CRC – HDLC. Multiple Accesses: Random access – Controlled access. Wired LANS: IEEE standards – standard Ethernet – changes in the standard. Wireless LANS: IEEE 802.11: Architecture, MAC Sub layer, Addressing Mechanism.

UNIT III NETWORK LAYER 9

Logical addressing: IPv4, IPv6 addresses - Internet Protocol: Internetworking – IPv4, IPv6 – Address mapping – ARP, RARP, BOOTP, DHCP, ICMP, IGMP, Delivery - Forwarding - Routing protocols – DSDV, OSPF.

UNIT IV TRANSPORT LAYER 9

Process-to-Process delivery - User Datagram Protocol (UDP) – Transmission Control Protocol (TCP)/ Internet Protocol (IP) Suite – Congestion Control – Quality of services (QoS) – Techniques to improve QoS.

UNIT V APPLICATION LAYER AND SOFTWARE DEFINED NETWORKS 9

Domain Name System (DNS) – E-mail – HTTP – FTP - WWW, Software Defined Networking (SDN) – Modern Data Center – Traditional Switch Architecture – Evolution of SDN –SDN operations.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Larry Peterson Bruce Davie, “Computer Networks: A system Approach, 5th Edition, the Morgan Kaufmann Series in Networking- Publisher, 2011.
2. Behrouz A. Forouzan, “Data communication and Networking”, Tata McGraw-Hill, 4th Edition, 2011.

REFERENCES

1. Paul Goransson and Chuck Black, “Software Defined Networks: A comprehensive Approach”, First Edition, Morgan Kaufmann, 2014.
2. Thomas D. Nadeau, Ken Gray, “SDN: Software Defined Networks”, O’Reilly Media, 2013.
3. William Stallings, “Wireless Communication & Networking”, Pearson Education Asia, 2009.

19EC64C VLSI DESIGN L T P C QP
3 0 0 3 A

COURSE OUTCOMES

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

CO 1: Explain MOS transistor theory and CMOS process technology. (K2)
CO2: Estimate the delay, power dissipation of CMOS circuits.(K3)
CO3: Design Combinational and Sequential circuits using MOS transistors.(K3)
CO4: Describe the classification of ASIC and FPGA architectures and performance of the arithmetic building blocks.(K2)
CO5: Construct the VLSI system components using VerilogHDL (K3)

UNITI CMOS TECHNOLOGY 9

MOS Transistor Theory - Ideal I-V and C-V Characteristics of MOS Transistor, Non-ideal I - V Effects, DC Transfer Characteristics of CMOS Inverter, n well, twin tub and SOI CMOS processes, Lambda based design Rules, CMOS Process Enhancements, Technology- related CAD Issues, Manufacturing Issues.

UNITII CMOS CIRCUIT CHARACTERIZATION 9

Delay Estimation, Logical Effort and Transistor Sizing, Power Dissipation, Interconnect, Reliability, Scaling – Introduction to SPICE - Device models, Device characterization, Circuit characterization.

UNITIII COMBINATIONAL AND SEQUENTIAL CIRCUIT DESIGN 9

Combinational Circuit Design: Circuit Families – Static CMOS, Ratioed Circuits, Dynamic CMOS Circuits, Pass-transistor logic Circuits, Low power Logic Design, Comparison of CMOS Circuit Families Sequential Circuit Design: Sequencing Static Circuits, design of Latches and Flip-Flops.

UNITIV DESIGN OF ARITHMETIC BUILDING BLOCKS AND IMPLEMENTATION STRATEGIES 9

Data path circuits: Architecture for ripple carry adder, carry look ahead adder, high speed adder, Multiplier, Barrel shifter, Full Custom ASICs, Standard-Cell Based ASICs, Gate-Array-Based ASICs, Channeled, Channelless, Structured Gate Array and Architecture of Generic FPGA.

UNITV INTRODUCTION TO HDL 9

Design Methodologies – Modules – Instances – Test bench – Operators – Number Specification – Identifiers and Keywords – Data Types – Modules and Ports – Modeling: Structured Procedures, Procedural Assignments, Timing Controls, Conditional Statements, Multiway Branching, Loops, Sequential and Parallel Blocks - Design of combinational and sequential circuits using Gate-Level Modeling, Dataflow Modeling and Behavioral Modeling.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Weste and Harris, “CMOS VLSI DESIGN:A Circuit and Systems Perspective”, 4th Edition, Pearson Education, 2015.
2. Samir Palnitkar,"Verilog HDL, A Guide to Digital Design and Synthesis", 2nd Edition, Pearson Education, 2005.

REFERENCES

1. M.J.SSmith, "Application Specific integrated circuits", Pearson Education, 2008. (5th reprint)
2. Jan Rabaey, Anantha Chandrakasan, B.Nikolic, “Digital Integrated Circuits: A Design Perspective”, PHI, 2nd Edition, 2013 (reprint).
3. D.A. Pucknell & K.Eshraghian, “Basic VLSI Design”, PHI, 3rd Edition, 2006.
4. Wayne Wolf, “Modern VLSI design”, Pearson Education, 3rd Edition, 2007.
5. Uyemura J.P, “Introduction to VLSI circuits and systems”, Wiley, 2009.

19EC65C ANTENNA AND WAVE PROPAGATION L T P C QP

3 0 0 3 A

COURSE OUTCOMES

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

CO1: Explain the various Parameters of antenna- wire antenna.(K2)
CO2: Describe the various types of array antenna (K2)
CO3: Explain the aperture and special antennas for the given specification (K2)

CO4: Design broadband patch antenna and explain various antenna measurement techniques. (K3)
CO5: Explain various radio wave propagation mechanism(K2)

UNIT I ANTENNA FUNDAMENTALS 9

Basic properties of transmitting and receiving antenna, Antenna parameters: Radiation pattern, Directivity, Gain, Radiation resistance, Mutual impedance, Input impedance, Polarization, Bandwidth, Beamwidth, Effective aperture, Vector effective length, Antenna temperature. Reciprocity principle and its applications, Friss transmission formula. Wire antennas: Short dipole, Radiation resistance and Directivity, Half wave Dipole, Monopole, Small loop antennas.

UNIT II THEORY OF ARRAY ANTENNAS AND SMART ANTENNAS 9

Two-element Array, Linear Array and Pattern Multiplication, Uniform Array, Array with non-uniform Excitation - Binomial Array and Yagi-uda arrays. Basic Concepts of Smart Antennas -Beamforming- Fixed weight beamforming - Adaptive beamforming Antenna-MIMO antenna- study of 2 X 2 MIMO antenna system

UNIT III APERTURE ANTENNAS AND SPECIAL ANTENNAS 9

Aperture Antennas: Babinet's Principle, Slot antenna, Horn Antenna, Pyramidal Horn Antenna, Reflector Antenna-Flat reflector, Corner Reflector, Common curved reflector shapes, Lens Antenna. Special Antennas: Broadband antenna, Frequency independent antenna, log periodic antennas, Helical geometry, transmission radiation modes, practical design considerations, wide band characteristics of helical antenna.

UNIT IV ANTENNAS FOR MODERN AND WIRELESS APPLICATIONS AND ANTENNA MEASUREMENTS 9

Microstrip Patch Antenna-design of rectangular and circular patch - impedance matching of microstrip antennas, Antenna for Radar systems. Adaptive antenna, RFID antenna, Ultra wideband antenna, Terahertz antenna. Measurements: Radiation Pattern measurement, Gain and Directivity Measurements, Anechoic Chamber.

UNIT V RADIO WAVE PROPAGATION 9

Ground Wave Propagation - Free-space Propagation - Ground Reflection, Tropospheric Propagation- Ionospheric propagation - Structure of ionosphere, skip distance, Virtual height, Critical frequency, MUF, Electrical properties of ionosphere, Faraday rotation, Whistlers.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. John D Kraus, Ronald J Marhefka and Ahmad S Khan, “Antennas for all Applications”, Tata McGraw-Hill Book Company, 4th Edition, 2010.
2. K.D Prasad, “Antennas and Wave Propagation”, Satya Prakashan Publications, 2nd Edition, 2008.

REFERENCES

1. Constantine A. Balanis, “Antenna Theory: Analysis and Design”, John Wiley, 3rd Edition, 2005.
2. C.Rowell, E.Y.Lam, “Mobile Phone Antenna Design”, IEEE Antenna & Propagation Magazine, Vol 54, No.4, Pages (14-34), 2012.

3. A.R.Harish, M.Sachidananda, "Antennas and Wave propagation", Oxford University Press, 1st Edition, 2007.
4. S.R.Saunders, "Antennas and Propagation for Wireless Communication", 2nd Edition, John Wiley, 2007.
5. Yi Huang and Kevin Boyle, "Antenna From Theory to Practice", 1st Edition, John Wiley, 2008.

19EC66C COMPUTER NETWORKS LABORATORY L T P C
0 0 3 1.5

COURSE OUTCOMES

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

CO1: Describe the concepts of computer networking and analyze the operations of various Error Detection algorithms. (K2)
CO2: Demonstrate the protocols in network layer and transport Layer. (K3)
CO3: Exemplify the concepts of CIA and create network environment. (K3)

LIST OF EXPERIMENTS

1. Topology orientation and building a small network
2. Analysis of logical link control layer protocols- Stop & wait, Sliding Window
3. Examining the protocols in the Network layer
4. Analysis of Network Data Traffic.
5. Observing TCP & UDP using Netstat and Wireshark
6. Study and Configuration of Subnetting
7. Implementation of Routing Protocols (RIP & OSPF).
8. Implementation of VLAN & NAT

P: 30 TOTAL: 30 PERIODS

19EC67C VLSI DESIGN LABORATORY L T P C
0 0 3 1.5

COURSE OUTCOMES

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

CO1: Write Verilog HDL code for various digital circuit. (K3)
CO2: Synthesize and implementation of digital Circuits in FPGAs. (K3)
CO3: Analyze the characteristics of Inverter, Current source, Current Mirrors and Differential Amplifier. (K2)

LIST OF EXPERIMENTS

Experiments using HDL simulator and FPGA implementation software

1. Design entry and simulation of combinational logic circuits (8 bit adder, 4 bit multiplier, address decoders, multiplexers), test bench creation, functional verification, and concepts of concurrent and sequential execution to be highlighted
2. Design entry and simulation of counters, shift registers and state machines. Critical paths and static timing analysis to be identified.
3. Synthesis, Place and Route and Post Place and Route simulation of the components simulated in I and II.
4. Implementation of the digital circuits such as 8 bit adder, 4 bit multiplier, address decoder, multiplexer, counters and shift registers on FPGA.

Experiments using full custom/semi custom IC design software

1. Design and simulation of a CMOS inverter. Perform layout simulation and parasitic extraction.
2. Schematic Entry and simulation of MOS differential amplifier, Determination of gain, bandwidth, output impedance and CMRR.
3. Schematic Entry and simulation of Current source and Current Mirror.

P: 45; TOTAL: 45 PERIODS

19EC68C PRODUCT DEVELOPMENT LABORATORY L T P C
1 0 2 2

COURSE OUTCOMES

Upon Successful completion of this course, the students will be able to

CO1: Conceive a new concept / idea for a new product / modification of the existing product. (K2)

CO2: Conduct market survey to identify the marketability of the proposed product (K3)

CO3: Analyze the various aspects to be considered in making the product as technically and financially feasible (K4)

UNIT I NEED IDENTIFICATION, TARGET SPECIFICATIONS AND CONCEPT SELECTION 20

Planning-customer need identification through empathy, problem definition, target specifications, concept development and selection.

UNIT II PROTOTYPING AND DEMONSTRATION 25

Prototype development and demonstration - cost estimation - product documentation

L: 15; P: 30; TOTAL: 45 PERIODS

REFERENCES

1. Michael G Luchs, Scott Swan, Abbie Griffin, “Design Thinking: New Product Development Essentials from the PDMA”, Willey, 2015
2. Christian Muller-Roterberg, “Design Thinking”, Wiley Publications, 2021
3. Anita Goyal, Karl T Ulrich, Steven D Eppinger, “Product Design and Development”, Tata Mc Graw Hill Education, 4th Edition, 2011.
4. George E Dieter, Linda C Schmidt, “Engineering Design”, Mc-Graw Hill International Edition, 5th Edition, 2013.
5. Kevin Otto, Kristin Wood, “Product Design”, Indian Reprint, Pearson Education, 2013

Mentor Activities

- Forming multidisciplinary/interdisciplinary batches among the students
- Facilitating the batches to define a problem through empathizing
- Guiding the batches to develop a prototype to verify the functionality of the concept
- Evaluating the students’ activities through demonstration and presentations

End semester Assessments can be made through

- Product demonstration and presentation

Other points

- This course is for all department students
- Course instructor and mentors will be responsible for the academic process.
- In a project batch, maximum number of students shall be limited to four
- Project batch may be interdisciplinary / multidisciplinary

- Multidisciplinary project batches are encouraged and permitted to take mentors from various discipline.

19EC71C PROJECT MANAGEMENT AND FINANCE L T PC
(Common to all Programmes) 3 0 0 3

COURSE OUTCOMES

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

CO1: Explain the concept of operational and project management. (K2)

CO2: Define the scope of a project and develop the project plan. (K2)

CO3: Evaluate the technical, business and social environment related to the project. (K3)

CO4: Formulate and manage project team successfully. (K5)

CO5: Monitor and control projects using tools and techniques. (K3)

UNIT I BASIC CONCEPT 9

Concept and categories of project - Project development cycle - Concept, tools and techniques of project management - Logistics and supply chain management - Forms of project organizations.

UNIT II THE VERTICAL STRUCTURE PLANE 9

Project identification, formulation and preparation. Market and demand estimation - Market survey techniques - Demand forecasting. Materials management - Analysis of materials input, technology, production, plant capacity, location and site, civil works, charts, layouts and work schedule. Cost of project - Means of financing, estimates of cost - Financial projections.

UNIT III PROCESS OF PROJECT APPRAISAL 9

Technical, Economic, Financial, Legal and Social appraisal of the Industrial Projects. Problems due to rate of discount, wage-rate, exchange rates, treatment of taxes, social cost-benefits - treatment of risk and uncertainty - sensitivity analysis and probability approach - Single as well as multiple projects - Big data analytics - PLM and SLM.

UNIT IV PROJECT TEAM FORMULATION AND MAXIMIZING PARTICIPATION 9

Project Team frame works - Project Team cultures - Barriers and challenges - Selecting Team Members- Key skills of effective project leaders - Giving / receiving feedback from different members of the project.

UNIT V IMPLEMENTATION, MONITORING AND CONTROL OF PROJECTS 9

Project scheduling, network techniques for resource, cost budgeting and scheduling - project management teams and coordination - Monitoring and post implementation, evaluation of the project - ERP - Project financing.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Gobalakrishnan P and Ramamoorthy V.E., “Textbook of Project Management”, Macmillan Publications, 2014.
2. Maylor “Project Management”, 3rd Edition, Pearson, 2010.

REFERENCES

1. Gido, “Effective project management”, 3rd Edition, Cengage Learning, 2008.

2. Gray and Larson, “Project Management: The Managerial Process”, 3rd Edition, TMH, 2010.
3. Choudhury S, “Project Management”, Tata Mc-Graw Hill Publishing Co.,1st Edition, 2007.

19EC72C PROFESSIONAL ETHICS AND HUMAN VALUES L T P C
3 0 0 3

COURSE OUTCOMES

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

CO1: Recognize the core human values that shape the ethical behavior of an engineer. (K2)
CO2: Expose awareness on professional ethics. (K2)
CO3: Analyze the engineering ethical breach from past study. (K2)
CO4: Distinguish and apply safety, responsibility and rights in workplaces. (K2)
CO5: Discuss about the global issues with regard to ethics. (K2)

UNIT I HUMAN VALUES 9

Morals, Values and Ethics - Integrity - Work Ethics - Service Learning - Civic Virtue - Respect for Others - Living Peacefully - Caring - Sharing - Honesty - Courage - Valuing Time - Cooperation - Commitment - Empathy - Self-Confidence - Character – Spirituality.

UNIT II ENGINEERING ETHICS 9

Senses of 'Engineering Ethics' - variety of moral issued - types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy - Models of Professional Roles - theories about right action - Self-interest - customs and religion - uses of ethical theories.

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION 9

Engineering as experimentation - engineers as responsible experimenters - codes of ethics - a balanced outlook on law - Case study: The challenger disaster.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS 9

Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - Collegiality and loyalty - respect for authority - collective bargaining - confidentiality - conflicts of interest - occupational crime - professional rights - employee rights - Intellectual Property Rights (IPR) - discrimination. Case studies: The Three mile island and Chernobyl disaster

UNIT V GLOBAL ISSUES 9

Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers - consulting engineers - engineers as expert witnesses and advisors - Code of Conduct – Corporate Social Responsibility.

L: 45 TOTAL:45 PERIODS

TEXT BOOKS

1. Mike W Martin and Roland Schinzinger, “Ethics in Engineering”, 4thEdition, McGraw-Hill, New York 2017.
2. Govindarajan M, Natarajan S and Senthil Kumar VS, “Engineering Ethics”, Prentice Hall of India, New Delhi, 2013.

REFERENCES

1. John R Boatright, "Ethics and the Conduct of Business", 4th Edition, Pearson Education, New Delhi, 2017.
2. Charles D and Fleddermann, "Engineering Ethics", Pearson Education / Prentice Hall, New Jersey, 2012.
3. Charles E Harris, Michael S Protchard and Michael J Rabins, "Engineering Ethics - Concepts and Cases", Fourth Edition, Wadsworth Thompson Learning, United States, 2005.
4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford 2001.

19EC73C **COMPREHENSION** **L T P C**
0 0 2 1

COURSE OUTCOME

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

CO1: Recollect the technical knowledge acquired during the course of study.(K2)
CO2: Demonstrate the comprehensive knowledge in technical interviews.(K4)

COURSE CONTENT AND ASSESSMENT PATTERN

The students will review the following subjects to improve their competency level:

1. Electron Devices
2. Circuit Theory
3. Signals and Systems
4. Control Systems
5. Analog and Digital Communication
6. Digital Circuits and Microprocessor
7. Computer Networks
8. VLSI Design
9. Data Structures and OOPS
10. General Aptitude

- The staff-coordinator is responsible for scheduling the session plans, monitoring the activities and recording the continual assessments.
- The technical seminars and group discussions will be assisted by subject experts in the department.
- Each student must participate in all the activities and their performance assessment must be recorded.

P: 30 TOTAL: 30 PERIODS

REFERENCES

1. Dr.R.S.Aggarwal, "Quantitaive Aptitude for Competitive Examinations", S Chand Publications, New Delhi, 20th edition, 2013
2. BARRON's GRE, Barron's Educational Series Inc., U.S., 20th Edition, 2013
3. Yashavant P. Kanetkar, "Let Us C", BPB Publications, 2011
4. E.Balagurusamy, "Object Oriented Programming with C++", McGraw Hill Company Limited, 2007
5. Shakuntala Devi, "Puzzles To Puzzle To You" Orient Paperbacks, 1st Edition, 2001
6. www.indiabix.com

Assessment procedure and pattern may be structured and well defined as follows.

No. of Assessments: **Three**

Continuous Assessment Test 1 - (50 Marks) **- Duration : 90 Min**

General Aptitude Questions - 20 Marks
Core Subject Questions - 20 Marks
C/C++ - 10 Marks

Continuous Assessment Test 2 - (50 Marks) - Duration : 90 Min
General Aptitude Question - 20 Marks
Core Subject Questions - 20 Marks
C/C++ - 10 Marks

Continuous Assessment Test 3 - (50 Marks) - Duration : 90 Min
General Aptitude Questions - 20 Marks
Core Subject Questions - 20 Marks
C/C++ - 10 Marks

19EC74C PROJECT WORK – I L T P C
0 0 6 3

COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: identify an innovate or creative idea / concept / solution to a problem (K3)
CO2: perform the detailed literature survey related to concept / idea (K2)
CO3: implement basic prototype to demonstrate the concept (K4)

1. The Project is a theoretical study/analysis / prototype design / modeling and simulation or a combination of these.
2. Should be done as group (preferably four students) project.
3. The progress of the project is evaluated based on a minimum three reviews and final viva-voce examination.
4. A project report is required to be submitted in the standard prescribed format.

P: 90; TOTAL:90 PERIODS

19EC81C PROJECT WORK – II L T P C
0 0 12 6

COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: design and develop the working model (K3)
CO2: work independently to complete the project along with team members (K2)
CO3: demonstrate the results and documents the report (K4)

Project work shall be based on any of the following:
1. Fabrication of product/ testing setup of an experimentation unit/ apparatus/ small equipment, in a group.
2. Experimental / Theoretical verification of principles used in the concept.
3. Projects having valid database, data flow, algorithm, and output reports, preferably software based.
4. Research findings, Recommendations and future scope.

P: 180; TOTAL:180 PERIODS

19EC82C **INTERNSHIP / IN-PLANT TRAINING** **L T P C**
0 0 4 2

COURSE OUTCOMES

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

CO1: acquire the knowledge of different industrial / organizational activities (K2)

CO2: document the work and communicate effectively through technical presentation (K2)

1. Student shall undergo internship/in-plant training after getting prior permission from the department
2. A report should be submitted after the successful completion of internship / in-plant training.

P: 60; TOTAL: 60 PERIODS

R-2019 B.E. ECE
PROGRAMME ELECTIVE COURSES

19EC01E SPEECH AND AUDIO PROCESSING L T P C QP
3 0 0 3 A

COURSE OUTCOMES

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

CO1: Understand the process of speech production system and auditoryperception system (K2)
CO2: Understand the speech signal using deterministic and stochasticprocess models (K2)
CO3: Determine the linear prediction coefficients for the speech samples (K2)
CO4: Understand the audio processing and acoustic effects (K2)
CO5: Design speech and audio coding algorithm (K2)

UNIT I SPEECH PRODUCTION AND AUDITORY PERCEPTION 9

Speech Production and Modeling- Origin, Classification, Modeling the Speech Production System, Human Auditory System- Structure, Absolute Threshold, Masking and Phase Perception.

UNIT II SPEECH ANALYSIS 9

Pitch Period Estimation, All-Pole and All-Zero Filters, Stochastic Processes and Models- Periodogram, Autoregressive Model, Autocorrelation Estimation.

UNIT III LINEAR PREDICTION AND QUANTIZATION 9

The Problem of Linear Prediction, The Leroux–Gueguen Algorithm, Long-Term Linear Prediction, Synthesis Filters, Scalar Quantization, Vector Quantization, Scalar Quantization of Linear Prediction coefficients.

UNIT IV AUDIO PROCESSING AND ACOUSTIC EFFECTS 9

Studio Technology, Digital Transmission Systems, Storage Media, Audio Components for Home Entertainment, Room Acoustics, Early Reflections, Reverberation, Approximation of Room Impulse Response.

UNIT V AUDIO CODING 9

Lossless Audio Coding, Lossy Audio Coding, Psychoacoustics, MPEG Layer I, II and III, The CELP Speech Production model, The Principle of Analysis-by-Synthesis, Encoding and Decoding.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Dr. Shaila D. Apte, “Speech and Audio Processing”, Wiley, 2019.
2. Wai C. Chu, “Speech Coding Algorithms - Foundation and Evolution of Standardized Coders” John Wiley & Sons, 2003.
3. Tokunbo Ogunfunmi, Roberto Togneri, Madihally (Sim) Narasimha, “Speech and Audio Processing for Coding, Enhancement and Recognition”, Springer-Verlag New York, 2015.

REFERENCES

1. Umesh Gupta R.S. Kaler, M. Kulkarni, “Digital Signal Processing”, Wiley, 2019.
2. NilanjanDey, “Intelligent Speech Signal Processing”, First Edition, 2019.
3. Ken.C.Pohlmann, “Principles of Digital Audio”, McGraw-Hill, Sixth edition, 2011.
4. Andreas Spanias, Ted Painter, Venkatraman Atti, “Audio Signal Processing and Coding”, Wiley, 2007.

19EC02E DIGITAL IMAGE AND VIDEO PROCESSING L T P C QP
3 0 0 3 A

Pre-requisites : Signal Processing

COURSE OUTCOMES

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

CO1 : Understand the fundamentals in image processing (K2)
CO2 : Describe different image enhancement techniques (K2)
CO3 : Understand the fundamentals of image restoration techniques (K2)
CO4 : Understand various steps in video processing (K2)
CO5 : Describe different two-dimensional motion estimation methods in video processing (K2)

UNIT I DIGITAL IMAGE FUNDAMENTALS 9

Elements of digital image processing systems –Elements of visual perception, brightness, contrast, hue, saturation, mach band effect –Color image fundamentals –RGB, HSI models, Image sampling, Quantization –Two–dimensional mathematical preliminaries, 2D transforms –DFT, DCT, KLT, DWT and SVD.

UNIT II IMAGE ENHANCEMENT 9

Spatial filtering –Intensity Transformation –Histogram equalization and specification techniques, Noise distributions, Image Smoothing, Image sharpening, Median, Geometric mean, Harmonic mean –Contraharmonic mean filters –Homomorphic filtering –Color image enhancement.

UNIT III IMAGE RESTORATION 9

Model of the Image Degradation/Restoration Process –Noise Models –Restoration in the Presence of Noise Only –Spatial Filtering –Periodic Noise Reduction by Frequency Domain Filtering –Linear, Position–Invariant Degradations –Estimating the Degradation Function –Inverse Filtering –Minimum Mean Square Error (Wiener) Filtering –Constrained Least Squares Filtering –Geometric Transformations.

UNIT IV BASIC STEPS OF VIDEO PROCESSING 9

Analog video, Digital Video, Time varying image formation models : 3D motion models, Geometric Image formation, Photometric Image formation, Sampling of video signals, Filtering operations.

UNIT V 2D MOTION ESTIMATION 9

Optical flow, General methodologies, Pixel based motion estimation, Block matching algorithm, Mesh based motion estimation, global motion estimation, Region based motion estimation, multi resolution motion estimation, Waveform based coding, Block based transform coding, predictive coding, Application of motion estimation in video coding.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Rafael C. GonzalezandRichard E. Woods, “Digital Image Processing', 3rd Edition, Prentice Hall, 2009.
2. Anil K. Jain, “Fundamentals of Digital Image Processing”, Pearson Education, 2003.
3. Yao wang, Joem Ostarmann and Ya-quin Zhang, “Video processing and communication”, 1stEdition, PHI

REFERENCES

1. Kenneth R. Castleman, “Digital Image Processing”, Pearson, 2006.
2. Rafael C. Gonzalez, Richard E. Woods and Steven Eddins, “Digital Image Processing using MATLAB”, Pearson Education, Inc., 2004.

3. D. E. Dudgeon and RM. Mersereau, "Multidimensional Digital Signal Processing", Prentice Hall Professional Technical Reference,1990.
4. William K. Pratt, "Digital Image Processing", 4th Edition, John Wiley, New York, 2007
5. Milan Sonkaet.al, "Image Processing, Analysis and Machine Vision", 3rdEdition, Vikas Publishing House, 2007.

WEB REFERENCES

1. www.digitalimageprocessingplace.com
2. www.ou.edu/class/.../articles/CompressionMethods_Gif_Jpeg_PNG.html

19EC03E MIXED SIGNAL DESIGN L T P C QP
3 0 0 3 A

COURSE OUTCOMES

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

CO1 : Understand the working of analog filters (K2)
CO2 : Discuss the working of switched-capacitor filters (K2)
CO3 : Describe the conversion from analog to digital data and vice versa (K2)
CO4 : Analyze the design systems involving mixed signals (K2)
CO5 : Discuss about frequency synthesizers and synchronization (K2)

UNIT I ANALOG FILTERS 9

Introduction to sampling theory- Analog continuous-time filters-Overview: passive and active filters; Basics of analog discrete-time filters and Z-transform

UNIT II SWITCHED CAPACITOR FILTERS 9

Switched-capacitor filters - Non-idealities in switched-capacitor filters; Switched-capacitor filter architectures; Switched-capacitor filter applications

UNIT III DATA CONVERTERS 9

Successive approximation ADCs, Dual slope ADCs, Flash ADCs, Pipeline ADCs, Hybrid ADC structures, High-resolution ADCs, DACs

UNIT IV SIGNALING MODES9

Mixed-signal layout, Interconnects and data transmission; Voltage-mode signaling and data transmission; Current-mode signaling and data transmission

UNIT V FREQUENCY SYNTHESIZERS AND SYNCHRONIZATION 9

Basics of PLL,Analog PLLs; Digital PLLs; DLLs.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. R. Jacob Baker, CMOS mixed-signal circuit design, Wiley India, IEEE press, 2009.
2. BehzadRazavi, Design of analog CMOS integrated circuits, 2nd Edition, McGraw-Hill, 2017.

REFERENCES

1. R. Jacob Baker, CMOS circuit design, layout and simulation, 4th Edition, IEEE press, 2019.
2. Rudy J, Van. De Plassche, CMOS Integrated ADCs and DACs, Springer, Indian Edition, 2005
3. Arthur B. Williams, Frd J Taylor, Electronic Filter Design Handbook, 4th Edition, McGraw-Hill, 2006.
4. R. Schauman, Design of analog filters, 2nd Edition, Prentice-Hall, 2010.

5. M. Burns et al., An introduction to mixed-signal IC test and measurement, Oxford university press, 1st Indian Edition, 2008

19EC04E ADAPTIVE SIGNAL PROCESSING L T P C QP
3 0 0 3 A

PRE-REQUISITES: Signal Processing, Probability and Random Process

COURSE OUTCOMES
Upon completion of this course, the students will be able to
- CO1 : Model systems to estimate power spectrum (K2)
- CO2 : Determine filter coefficients from the auto correlation and cross correlation of random sequences (K2)
- CO3 : Design adaptive filters and to study the applications of adaptive filtering (K3)
- CO4 : Apply the concept of Wiener filter for channel equalization (K3)
- CO5 : Employ wavelet transforms for various applications (K2)

UNIT I PARAMETRIC METHODS FOR POWER SPECTRUM ESTIMATION 9
Discrete random process –Autocorrelation and Auto covariance properties –Relationship between the auto correlation and the model parameters –White noise, Power Spectral Density–Spectrum estimation

UNIT II FILTERING 9
Wiener filter-Principle of orthogonality – Minimum mean square error, Wiener Hopf Equations- Error-Performance Surface- Kalman Filter.

UNIT III ADAPTIVE SIGNAL PROCESSING 9
FIR adaptive filters –Steepest descent adaptive filter –LMS algorithm –Convergence of LMS algorithms –Application: Noise cancellation –Channel equalization –Adaptive recursive filters –Recursive least squares – ARMA, AR and MA Model parameters.

UNIT IV APPLICATIONS 9
Signal enhancement and prediction –System Identification- Channel equalization – Beamforming- Echo cancellation.

UNIT V ADVANCED TRANSFORM TECHNIQUES 9
Short Time Fourier Transform –The Gabor Transform –Discrete Wavelet Transform – Perfect Reconstruction Filter Banks and wavelets –Recursive multi–resolution decomposition –Haar Wavelet –1 D and2 D decomposition

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS
1. Monson H.Hayes, “Statistical Digital Signal Processing and Modeling”, Wiley India Pvt. Ltd, 2008.
2. Raghuveer. M. Rao, Ajit S.Bopardikar, “Wavelet Transforms, Introduction to Theory and applications”, Pearson Education, 2000.

REFERENCES
1. L.R.Rabiner and R.W.Schafer, “Digital Processing of Speech Signals”, Pearson Education, 2009.
2. Roberto Crist, “Modern Digital Signal Processing”, Thomson Brooks/Cole, 2004.

3. K.P. Soman, N.G.Resmi and K.I. Ramachandran, “Insight into Wavelets: From Theory to Practice”, 3rdEdition, PHI Learning, 2010.

WEB REFERENCES

1. http://ee.lamar.edu/gleb/adsp/Lecture%2009%20–%20Parametric%20SE.pdf2
2. http://www.dspalgorithms.com/aspt/asptnode29.htm

19EC05E	WAVELET TRANSFORMS	L	T	P	C	QP
		3	0	0	3	A

COURSE OUTCOMES

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

CO1 : Understand the concepts of vector spaces and signal spaces (K2)
CO2 : Implement Multiresolution processing (K3)
CO3 : Understand Continuous wavelet transform (K4)
CO4 : Understand Discrete wavelet transform (K4)
CO5 : Understand with the wavelets to specific applications (K3)

UNIT I VECTOR SPACES AND SIGNAL SPACES 9

Vector Spaces - properties - dot product - basis - dimension, orthogonality and orthonormality - relationship between vectors and signals - Signal spaces - concept of Convergence – Hilbert spaces for energy signals - Generalised Fourier Expansion

UNIT II MULTI RESOLUTION ANALYSIS 9

Definition of Multi Resolution Analysis (MRA) - Haar basis - Construction of general orthonormal MRA-Wavelet basis for MRA - Continuous time MRA interpretation for the DTWT - Discrete time MRA- Basis functions for the DTWT - PRQMF filter banks

UNIT III CONTINUOUS WAVELET TRANSFORMS 9

Wavelet Transform - definition and properties - concept of scale and its relation with frequency - Continuous Wavelet Transform (CWT) - Scaling function and wavelet functions (Daubechies, Coiflet, Mexican Hat, Sinc, Gaussian, Bi-Orthogonal) - Tiling of time -scale plane for CWT.

UNIT IV DISCRETE WAVELET TRANSFORMS 9

Filter Bank and sub band coding principles - Wavelet Filters - Inverse DWT computation by Filter banks - Basic Properties of Filter coefficients - Choice of wavelet function coefficients - Derivations of Daubechies Wavelets - Mallat's algorithm for DWT.

UNIT V WAVELET APPLICATIONS 9

Signal Compression - Image Compression techniques: EZW-SPIHT Coding - Image denoising techniques: Noise estimation – Shrinkage rules - Shrinkage Functions - Edge detection and object Isolation, Image Fusion, and Object Detection.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Rao.R.M and A.S.Bopardikar, "Wavelet Transforms: Introduction to theoryand Applications”, Prentice Hall PTR, 3rdEdition, 2012.
2. K.P.Soman and K.I.Ramachandran, “Insight into Wavelets – From Theoryto practice”, PHI Learning Private Limited, 3rd Edition, 2013

REFERENCES

1. Prasad, "Wavelet analysis with applications to image processing”, T & FIndia, 2015

2. Vetterli M, Kovacevic J, "Wavelets and Sub-band Coding", CreateSpace Independent Publishing Platform, Second Edition, 2013
3. Mallat S, "A Wavelet Tour of Signal Processing", Academic Press, 3rd Edition, 2008.
4. Bachman, "Fourier and Wavelet Analysis ", G, Springer, Edition 2019

19EC06E	DIGITAL SIGNAL PROCESSORS	L	T	P	C	QP
		3	0	0	3	A

COURSE OUTCOMES

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

CO1 :Recognize the fundamentals of Real time DSP.(K2)
CO2 :Explain the architecture details of BLACKFIN Processor (ADSP BF533) (K2)
CO3 :Understand the functional blocks of ADSP SC570 processor(K1)
CO4 :Write simple programs using BLACKFIN Processor Instructions (K3)
CO5 :Describe about the memory system and data transfer types (K2)

UNIT I OVERVIEW OF REALTIME DSP 9

Number formats in DSP systems – Dynamic Range and Precision-Quantization error in DSP implementations, A/D Conversion errors, DSP Computational errors - Real time Vs Offline processing-sample by sample processing mode-Block processing mode-performance parameters for real time DSP implementations.

UNIT II BLACKFIN PROCESSOR ARCHITECTURE 9

Introduction to Micro Signal Architecture –BLACKFIN processor family- functional blocks of ADSP BF533-data formats, data types and register files-Computational units–operating modes and states-program sequencer-data address generator

UNIT III INTRODUCTION TO SHARC PROCESSOR ADSP SC570 9

Trends in multi core DSP platforms-multi core DSP processor classification-functional blocks of ADSP SC570-general purpose ports-timer-mobile storage interface-media interface-two wire interface-audio interface-enhanced DMA interface

UNIT IV INSTRUCTION SET 9

Load/Store, move, Arithmetic and Logical operations, Bit operations, Shift/Rotate operations, Program flow control - Programs for working on Load-Store – Move – Buffers – Loops-Programs for working on Arithmetic and Logical instructions-Programs for working on Program flow control and Bit operations

UNIT V MEMORY SYSTEM AND DATA TRANSFER 9

Overview of signal acquisition and data transfer to memory: understanding CODEC, interfacing ADI 836A with ADSP BF533, data communication through serial port-Cache memory concept in ADSP BF533 Processor-DMA operations and configuration setup for data transfer.

L:45TOTAL:45 PERIODS

TEXT BOOKS

1. Woon-SengGan, Sen.M.Kuo, "Embedded Signal Processing with Micro-Signal Architecture", John Wiley Sons, 2007
2. Venkataramaniand M.Bhaskar, "Digital Signal Processors, Architecture,Programmingand Applications",TMH, 2nd Edition,2011.
3. ADSP-BF533 Blackfin Processor Hardware Reference (Rev3.6),2013.
4. ADSP-SC570Blackfin Processor Hardware Reference (Rev1.0),2018.

REFERENCES

1. Steven K smith, "The scientist and engineers guide to DSP", California technical publishing, USA, 2nd Edition, 1993
2. K.Padmanabhan, R.Vijayarajeswaran, Ananthi.S, "A Practical Approach to Digital Signal Processing", New Age International, 2nd Edition, 2013.
3. JonathamStein, "Digital Signal Processing",John Wiley, 2005.
4. Lapsley, "DSP Processor Fundamentals, Architectures and Features", S.Chand &Co., 2000
5. IEEE Signal Processing Magazine, Special Issue on Signal Processing on Platforms with Multiple Cores, Nov. 2009
6. www.analog.com

19EC07E	BIO-SIGNAL PROCESSING	L	T	P	C	QP
		3	0	0	3	A

COURSE OUTCOMES

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

CO1 : Explain the model of bio-medical signals. (K2)
CO2 : Analyze and process neurological signals (K2)
CO3 : Classify the cardiological signals. (K2)
CO4 : Investigate optimal and adaptive filtering techniques for removingartifacts. (K2)
CO5 :Explain pattern recognition technique for bio-medical signalclassification (K2)

UNIT I INTRODUCTION TO BIO-MEDICAL SIGNAL 9

Nature of Bio-medical Signals, Typical Sources of Bio-medical Signals, Bio-medical Signal Analysis: Objectives and Difficulties-Computer Aided Diagnosis. Concurrent, Coupled and Correlated Processes: Illustration with case studies, Application-segmentation of PCG.

UNIT II NEUROLOGICAL SIGNAL PROCESSING 9

The Brain and its potentials, Electrophysiological origin of brain waves, EEG signal and its characteristics, EEG analysis, Linear prediction theory, AR Method for EEG, Recursive estimation of AR parameters, Spectral error measure, Adaptive segmentation, Transient detection and elimination, Overall Performance.

UNIT III CARDIOLOGICAL SIGNAL PROCESSING 9

Basic electrocardiography, ECG Data Acquisition, ECG lead systems, ECG parameters and their estimation, Use of multi scale analysis for parameter estimation, Arrhythmia analysis monitoring, Long-term continuous ECG recording.

UNIT IV FILTERING FOR REMOVAL OF ARTIFACTS 9

Time-domain Filters, Frequency-domain Filters, Optimal Filtering - Wiener Filter, Adaptive Filters for Removal of Interference, Selecting an Appropriate Filter, Application: Removal of Artifacts in the ECG, Maternal - Fetal ECG and Muscle-contraction Interference.

UNIT V BIO-SIGNAL CLASSIFICATION AND DIAGNOSTIC DECISION 9

Diagnostic of bundle-branch block-Illustration, Pattern classification, Supervised and Unsupervised pattern classification, probabilistic models and statistical decision. Training test steps, Neural Networks and Applications.

L:45TOTAL:45 PERIODS

TEXT BOOKS

1. D.C. Reddy, "Bio-medical Signal Processing Principles and Techniques", Tata McGraw-Hill, 2nd Edition reprint, 2016.

2. Rangaraj M.Rangayyan, “Bio-medical Signal Analysis: A Case-Study Approach”, Wiley, 2nd Edition Reprint 2015.

REFERENCES

1. Willis J Tompkins, “Bio-Medical Digital Signal Processing”, Prentice Hall of India, New Delhi, 3rd Edition Reprint 2013.
2. Eugene N. Bruce, “Bio-medical Signal Processing and Signal Modeling”, John Wiley & Sons, 2nd Edition 2014.
3. John L.Semmlow, “Bio-signal And Bio-medical Image processing Matlab Based Applications”, Marcel Dekker Inc., 2nd Edition Reprint 2014.
4. Leif Sörnmo and Laguna, “Bio-electrical Signal Processing in Cardiac andNeurological Applications”, Elsevier, 1st Edition, Reprint 2015.

19EC18E	INTRODUCTION TO MEMS	L	T	P	C	QP
		3	0	0	3	A

COURSE OUTCOMES

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

CO1 : Develop electrical and mechanical model of MEMS and understand materials and fabrication aspects of MEMS and Microsystems (K2)
CO2 : Analyze the mechanics of MEMS design (K2)
CO3 : Analyze electrostatic model and circuit issues in MEMS (K2)
CO4 : Explain the general concept and applications of MEMS (K2)
CO5 : Illustrate the concepts of Optical and RF MEMS (K2)

UNIT I MEMS AND MICROSYSTEMS 9

MEMS and Microsystems, Miniaturization, Typical products, Micro sensors, Micro actuation, MEMS with micro actuators, Microaccelorometers and Micro fluidics, MEMS Materials: Substrates and Wafers, Active substrate materials, Silicon, Silicon compounds, Silicon Piezoresistors, Gallium Arsenide, Quartz, Polymers, Packaging materials, Micro fabrication-Substrate, wafer cleaning, Pattern transfer.

UNIT II MECHANICS FOR MEMS DESIGN 9

Elasticity, Stress, strain and material properties, Bending of thin plates, Spring configurations, torsional deflection, Mechanical vibration, Resonance, Thermo mechanics – actuators, force and response time, Fracture and thin film mechanics.

UNIT III ELECTRO STATIC DESIGN AND SYSTEM ISSUES 9

Electrostatic Actuators : charge control, voltage control, spring suspended C, pull-in voltage, linearization methods, comb drive actuators, levitation, equivalent circuits, Piezoelectric, Thermal, Magnetic actuators, gap closers, rotary finger pull up, inch worms, Electronics Interface, Feedback systems, Noise, circuit and system issues.

UNIT IV FABRICATION ISSUES, DESIGN CHALLENGES ANDAPPLICATION OF MEMS 9

Scaling issues for MEMS- Scaling issues of Physical systems, Computational issues, Fabrication issue, and Material issue. Design rules: Manufacturing issues and design rule checking.

MEMS systems in industrial and automotive applications- Sensors and analysis systems, Case studies – Capacitive accelerometer, Peizo electric pressure sensor, Microfluidics for Biological application, Microelectrode arrays, CAD for MEMS.

UNIT V INTRODUCTION TO OPTICAL AND RF MEMS 9

Optical MEMS, - System design basics – Gaussian optics, matrix operations, resolution. Case studies- MEMS scanners and retinal scanning display, Digital Micro mirror devices. RF Mems – design basics, case study – Capacitive RF MEMS switch, performance issues, Case Study: Micro machined Antennas, Micro strip antenna, Micromachining for antennas fabrication, Reconfigurable antennas

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Stephen D Senturia, "Microsystems Design", Kluwer Academic Publishers Springer, 2016.
2. Nadim Maluf, "An Introduction to Micro Electro Mechanical System Engineering", Artech House, 2nd Edition, 2004.

REFERENCES

1. Ai QunLiu,"Photonic MEMS Devices", CRC press, Taylor & Francis group, Boca Raton, 2009.
2. Chang Liu, "Foundations of MEMS", Pearson Education, 2012.
3. A.R.Jha, "MEMS and Nanotechnology-Based Sensors and Devices forCommunications,Medical and Aerospace Applications", CRC press, Taylor & Francis, (2008).

19EC19E	**INFORMATION THEORY AND CODING**	**L**	**T**	**P**	**C**	**QP**
		3	**0**	**0**	**3**	**A**

COURSE OUTCOMES

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

CO1: Comprehend fundamentals required for subsequent development ofinformation theory (K2)
CO2: Understand the compression of data without any loss in information using source coding techniques (K2)
CO3: Describe various binary channels and analyze the channel capacity (K2)
CO4:Understand the essentials of information theory for Gaussian channels (K2)
CO5:Explain the basic concepts of rate distortion theory (K2)

UNIT I FUNDAMENTALS OF INFORMATION THEORY 9

Entropy, Joint Entropy and Conditional Entropy, Relative Entropy and Mutual Information, Chain Rules for Entropy, Jensen's Inequality and its consequences, Log Sum Inequality and its applications, Data-Processing Inequality, Fano's Inequality, Markov Chains, Entropy Rate.

UNIT II DATA COMPRESSION 9

Kraft Inequality, Variable Length Codes, Prefix Codes, Optimal Codes, Bounds on the Optimal Code Length, Kraft Inequality for Uniquely Decodable Codes, Source Coding Theorem, Huffman Codes and its optimality, Shannon–Fano–Elias Coding, Arithmetic codes, Lempel Ziv codes, Run Length codes.

UNIT III CHANNEL CAPACITY 9

Noiseless Binary Channel, Noisy Channel with Non overlapping Outputs, Binary Symmetric Channel, Binary Erasure Channel, Symmetric Channels, Properties of Channel Capacity, Channel Coding Theorem, Zero-Error Codes, Hamming Codes, Feedback Capacity, Source–Channel Separation Theorem.

UNIT IV DIFFERENTIAL ENTROPY AND GAUSSIAN CHANNEL 9

Differential Entropy, AEP for Continuous Random Variables, Joint and Conditional Differential Entropy, Properties of Differential Entropy, Gaussian Channel, Converse to the Coding Theorem for Gaussian Channels, Band limited Channels, Parallel Gaussian Channels, Gaussian Channels with Feedback.

UNIT V RATE DISTORTION THEORY 9

Quantization, Definitions, Calculation of the Rate Distortion Function – Binary function, Gaussian function, Simultaneous Description of Independent Gaussian Random Variables, Converse to the Rate Distortion Theorem, Strongly Typical Sequences and Rate Distortion, Characterization of the Rate Distortion Function, Computation of Channel Capacity and the Rate Distortion Function.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Thomas M. Cover, Joy A. Thomas, “Elements of Information Theory”, John Wiley & Sons, 2012.
2. Monica E. Borda, "Fundamentals in Information Theory and Coding", Springer, 2011.

REFERENCES

1. PredragIvanis, Dusan Drajic, "Information Theory and Coding - Solved Problems", Springer International Publishing, 2017
2. A. B. Robert, Information Theory, Dover Special Priced Titles, 2007.
3. R. M. Roth, Introduction to Coding Theory, Cambridge University Press, 2006.
4. R. E. Blahut, Algebraic Codes for Data Transmission, Cambridge University Press, 2002.

19EC20E	SATELLITE COMMUNICATION	L	T	P	C	QP
		3	0	0	3	A

COURSE OUTCOMES

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

CO1 : Understand the orbital mechanics. (K2)
CO2 : Classify different launch vehicles and describe the working of thespace segment subsystems. (K2)
CO3 : Evaluate the satellite link budget and estimate the performanceimpairments. (K2)
CO4 : Understand different earth station parameters and its measures.(K2)
CO5 : Illustrate the different applications of satellite. (K2)

UNIT I SATELLITE ORBITS 9

Kepler's Laws, Newton's laws, orbital parameters, orbital perturbations, Station keeping, Geostationary and non-Geo-stationary orbits - Look Angle Determination- Limits of visibility –eclipse - Sub satellite point -Sun transit outage.

UNIT II SPACE SEGMENT AND LAUNCH VEHICLES 9

Launching Procedures, Hohmann Transfer, Different types of latest Indian Launch Vehicles, Spacecraft Technology- Structure, Primary power, Attitude and Orbit control, Telemetry, Tracking and Command. Thermal control and Propulsion, Communication, Payload and supporting subsystems.

UNIT III SATELLITE LINK DESIGN 9

Satellite uplink and downlink Analysis and Design, link budget, C/N calculation, Performance impairments-system noise, inter modulation distortion, interference, Propagation Characteristics and Frequency considerations- System reliability and design life time.

UNIT IV EARTH SEGMENT 9

Earth Station Technology - Terrestrial Interface, Transmitter and Receiver, Antenna Subsystems, DBS, DTH, TVRO, MATV, CATV, Test Equipment, Measurement of G/T,C/N0, EIRP, Antenna Gain.

UNIT V SATELLITE APPLICATIONS 9

GSAT Series, INSAT, VSAT, Mobile Satellite Services: GSM, GPS, IRNSS, INMARSAT,LEO, MEO, Satellite Navigational System, Digital Audio Broadcast (DAB), Remote sensing satellites, Weather forecasting satellites, RADARSAT.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Dennis Roddy, "Satellite Communication", McGraw Hill International, 4th Edition, 2006.
2. Anil K. Maini, Varsha Agrawal, "Satellite Communication", Wiley India, 3rd Edition, 2014.
3. T.Pratt, C.W.Boastian, Jere my Allnutt, Satellite Communication, 2013, 2nd Edition, John Willey & Sons, New Jersy.

REFERENCES

1. Bruce R. Elbert, "Introduction to Satellite Communication", Artech House Bostan London, 3rdEdition, 2008.
2. M.Richharia, "Satellite Communication Systems-Design Principles", Macmillan, 2nd Edition, 2006.
3. Tri T. Ha, "Digital Satellite Communication", McGraw Hill, 2nd Edition, 2009.

19EC21E	RADAR AND NAVIGATIONAL AIDS	L	T	P	C	QP
		3	0	0	3	A

PRE REQUISITE

A) Antennas and Wave Propagation
B) RF and Microwave Engineering

COURSE OUTCOMES

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

CO1: Design different parameters of a Radar system (K3)
CO2: Explain threshold detection and constant false alarm rate detectors (K2)
CO3: Explain Doppler processing (K2)
CO4: Explain Pulse Compression technique (K2)
CO5: Apply acquainted with navigational aids (K2)

UNIT I BASICS OF RADAR 9

Radar concept, basic radar measurements, basic radar functions, radar range equation: Amplitude model, simple point target radar range equation, distributed target radar range equation, noise model and signal to noise ratio, search mode fundamentals, overview of detection fundamentals, General characteristics of clutter and clutter modeling.

UNIT II THRESHOLD DETECTION AND CONSTANT FALSE ALARM RATE DETECTORS 9

Detection strategies for multiple measurements, Introduction to optimal detection: Hypothesis testing and Neyman-Pearson criterion, statistical models for noise and target RCS in radar, threshold detection of radar signals, Overview of detection theory, false alarm impact and sensitivity, CFAR detectors, Cell averaging CFAR, robust CFARs, adaptive CFARs.

UNIT III DOPPLER PROCESSING 9

Review of Doppler shift and pulsed radar data, Pulsed radar Doppler data acquisition and characteristics, Moving Target Indication, Pulse Doppler Processing, Tracking Radar.

UNIT IV FUNDAMENTALS OF PULSE COMPRESSION WAVEFORMS 9

Pulse compression waveforms, Linear Frequency Modulated Waveforms, Phase coded waveforms.

UNIT V NAVIGATION SYSTEMS 9

Four Methods of Navigation, Hyperbolic Navigation System, LORAN – DECCA navigation system, Inertial Navigation System, Instrument Landing System, GPS principle of operation – Position location determination – GPS receiver – Differential GPS.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Mark A.Richards, James A.Scheer, William A.Holm," Principles of Modern Radar", Scitech Publishing Pvt Ltd, 2nd Edition, 2014.
2. N.S.Nagaraja, "Elements of Electronic Navigation Systems", 2nd Edition, Tata McGraw–Hill, 2004.

REFERENCES

1. Mark A.Richards, "Fundamentals of Radar Signal Processing", Tata McGraw Hill, 2nd Edition, 2014.
2. Skolnik M, "Introduction to Radar Systems", Tata McGraw–Hill, 2nd Edition, 2015.
3. Bassem R.Mahafza, "Radar Systems Analysis and Design Using MATLAB", 3rd Edition, Chapman and Hall/CRC, 2013
4. Lee Andrew Harrison, "Introduction to Radar With Python and Matlab", Artech House; Illustrated Edition, 2019.

19EC22E	STATISTICAL THEORY OF COMMUNICATION	L	T	P	C	QP
		3	0	0	3	A

COURSE OUTCOMES

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

CO1 : Demonstrate the basics of classical detection and estimation theory. (K2)
CO2 : Estimate the signal parameters. (K2)
CO3 : Understand the receiver filter for detecting deterministic signal. (K2)
CO4 : Estimate random signal with unknown parameters (K2)
CO5 : Explain the signal estimation in discrete time (K2)

UNIT I CLASSICAL DETECTION AND ESTIMATION THEORY 9

Introduction –Review of Gaussian variables and processes; problem formulation and objective of signal detection and signal parameter estimation in discrete-time domain.

Simple binary hypothesis tests – M Hypothesis – Estimation theory – Composite hypothesis – General Gaussian problem – Performance bounds and approximations

UNIT II DETECTION OF SIGNALS – ESTIMATION OF SIGNALPARAMETERS 9

Detection and Estimation in White Gaussian and Non-White Gaussian noise – Signals with unwanted parameters: The Composite hypothesis problem – Multiple channels – Multiple parameter estimation.

UNIT III DETECTION OF DETERMINISTIC SIGNALS 9

Matched filter detector and its performance; generalized matched filter; detection of sinusoid with unknown amplitude, phase, frequency and arrival time, linear model.

UNIT IV DETECTION OF RANDOM SIGNALS 9

Estimator-correlator, linear model, general Gaussian detection, detection of Gaussian random signal with unknown parameters, weak signal detection.

UNIT V SIGNAL ESTIMATION IN DISCRETE TIME 9

Linear Bayesian estimation, Weiner filtering, dynamical signal model, discrete Kalman filtering.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Harry L. Van Trees, “Detection, Estimation and Modulation theory”, Part I, John Wiley & Sons, NY, USA, 2nd Edition, 2013.
2. P.Eugene Xavier, “Statistical theory of Communication”, New Age International Ltd. Publishers, New Delhi, 2007.

REFERENCES

1. L. L. Scharf, “Statistical Signal Processing: Detection, Estimation, and Time Series Analysis”, Addison Wesley, 2012
2. H. V. Poor, "An Introduction to Signal Detection and Estimation", Springer, 2nd Edition, 1998.
3. S. M. Kay, "Fundamentals of Statistical Signal Processing: Estimation Theory", Prentice Hall PTR, 1993.
4. S. M. Kay, "Fundamentals of Statistical Signal Processing: Detection Theory", Prentice Hall PTR, 1998.

19EC23E MULTIMEDIA COMPRESSION AND COMMUNICATION L T P C QP
3 0 0 3 A

COURSE OUTCOMES

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

CO1: Analyze the algorithms used for individual samples and block of text compression (K2)
CO2: Analyze the algorithms used for lossy and lossless image compression (K3)
CO3: Describe the different audio compression principles for speech synthesis and analysis (K2)
CO4: Discuss the different video compression principles (K2)
CO5:Illustrate the service requirements, protocols and mechanisms used for different multimedia applications (K2)

UNIT I TEXT COMPRESSION 9

Compression Principles - Huffman coding –Adaptive Huffman coding –Arithmetic coding – Shannon-Fano coding–Dictionary techniques–LZW family algorithms – Vector quantization.

UNIT II IMAGE COMPRESSION 9

Image Compression: Fundamentals –Lossy compression-JPEG Standard –Wavelet Based compression –EZW, SPIHT coders–Lossless compression-CALIC-JPEG LS-Facsimile encoders.

UNIT III AUDIO COMPRESSION 9

Audio compression Techniques –law, A-Law companding –Frequency domain and filtering –Basic sub-band coding –Application to speech coding –G.722 –MPEG audio – progressive encoding –Silence compression, Speech compression –Formant and CELP vocoders.

UNIT IV VIDEO COMPRESSION 9

Video compression techniques and Standards –MPEG video coding: MPEG-1 and MPEG-2 video coding: MPEG-3 and MPEG-4 –Motion estimation and compensation techniques – H.261 Standard –DVI technology –DVI real time compression –Current Trends in Compression standards

UNIT V MULTIMEDIA NETWORKING 9

Multimedia networking applications, Streaming stored audio and video, Making the best Effort service, Protocols for real time interactive Applications, Distributing multimedia, Beyond best effort service, Scheduling and policing mechanisms, Integrated services, Differentiated Services, RSVP.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. David Salomon, G. Motta, “Handbook of DataCompression”, 5th Edition, Springer-Verlag, London, 2010.
2. Khalid Sayood, “Introduction to Data Compression”, Morgan Kauffman, 4th Edition, 2012.
3. Kurose and W.Ross, “Computer Networking - a Top down approach”, Pearson Education, 8th Edition, 2020.

REFERENCES

1. Ze-Nian Li, Mark S Drew, “Fundamentals of Multimedia”, Springer, 3rd Edition, 2020.
2. Fred Halshall, “Multimedia communication - Applications, networks, protocols and standards”, Pearson Education, 1st Edition, 2011
3. Yun Q.Shi and Huifang Sun, “Image and Video Compression for Multimedia Engineering - Fundamentals, Algorithms & Standards”, CRCpress, 2nd Edition, 2017.
4. Peter Symes, “Digital Video Compression”, McGraw Hill, 1st Edition, 2004.
5. Mark Nelson, “Data compression”, BPB Publishers, New Delhi, 2nd Edition, 2008.

19EC24E GLOBAL NAVIGATION SATELLITE SYSTEM L T P C QP

3 0 0 3 A

COURSE OUTCOMES

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

CO1 : Describe the working of GPS (K2)
CO2 : Explain the satellite constellation, signal structure and errors in GPS (K2)
CO3 : Illustrate the applications of GPS (K2)
CO4 : Explain the principle of differential GPS (K2)
CO5 : Compare different navigational satellite system (K2)

UNIT I OVERVIEW OF GPS 9

Introduction to Global navigation satellite system, Kepler’s law and orbital dynamics, Satellite Orbital parameters, Orbital Perturbations, GPS observables, Basic Equations for

finding user position, pseudorange measurement in receiver, user position determination from pseudo ranges.

UNIT II GPS SATELLITE CONSTELLATION AND SIGNAL STRUCTURE 9

GPS System segments -signals -signal generation –Signal characteristics –signal power levels, Determination of GPS satellite coordinates, GPS data formats: Receiver Independent Exchange format (RINEX).

UNIT III GPS RECEIVERS AND ERRORS 9

GPS receiver, Signal conditioning, Signal Acquisition, Carrier and code tracking, Converting tracking outputs to Navigation data, Subframe matching and Parity check, GNSS antennas, Weak signals and their Acquisition, GPS Error sources, Error correction models, Receiver noise, Ionospheric effects on GPS signals.

UNIT IV DIFFERENTIAL GPS 9

Basic concepts of DGPS, Local area DGPS, Extension of Range of Accurate DGPS, Real time and Post processing DGPS, Data link, Radio Technical Commission for Maritime services format (RTCM)

UNIT V GLOBAL NAVIGATION SATELLITE SYSTEM 9

GLONASS components –Constellation details –Signal structure –Time and Co-ordinate systems, NAVSTAR GPS, GALILEO.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. G S Rao, “Global Navigation Satellite Systems”, McGraw-Hill publications, New Delhi, 2010.
2. Madry, Scott, “Global Navigation Satellite Systems and Their Applications”, Springer-Verlag New York, 2015

REFERENCES

1. Margaret Ziegler, “Global Navigation Satellite Systems”, Clanrye International, 2015
2. Asher Clark, “Global Navigation Satellite Systems and Their Application”, Larsen and Keller Education, 2017.
3. Shusen Tan, “GNSS Systems and Engineering”, Wiley, 2017.
4. B. Bhatta, “Global Navigation Satellite Systems”, B.S publications, 2010.

19EC25E ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY

L	T	P	C	QP
3	0	0	3	A

COURSE OUTCOMES

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

CO1 : describe EMI/EMC concepts to practical electronic design. (K2)
CO2 : discuss various EMI coupling principles. (K2)
CO3 : understand the concepts of EMI control techniques. (K2)
CO4 : describe the various standards and regulations. (K2)
CO5 : Analyze EMI test methods and instrumentation. (K2)

UNIT I BASIC THEORY 9

Introduction to EMI and EMC, Intra and inter system EMI, Elements of Interference, Sources and Victims of EMI, Conducted and Radiated EMI emission and susceptibility, Case Histories, Radiation hazards to humans, Various issues of EMC, EMC Testing categories, EMC Engineering Application.

UNIT II COUPLING MECHANISM 9

Electromagnetic field sources and Coupling paths, Coupling via the supply network, Common mode coupling, Differential mode coupling, Impedance coupling, Inductive and Capacitive coupling, Radiative coupling, Ground loop coupling, Cable related emissions and coupling, Transient sources, Automotive transients.

UNIT III EMI MITIGATION TECHNIQUES 9

Working principle of Shielding and Murphy"s Law, LF Magnetic shielding, Apertures and shielding effectiveness, Choice of Materials for H, E, and free space fields, Gasketting and sealing, PCB Level shielding, Principle of Grounding, Isolated grounds, Grounding strategies for Large systems, Grounding for mixed signal systems, Filter types and operation, Surge protection devices, Transient protection.

UNIT IV STANDARDS AND REGULATION 9

Need for Standards, Generic/General Standards for Residential and Industrial environment, Basic Standards, Product Standards, National and International EMI Standardizing Organizations; IEC, ANSI, FCC, AS/NZS, CISPR, BSI, CENELEC, ACEC. Electro Magnetic Emission and susceptibility standards and specifications, MIL461E Standards.

UNIT V EMITEST METHODS AND INSTRUMENTATION 9

Fundamental considerations, EMI Shielding effectiveness tests, Open field test, TEM cell for immunity test, Shielded chamber , Shielded anechoic chamber, EMI test receivers, Spectrum analyzer, EMI test wave simulators, EMI coupling networks, Line impedance stabilization networks, Feed through capacitors, Antennas, Current probes, MIL -STD test methods, Civilian STD test methods.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Clayton Paul, “Introduction to Electromagnetic Compatibility”, Wiley Interscience, 2006
2. V. Prasad Kodali, “Engineering Electromagnetic Compatibility”, IEEE Press, Newyork, 2001.

REFERENCES

1. C.R.Paul, “Introduction to Electromagnetic Compatibility”, John Wiley and Sons, Inc, Second Edition, 2006.
2. Bemhard Keiser, “Principles of Electromagnetic Compatibility”, Artechhourse, Norwood, Third Edition, 1989.
3. Henry W.Ott. “Noise Reduction Techniques in Electronic Systems”, A Wiley Inter Science Publications, John Wiley and Sons, New York, Second Edition, 1988.
4. Donald R. J. White, William G. Duff, “A Handbook Series on Electromagnetic Interference and Compatibility: Electrical noise and EMI specifications, Standards and Regulations”, Don White Consultants, 1981.

19EC26E ADVANCED WIRELESS COMMUNICATION L T P C QP
3 0 0 3 A

COURSE OUTCOMES

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

CO1: Explain the multiple access technique and physical layer parameters for Long Term Evolution. (K2)

CO2: Apply MIMO basics for the fourth Generation wireless communication technologies. (K3)
CO3: Analyze the concept of multiple access technique required for 5G wireless communications. (K3)
CO4: Explain the significance and implementation of mm-Wave communication for the next generation wireless networks. (K2)
CO5: Explain the concepts of Massive MIMO. (K2)

UNIT I EVOLUTION OF WIRELESS COMMUNICATION TOWARDS LTE 9

Evolution of mobile systems before LTE, 3GPP Process, Higher Data rate in mobile Communication, Single Carrier Vs Multi Carrier Transmission, Principles of OFDM - Modulation and Demodulation, Guard Interval, Guard Band, Bit Error Rate, Water-Filling Algorithm, Training symbol based and DFT based channel estimation, PAPR, OFDMA, Physical Layer Parameters for LTE.

UNIT II TECHNOLOGY FOR LTE–MIMO 9

Antenna Diversity, Space-Time Coding, Space-Time Block Code, SDMA, BLAST Architectures, MIMO Signal Model, Single User MIMO techniques, Multi-User MIMO techniques, Capacity of MIMO Communication Systems. MIMO schemes in LTE

UNIT III EVOLUTION OF WIRELESS COMMUNICATION TOWARDS 5G 9

Evolution of LTE technology beyond 4G -Demands, Challenges and 5G Roadmap, Candidate Waveform for 5G –Filter Bank Multicarrier Modulation, Universal Filtered OFDM, Generalized Frequency Division Multiplexing, Non-orthogonal schemes for efficient multiple access.

UNIT IV MILLIMETER WAVE COMMUNICATIONS 9

Spectrum and regulations –Channel propagation –Hardware technologies for mmWave Systems-Deployment scenarios-Architecture and Mobility -Beamforming -Physical layer techniques-Transmission schemes.

UNIT V MASSIVE MIMO COMMUNICATION 9

Multiple Base Station Antennas and Multiple Terminals -single-Cell System and Multi-Cell System, Capacity, Pilot design, Resource allocation and transceiver algorithms, Fundamentals of baseband and RF implementations, Channel models.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Simon Haykin, Michael Moher and David Koilpillai, “Modern Wireless Communication”, 1st Edition, Pearson Education, 2015.
2. Yong Soo Cho, Jaekwon Kim, Won Young Yang and Chung G. Kang, “MIMO-OFDM Wireless Communications with MATLAB”, John Wiley &Sons (Asia) Pvt Ltd., 2010.
3. Stefania Sesia, Issam Toufik, Matthew Baker, “LTE-The UMTS Long Term Evolution from theory to practise, John Wiley & Sons Ltd, 2011.
4. AfifOsseiran, Jose F.Monserrat, Patrick Marsch, “5G Mobile and Wireless Communications Technology”, Cambridge University Press, 2016

REFERENCES

1. Andreas F.Molisch, “Wireless Communications”, John Wiley & Sons Limited,2016.
2. Jochen Schiller, “Mobile Communications”, 2nd Edition, Pearson Education, 2012.
3. David Tse and Pramod Viswanath, “Fundamentals of Wireless Communication”, Cambridge University Press, 2005.
4. Tzi-Dar Chiueh and Pei-Yun Tsai, “OFDM Baseband Receiver Design for Wireless Communications” John Wiley & Sons (Asia) PrivateLimited, 2007.

5. Erik Dahlman, Stefan Parkvall, and Johan Sköld, “4G LTE/LTE-Advancedfor Mobile Broadband”, Academic Press, Elsevier, 2011.
6. Athanasios G.Kanatas, Konstantina S. Nikita and Panagiotis Mathiopoulos, “New Directions in Wireless Communications Systems From Mobile to 5G”, CRC Press, Taylor & Francis Group, 2018.

19EC27E ERROR CONTROL CODES L T P C QP
3 0 0 3 A

COURSE OUTCOMES

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

CO1: Understand linear algebra essential for channel coding (K2)
CO2: Design a convolutional encoder and decoder for error control (K2)
CO3: Comprehend error correction methods implemented in a digital communication system which involves convolution codes (K2)
CO4 : Design a turbo encoder and decoder for error control (K2)
CO5 : Explain the fundamentals of Low Density Parity Check codes (K2)

UNIT I CHANNEL CODING ALGEBRA 9

Types of codes, Modulation and coding, Maximum likelihood decoding, Types of error, error control strategy, Performance measures, Coded modulation, Groups, Fields, Binary field arithmetic, construction of Galois Field (GF), properties of GF, Computations using GF arithmetic, vector spaces, matrices, Case study: CRC Encoding and Decoding.

UNIT II CONVOLUTIONAL CODES 9

Encoding methods, Structural and distance properties, Catastrophic encoders, polynomial and rational encoders, constraint length and minimal encoders, systematic encoders, Optimum decoding, Implementation issues, add-compare-select method, decoding streams of data, output decisions, Hard and soft decoding, quantization, synchronization issues, asymptotic coding gain, puncturing.

UNIT III ERROR CORRECTION STRATEGIES 9

Burst-error-correcting codes, Single and Phased Burst-error-correcting codes, Bunds on Burst-error-correcting capability, Burst-error-correcting convolutional codes, Interleaved convolutional codes, Burst-and-Random-error-correcting convolutional codes, Basic Automatic-Repeat-Request (ARQ) schemes, Selective-Repeat ARQ, Hybrid ARQ, Hybrid ARQ systems using Convolutional codes.

UNIT IV TURBO CODES 9

Parallel concatenated codes, Turbo encoding, distance properties of Turbo codes, performance analysis, design of turbo codes, Iterative decoding of turbo codes.

UNIT V LOW DENSITY PARITY CHECK CODES 9

LDPC codes, Tanner Graph, Geometric Construction, EG-LDPC and PG LDPC codes, decoding of LDPC codes, Code construction by column and row splitting, Breaking cycles in Tanner graph, Shortened finite geometry LDPC codes, Construction of Gallager LDPC codes, random LDPC codes, Irregular LDPC codes.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Shu Lin, Daniel J. Costello, “Error Control Coding: Fundamentals and Applications”, Second Edition, Pearson, 2011
2. W. Cary Huffman, "Fundamentals of Error-Correcting Codes", Cambridge University Press, June 2012

REFERENCES

1. Juane Li, Shu Lin, Khaled Abdel-Ghaffar, William E. Ryan, and Daniel J. Costello, "LDPC Code Designs, Constructions, and Unification", Cambridge University Press, December 2016
2. R. M. Roth, Introduction to Coding Theory, Cambridge University Press, 2006.
3. Tood.K. Moon, “Error Correction Coding: Mathematical Methods and Algorithms”, John Wiley 2005.
4. S.B. Wicker, “Error Control Systems for Digital Communication and Storage”, Prentice-Hall 1995

19EC28E	MICROWAVE THEORY AND TECHNIQUES	L	T	P	C	QP
		3	0	0	3	A

COURSE OUTCOMES

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

CO1 : Understand the basics of RF and Microwave transmission line (K2)
CO2 : Explain various microwave network parameters and devices. (K2)
CO3 : Describe the design of microwave circuit. (K2)
CO4 : Describe the application based antenna system and measurement of network antenna parameter. (K2)
CO5 : Explain different applications of microwave systems. (K2)

UNIT I RF AND MICROWAVE TRANSMISSION LINE 9

Introduction to Microwaves – History and Applications, Mathematical model of Microwave Transmission – Concept of mode, Characteristics of TEM, TE and TM modes, Losses associated with microwave transmission, Concept of impedance in microwave transmission, Analysis of RF and Microwave Transmission lines – Coaxial line, Rectangular waveguide, Circular waveguide, Microstrip line.

UNIT II MICROWAVE NETWORK ANALYSIS AND DEVICES 9

Equivalent voltages and currents for non-TEM lines, Network parameters for microwave circuits, Scattering Parameters, Microwave Passive Components – Power divider, Resonator, Microwave Active Components – Oscillators, Mixers.

UNIT III MICROWAVE DESIGN PRINCIPLES 9

Impedance transformation, Impedance matching, Microwave Filter design, RF and Microwave amplifier design, Microwave power amplifier design, Low noise amplifier design, Microwave Mixer and Oscillator design

UNIT IV MICROWAVE ANTENNA AND MEASUREMENTS 9

Microwave antenna parameters, Microwave antenna – Ground based systems, Airborne based systems, Satellite borne systems, Microwave planar antenna. Measurements – Network Analyzer and Measurement of scattering parameters, Spectrum Analyzer and Measurement of spectrum of a microwave spectrum of a microwave signal.

UNIT V MICROWAVE SYSTEM AND MODERN TRENDS 9

Radar systems, Cellular phone, Satellite communication, RFID, GPS, Effect of Microwaves on human body, Medical and Civil applications of microwaves, EMI/EMC, MMIC, RF MEMS, Microwave Imaging.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. David M. Pozar, "Microwave Engineering", Third Edition, Wiley India.
2. S.Ramo, J.R.Whinnery and T.V.Duzer, "Fields and Waves in Communication Electronics", Third Edition, Wiley India

REFERENCES

1. R.E.Collin, "Foundations for Microwave Engineering", 2nd Edition, IEEE Press.
2. Samuel Y Liao, “Microwave Devices and Circuits”, Pearson Education, 3rd Edition, 2003.
3. M. M. Radmanesh, “RF and Microwave Electronics illustrated”, Pearson Education, 2007.

19EC29E	FIBER OPTIC COMMUNICATIONS	L	T	P	C	QP
		3	0	0	3	A

COURSE OUTCOMES

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

CO 1 : Understand the concept of light propagation through optical fiber.(K2)
CO 2 : Explain the various losses and dispersion in optical fiber. (K2)
CO 3 : Describe the different optical sources and receivers.(K2)
CO 4 : Measure various fiber optic parameters.(K2)
CO 5 : Explain different types of optical networks.(K2)

UNIT I RAY THEORY IN FIBER OPTICS 9

Introduction**,** Ray theory transmission- Total internal reflection-Acceptance angle – Numerical aperture – Skew rays – Electromagnetic mode theory of optical propagation – EM waves – modes in Planar guide – phase and group velocity – cylindrical fibers – SM fibers.

UNIT II TRANSMISSION CHARACTERISTICS OF OPTICAL FIBERS 9

Attenuation – Material absorption losses in silica glass fibers – Linear and Nonlinear Scattering losses - Fiber Bend losses – Mid band and far band infrared transmission –Intra and Inter Modal Dispersion – Over all Fiber Dispersion – Polarization – Nonlinear effects – Overview - SPM,CPM,SBS,SRS.

UNIT III OPTICAL SOURCES AND RECEIVERS 9

Optical sources: Light Emitting Diodes - LED structures - surface and edge emitters, monoand hetero structures - quantum efficiency, injection laser diode - ILD structures - comparison of LED and ILD. Optical Detectors: PIN Photo detectors, Avalanche photo diodes, construction, characteristics and properties, Comparison of performance - Fundamental receiver operation, Pre amplifiers, Error sources, Receiver Configuration.

UNIT IV FIBER OPTIC MEASUREMENTS AND DEVICES 9

Fiber Refractive index profile– Fiber alignment and Joint Losses – Fiber Splices – Fiberconnectors – Expanded Beam Connectors – Fiber Couplers. Fiber cut- off

Wavelength –Fiber Numerical Aperture– Fiber diameter, OTDR: OTDR Field application - OTDR Trace-OTDR Attenuation measurement - Fiber fault location.

UNIT V OPTICAL NETWORKS 9

Basic Networks – SONET / SDH – Broadcast and select WDM Networks –Wave length Routed Networks – Performance of WDM - Solutions – Optical CDMA – Ultra High Capacity Networks.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. John M. Senior, "Optical Fiber Communication", Pearson Education, 3rd Edition, 2014.
2. Gerd Keiser, "Optical Fiber Communication", McGraw Hill, 4th Edition, 2015.

REFERENCES

1. J.Gower, "Optical Communication System", Prentice Hall of India, 2nd Edition, 2003.
2. Rajiv Ramaswami, "Optical Networks", 3rd Edition, Elsevier, 2012.
3. Govind P. Agarwal, "Fiber-optic communication systems", 3rd Edition, John Wiley & sons, 2004.
4. R.P. Khare, "Fiber Optics and Optoelectronics", Oxford University Press, 1st Edition, 2013.

19EC35E NANO ELECTRONICS L T P C QP

3 0 0 3 A

COURSE OUTCOMES

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

CO1: Explain the basic concepts of nanoelectronics and various aspects of nanoelectronics. (K2)
CO2: Determine the various effects of Semiconductor materials and carbon nanotubes. (K3)
CO3: Explain the basic concepts of MOS scaling. (K2)
CO4: Analyse the advanced nanoscale devices (K3)
CO5: Explain FET-based Biosensor devices. (K2)

UNIT I INTRODUCTION TO NANOELECTRONICS 9

Introduction to nanoelectronics, Limitations of conventional microelectronics. Classical Particles, Classical Waves and Quantum Particles-Quantum Mechanics of Electronics - Schrödinger wave equation.

UNIT II MATERIALS FOR NANOELECTRONICS 9

Introduction- Semiconductors, Crystal lattices: Bonding in crystals- Electron energy bands- Semiconductor heterostructures-Lattice-matched and pseudomorphic heterostructures- Carbon nanomaterials: nanotubes and fullerenes.

UNIT III SHRINK-DOWN APPROACHES 9

Moore's Law- Technology Scaling and Reliability Challenges.Basic MOS Transistor- Types, Modes of operation, n-MOS operation, Drain Current, Threshold Voltage, Energy band diagram of MOSFET, nanoscale MOSFET, SCEs- scaling limits, system integration limits.

UNIT IV ADVANCED NANOSCALE DEVICES 9

Double Gate MOSFETs, Tri-Gate MOSFETs, Tunnel FETs-Multi-Gate TFETs and Heterojunction TFETs- Graphene and Carbon Nanotube Transistors.

UNIT V NANO ELECTRONICS SENSORS AND APPLICATIONS 9

Principles- Components of biosensor-Classification of Biosensors based on transducers, FET based Biosensor- ion-sensitive field-effect transistor-operation and fabrication-Characteristics and Performance.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. G.W. Hanson, Fundamentals of Nanoelectronics, Pearson, 2009.
2. Vladimir V. Mitin, Viatcheslav A. Kochelap, Michael A. Stroscio, "Introduction to Nanoelectronics: Science, Nanotechnology, Engineering, and Applications", Cambridge University Press 2011.

REFERENCES

1. Chandran Karunakaran, Kalpana Bhargava, Robson Benjamin, Biosensors and Bioelectronics, Elsevier Science, 2015.
2. Pierre R. Coulet, Loïc J. Blum, Biosensor Principles and Applications, CRC press-2019.
3. Donald A. Neamen, "Semiconductor Physics and Devices Basic Principles", Third Edition, McGraw-Hill Higher- Education, 2003.

19EC36E	ADVANCED MICROPROCESSORS	L	T	P	C	QP
		3	0	0	3	A

COURSE OUTCOMES

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

CO1: Describe the architecture of ARM cortex M3. (K2)
CO2: Explain the data structures of Cortex-family. (K2)
CO3: Understand exceptionsofCORTEXM3 system (K2)
CO4: Write interrupt handling programs in CORTEXM3. (K3)
CO5: understand the concept behind Muticore processor (K2)

UNIT I ARM CORTEX–M3 PROCESSOR 9

Overview of ARM Cortex Profile Processor –CortexM3 Processor Architecture Registers-General Purpose Registers, Special purpose Registers-Operation Modes-Memory Map-Bus Interface-MPU-interrupts and Exceptions- Stack Memory Operations-Reset Sequence-Debugging Support.

UNIT II DATA STRUCTURES IN CORTEX M3 9

Concept of the directives -Different directives :Directives for simple memory reservation, directive for memory reservation with initialization, directives form memory management, directive for project management- Special directives-Operands for Common instruction,-Addressing modes-Bit banding concept –Alternative Structures-Compound condition: Alternative with AND, Iterative with AND, Alternative with OR Cortex instruction set-Simple Assembly programming with CORTEXM3.

UNIT III MANAGING EXCEPTIONS 9

Process after reset-possible exceptions: NMI, TRAPS like hard fault, memory management fault, bus fault, usage fault, SVC all trap, monitor, PENDSV service, Internal SYSTICK timer-Interrupts- Priority management: Priority levels and sub levels, nested

mechanism-Entry and return in exception processing–NVIC registers for exception handling-SimpleAssemblyprogrammingwithCORTEXM3.

UNIT IV INTERNALMODULARITYANDEXTERNALMODULARITY 9

Internal Modularity: Concepts of procedure-procedure arguments:Arguments by value and by reference, passing arguments by general registers, passing arguments by stack, passing arguments by system stack, local data & its reservation, chained list-Simple Assembly programming with CORTEXM3.

External Modularity: Different tools in ARM tool chain-Role of Assembler: Files produced by Assembler, placement counters, symboltable, translation, relocation table-Role of the linker: Functioning principle, product of the linker like mapfile and executable file image, scatter loading file-loader and debugging unit- Simple Assembly programming with CORTEXM3.

UNIT V MULTI-CORE PROCESSORS 9

Single core AND Multi-core architectures comparison – SIMD and MIMD systems – Symmetric and Distributed Shared Memory Architectures – Cache coherence - Performance Issues – Parallel program challenges- concept of Open MP Execution Model-OpenMP and MPI comparison.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Vincent Mahout, “Assembly Language programming-ARM CortexM3”, John Wiley& Sons, 2012
2. JosephYiu,“TheDefinitiveGuidetotheARMCortex-M3”,Elsevier, 2nd Edition, 2010
3. Peter S. Pacheco, An Introduction to Parallel Programming-ll, Morgan-Kauffman Elsevier, 2011.

REFERENCES

1. Andrew N.Sloss, Dominic Symes, Chris Wright, “ARM System Developer"s Guide Designing and Optimizing System Software”,Morgan Kaufmann,1st Edition, 2004
2. Steave Furber, “ARM System-On-Chip Architecture”, Addison Wesley, 2nd Edition, 2000
3. Daniel W.Lewis, “Fundamentals of Embedded Software with the ARMCortex-M3”, Prentice Hall, 1st Edition, 2012.
4. Michael J Quinn, Parallel programming in C with MPI and OpenMPll, Tata McGraw Hill, 2003.
5. Shameem Akhter and Jason Roberts, Multi-core Programming, Intel Press, 2006.

19EC37E	FUNDAMENTALS OF SEMICONDUCTOR CHIP TESTING	L	T	P	C	QP
		3	0	0	3	A

COURSE OUTCOMES

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

CO1 : Explain the need for IC testing. (K2)
CO2 : Describe the architecture of ATE. (K2)
CO3 : Analyze the performance of IC based on the IC testing principles.(K3)
CO4 : Explain the various features of CAD tools used for IC testing. (K2)
CO5 : Explain the concept of DFT.(K2)

UNIT I INTRODUCTION TO SEMICONDUCTOR IC TESTING 9

Design and manufacturing cycle of an IC –Logic Verification – Manufacturing defects in an IC – Manufacturing test – Need for CHIP testing – Types of CHIP testing – Engineering testing, production testing, QA testing, Customer inspection testing. Automated Test Equipment (ATE)– Types of ATE-ATE subsystems – Test head, Main frame, Test computer, Manipulator. Common accessories of an ATE – Load boards, Probe cards.

UNIT II AUTOMATIC TEST EQUIPMENT ARCHITECTURE9

Architecture of a mixed signal ATE – Digital subsystem, Pogo blocks, digitizers– Drivers, Comparators, PMU, Timing and formatting units,Sequence controller, Digital source memory, digital capture memory, ATE Pin Electronics. Analog source and Capture memory. Types of ATE- Digital ATE and Mixed Signal ATE.

UNIT III TESTING – CONCEPTS AND METHODS 9

Introduction to testing in digital domains – Data sheet of typical IC – DC Parametric test, continuity test, leakage test, IDD static test – VIL/VIH, VOL/VOH, IIL, IIH, IOL, IOH IDD dynamic test – AC Parameters Test – AC Timing Tests – Setup Time, Hold Time, Propagation Delay, ATE Time Measurement subsystem. Digital Functional Test – Pattern, Timing, Levels.Test plan and Test Programs

UNIT IV TEST DATA ANALYSIS USING CAD TOOLS AND ESD PROTECTION9

Introduction to data analysis– Data visualization tools – Data logs – Lot summaries – Wafer map – shmoo plots – Histograms – Statistical process control – Standard deviation – Mean – Process capability Index – Six sigma quality – Reproducibility – Introduction to ESD – Sources of ESD – ESD models – ESD protection circuits – Latch up test.

UNIT V FAULT MODELS AND PRINCIPLES OF DESIGN FOR TESTABILITY9

Fault models – Simple examples with stuck at and bridging faults – Controllability and observability – Principles of DFT – Scan based Techniques – Boundary scan test – JTAG-Built in self test.

L:45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Mark burns & Gordon W Roberts, “An Introduction to mixed signal IC testing and measurement”, Oxford University Press, 1st Edition, 2000.
2. Michael L. Bushnell &Vishwani D. Agrawal, “Essentials of electronic testing” Kluwer academic publishers, 2000.

REFERENCES

1. William J. Greig, “Integrated Circuit Packaging, Assembly and Interconnections”, Springer, 2007.
2. Artur Balasinki, “Semiconductors: Integrated Circuit Design for Manufacturability”, CRC Press, 1st Edition, 2011.

19EC38E	ARM PROCESSOR ARCHITECTURE AND PROGRAMMING	L	T	P	C	QP
		3	0	0	3	A

COURSE OUTCOMES

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

CO 1: Describe the different ARM processor families. (K2)
CO 2: Explain LPC2148 Microcontroller details. (K2)
CO 3: Explain LPC2148 system control details (K2)
CO 4: Write simple Embedded C programs using GPIO. (K3)
CO 5: Write Embedded C code for Timer, ADC, DAC and UART. (K3)

UNITI ARMPROCESSORFUNDAMENTALS 9

Introduction to ARM Processors, ARM programmers model, ARM architecture Revisions, ARM Nomenclature, Functional block diagram of ARM Processor Families: ARM 9, ARM 11 and Cortex, Comparison of Cortex families.

UNITII ARM INSTRUCTION SET 9

Data Processing Instructions, MOVE Instructions, Barrel Shifter Operations, Arithmetic Instructions, Logical Instructions, Comparison and Test Instructions, Multiply Instructions, Branch Instructions, Load – Store Instructions, Single Register Transfer, Single Register Load Store Addressing Modes, Multiple Register Transfer, Addressing Modes for Stack Operations, Swap Instruction, Software Interrupt Instruction, PSR, MRS and MSR Instructions.

UNIT III ARM ASSEMBLY PROGRAMMING 9

Instruction Scheduling – Register Allocation – Conditional Execution – Looping Constructs– Bit manipulation – Efficient switches – Handling unaligned data-Simple ARM assembly program for calculating: Division, Square roots, Random Number Generation, Saturated and Rounded Arithmetic.

UNIT IV EXCEPTION AND INTERRUPT HANDLING 9

Definition: Exception, Interrupt, Interrupt handler, ARM Processor Exceptions and Modes-Exception Priorities - Link Register Offsets – Interrupts - Interrupt Latency - Vector table, Basic Interrupt Stack Design and Implementation - Nested Vector interrupt controller of Cortex M3 Processor.

UNIT V ARM INTERFACING APPLICATIONS 9

GSM Interfacing - ZigBee Interfacing - LCD Display Interfacing - Sensor Interfacing (Ultrasonic, Hall effect sensors) – Quadrature encoder interfacing.

L: 45 TOTAL: 45 PERIODS

TEXT BOOK

1. Steve Furber, "ARM System-on-chip architecture", Pearson Education, 2nd Edition, 2005
2. Philip A. Laplante "Real time systems design and analysis", Wiley India Edition, 3rd Edition, 2006.

REFERENCES

1. Andrew N. Sloss, Dominic Symes, Chris Wright, "ARM System Developer's Guide
2. Designing and Optimizing System Software", Morgan Kaufmann, 2004.
3. www.arm.com
4. Cortex M3: Technical Reference Manual (TRM)

19EC39E EMBEDDED AND REAL TIME SYSTEMS L T P C QP
3 0 0 3 A

COURSE OUTCOMES

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

CO1 : Explain the fundamental concepts of embedded system. (K1)
CO2 : Explain the Interfacing schemes in embedded systems design.(K2)
CO3 : Describe real time system and its characteristics.(K2)
CO4 : Explain the basic properties of real time operating systems.(K1)
CO5 : interpret the services of UCOS III operating system (K2)

UNIT I INTRODUCTION TO EMBEDDED COMPUTING 9

Definition: Embedded system, Intelligent system, Expert System – Embedded system-classification – Embedded system design process – ARM Processor–CPU: Programming input and output – Supervisor mode, exception and traps - concept of interrupts in ARM processor family. Embedded System design Example.

UNIT II COMPUTING PLATFORM AND DESIGN ANALYSIS 9

I/O devices – Component interfacing – Memory mapped I/O – I/O mapped I/O– DevelopmentandDebugging–Programdesign–Modelofprograms–Basiccompilation techniques–Assembly and Linking,simple program for I/O devices.

UNIT III REAL TIME SYSTEMS 9

Definition : Real time and real time systems – real time system Model – real time system characteristics–High reliability achievement ways in real time system-Hardware considerations for real time system – Examples for real time system.

UNIT IV PROCESS AND OPERATING SYSTEMS 9

Definition: Multi - tasking and multi - processing – Context Switching – Operating Systems Scheduling policies: Rate monotonic, EDF, Comparison example –Inter Process Communication mechanisms – Message Mail boxes – Message Queues –Evaluating operating system performance.

UNIT V TASK MANAGEMENT AND MEMORY MANAGEMENT WITH MICRO C IIIOS 9

Introduction to MICRO C OSIII: Features, Services and variants. Task Management: Task creation, task stacks, stack checking, task priority, task suspending, task deletion program example for Multitasking. Memory management: Creating partition in memory, memory

control block, obtaining and returning memory control block functions program example for memory management implementation-Synchronization techniques

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Wayne Wolf, "Computers as Components – Principles of Embedded Computer System Design", Morgan Kaufmann, 2nd Edition, 2008.
2. Philip A.Laplante, "Real time systems design and analysis", Wiley India Edition, 3rd Edition, 2006.

REFERENCES

1. JeanJ.Labrosse, "Micro C/OS-III: The Real Time Kernal", CMP Books, 2010.
2. David E-Simon, "An Embedded Software Primer", Pearson Education, 2007.
3. K.V.K.K.Prasad, "Embedded Real-Time Systems: Concepts, Design & Programming", Dream tech Press, 2005.
4. Tammy Noergaard, "Embedded Systems Architecture", Elsevier, 2006.

19EC40E	PLC AND SCADA	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

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

CO1: Describe the PLC components and basic programming concept. (K2)
CO2: Explain the instructions used in PLC. (K2)
CO3: Develop the program using PLC for industrial applications. (K3)
CO4: Describe the functionality of SCADA. (K2)
CO5: Experiment to develop the program using PLC (K3)

UNIT I PROGRAMMABLE LOGIC CONTROLLER 10

Advantages of PLC over relay logic – Parts of PLC – Architecture - Principles of operation – PLC versus Computer – PLC Size and Application - PLC Hardware components - Different programming concept - Programming timers and counters.

UNIT II INSTRUCTIONS IN PLC 10

Instructions in PLC – Program control instructions - Data manipulation instructions - math instructions - sequencer and shift register instructions – Programming concept using Instructions.

UNIT III APPLICATIONS OF PLC 10

PLC Installation Practices - Editing and Troubleshooting – Data acquisition system - Application of PLC - Case study of bottle filling system, traffic light control system – Industrial Applications: Cement industry - Paint industry - Power plant.

UNIT IV SUPERVISORY CONTROL AND DATA ACQUISITION 10

Introduction to SCADA - SCADA Functional requirements and Components - General features, Functions and Applications, Benefits - Configurations of SCADA, RTU (Remote Terminal Units) Connections - SCADA Communication requirements - Structure of a SCADA Communications Protocol.

UNIT V PLC Application – Practical approach 20

Batch process control using Programmable Logic Controller - Level Process using Programmable Logic Controller - Reaction vessel control using Programmable Logic Controller - Automation of Traffic Light Control using Programmable Logic Controller - Automation of Bottle filling system using Programmable Logic Controller - Implementation of any control loop using SCADA system.

L: 40; P: 20 TOTAL: 60 PERIODS

TEXT BOOKS

1. Petruzella, Programmable Logic Controller, McGraw Hill, 5th Edition, 2016
2. M. Chidambaram, —Computer Control of Processes, Narosa Book Distributors Pvt. Ltd., 2009

REFERENCES

1. T. Hughes, Programmable Logic Controller, ISA press, 2007.
2. Krishna Kant, Computer based Industrial Control, Prentice Hall, New Delhi, 2011.

19EC41E	EMBEDDED SYSTEM ARCHITECTURE	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

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

CO1: Explain the Hardware architecture of embedded product. (K2)
CO2: Understand the software layered architecture of embedded product. (K2)
CO3: Distinguish the internal components of FPGA specific design. (K2)
CO4: Describe the printed circuit board design principles.(K2)
CO5: Understand the concept of final product assembly sequence. (K2)

UNIT I HARDWARE ARCHITECTURE 9

Understanding embedded system Product specifications with Examples - Component selection - Component package types-embedded system design flow types- Preparation of Block diagram to Final Product Architecture arrival

UNIT II SOFTWARE ARCHITECTURE 9

System software**–**Embedded system software layered architecture**-**Understanding of different Operating System (Linux, Windows, VxWorks, RTOS etc) features and architectures - Basics of Boot loader functionalities–significance of Kerneland Device drivers - File system types.

UNIT III FPGA ARCHITECTURE 9

Basic concepts of CPLD architecture - Difference of CPLD & FPGA - Basic interface protocol study – I2C, GPIO, SPI & UART - Packaging options –concept of on chip logic blocks design-FPGA Design flow - Preparation of Block diagram to Final FPGA Architecture arrival

UNIT IV PCB ARCHITECTURE 9

Understanding of PCB design principles - Different PCB options - PCB component placement guidelines - PCB layout routing - Gerber generation

UNIT V DESIGN FOR MANUFACTURING 9

Understanding of basic Component assembly process - Different ways of assembly – machine assembly/manual assembly - Component storage options - Assembly flow Understanding of basic mechanical ID design - Different mechanical enclosure options - Advantages & Disadvantages of different mechanical enclosure

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Vilas S bagad, “Electronics product design”, Technical publications, Pune 2009
2. Rajkamal, “Embedded system- Architecture, programming and design”, Mcgraw Hill, 2017.

REFERENCES

1. Shibu K.V, “Introduction to Embedded systems”, Mcgraw Hill, 2017.
2. Kiyofumi Tanaka, “Embedded systems –Theory and Methodology”, Intechpublication, Croatia, 2012.
3. Jack Ganssle, “The art of designing embedded system”, 2nd Edition, Newness publication, 2008.

19EC42E EMBEDDED SYSTEM ANALYSIS AND RISK MANAGEMENT L T P C
3 0 0 3

COURSE OUTCOMES

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

CO1: Explain embedded product design specific feasibility analysis. (K2)
CO2: Explain embedded product component specific feasibility analysis. (K2)
CO3: Understand the concept of embedded product validation. (K2)
CO4: Distinguish different certification standards.(K2)
CO5: Understand the concept of risk management. (K2)

UNIT I FEASIBILITY ANALYSIS: DESIGN SPECIFIC 9

Conceptual design arrival to Final Product Architecture-Product Use Case Analysis-Product Feature Analysis-End application Analysis

UNIT II FEASIBILITY ANALYSIS: COMPONENT SPECIFIC 9

Power Analysis-DC Analysis types-AC Analysis types-Thermal Analysis need and concepts-Signal Integrity testing methods-MTBF Analysis-Reliability Analysis-BOM Compliance Analysis-EMI/EMC Analysis need and types

UNIT III VALIDATION 9

Independent Verification and Validation concepts and methods- Endurance- Validation through Environmental -concept of design for manufacturing (DFM) and concept of design for testability

UNIT IV CERTIFICATION OF STANDARDS 9

Different Certifications need –types of Certifications for embedded system product-features of FCC/CE and UL standards - DO254 standards and its components- DO178

Standards and its components

UNIT V MARKET RESEARCH & RISK MANAGEMENT 9

Methods of Market research for products under Consumer, Industrial, Defence & Automotive domains- different schemes for existing products analysis and gap analysis- Product feature enhancement analysis- Product competitor analysis for existing products- arrival of Product cost vs market demand and its analysis.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Vilas S bagad, "Electronics product design", Technical publications, Pune 2009.
2. John P.Uyemura, "Introduction to VLSI circuits and Systems", Wiley student Edition, 2006.

REFERENCES

1. Gunarschirner, "Embedded system: Design, Analysis and verification", Springer, 2013.
2. Edward Ashford Lee, "Introduction to Embedded Systems – a cyber-physical system approach", 2nd Edition, MIT press, 2017.
3. Shibu K.V, "Introduction to Embedded systems", Mcgraw Hill, 2017.
4. Kiyofumi Tanaka, "Embedded systems –Theory and Methodology", Intech publication, Croatia, 2012.
5. Arnold Berger, "Embedded system Design –An Introduction to process, Tolls and Techniques", CMP Books, 2002.
6. Jack Ganssle, "The art of designing embedded system", 2nd Edition, Newness publication, 2008.
7. Kim H Pries, "Testing complex and embedded systems", CRC Press, 2010.

19EC43E CMOS FUNDAMENTALS L T P C

3 0 0 3

PRE-REQUISITES: Basic Knowledge in Semiconductor Devices

COURSE OUTCOMES

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

- CO1 Summarize the concept of IC fabrication and its underlying techniques.
- CO2 Comprehend the operation and device characterization of MOS and Nanometre devices
- CO3 Explain the Scaling Effects of CMOS ICs and its Impact on Design.
- CO4 Design various CMOS logic families
- CO5 Describe the operation of multi-gate MOS transistors.

UNIT I CMOS DEVICE TECHNOLOGY 9

IC definition and classification, IC design flow, Layout, DRC rules, Bulk crystal growth, doping techniques, Epitaxial growth, photolithography, double patterning, etching, Monolithic device fabrication, Bonding, and packaging.

UNIT II MOSFET STRUCTURE AND OPERATING PRINCIPLE 9

MOS capacitor-Accumulation - Depletion - Strong inversion - C-V characteristics of MOS - Energy bands-Threshold voltage - potential - Gate work function - Oxide and Interface charges - Body effect - MOS general structure and types of MOS, NMOS working:VI characteristics, PMOS working and VI characteristics.SOI MOSFETs

UNIT III SCALING OF CMOS DEVICES 9

Moore's Law and CMOS scaling- Scaling Theory-Processing Challenges to further CMOS miniaturization- Short Channel Effects-Effect of scaling - Channel length modulation - Punch-through - Hot carrier degradation -MOSFET breakdown.

UNIT IV CMOS LOGIC FAMILIES 9

Inverter, latches and flipflops-Delay Estimation, Logical Effort and Transistor Sizing, Power Dissipation-Dynamic CMOS Circuits, Pass-transistor logic Circuits-Comparison of CMOS Circuit Families.

UNIT V INTRODUCTION TO NOVEL MOSFETS 9

Multigate transistors-Double gate, Triple gate, Surround gate MOSFETs-FinFETs- Silicon Nanowire transistors.

L: 45 TOTAL: 45 PERIODS

REFERENCES

1. G. Streetman, and S. K. Banerjee, "Solid State Electronic Devices," 7th Edition, Pearson, 2014.
2. S. M. Sze and K. N. Kwok, "Physics of Semiconductor Devices," 3rd Edition, John Wiley&Sons, 2006.
3. Neil H.E.Weste, David Harris, and Ayan Banerjee, "CMOS VLSI Design", 3rd Edition, Pearson Education, 2008.
4. J P Colinge, FINFETs and other Multi-gate Transistors, Springer, Germany, 2010.

19EC44E DIGITAL VLSI SYSTEMS DESIGN L T P C
3 0 0 3

PREREQUISITES: Semiconductor Devices, Digital Electronics and Computer Organization

COURSE OUTCOMES

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

CO1 Explain the architectural design concepts of digital circuits.
CO2 Design the digital data path circuits.
CO3 Analyze the digital design for considering a speed factor.
CO4 Explain the sources of power dissipation in Digital ICs.
CO5 Explain the concept of Low power Digital VLSI design techniques

UNIT I ARCHITECTURAL DESIGN OF DIGITAL CIRCUITS 9

Efficient technique/s for Algorithm to Architecture Mapping- Fundamentals of Efficient Design and Implementation strategies of Digital VLSI Design (Clock Tree synthesis, Timing Closure, Synthesis)-Static Timing Analysis-Clock Skew

UNIT II DESIGN OF DATA PATH CIRCUITS 9

Recent Trends on Adder/Subtractor Design-Recent Trends on Multiplier/Divider Design-Efficient VLSI Architecture for FIR filter-Arithmetic and logic circuit-Processor Control Logic: Hardwired control unit-Micro programmed control unit

UNIT III HIGH SPEED DIGITAL DESIGN 9

Historical Perspective and Future Trends in Digital Circuit and System Design-Logical Effort - A way of Designing Fast CMOS Circuits- Arithmetic Implementation Strategies for Digital design-Interconnect aware design: Impact of scaling-Buffer insertion.

UNIT IV POWER DISSIPATION IN DIGITAL ICs 9

Static Power Dissipation: Transistor leakage mechanisms-Channel engineering for leakage reduction-Active Power Dissipation: Short circuit dissipation-Switching dissipation

UNIT V CIRCUIT TECHNIQUES FOR LOW POWER DESIGN 9

Designing for Low Power-Multiple Vth techniques-Dynamic Vth technique-Supply voltage scaling technique-Low voltage low power logic styles

L: 45 TOTAL: 45 PERIODS

REFERENCES

1. S.Ramachandran, “Digital VLSI Systems Design”, Springer International Edition, 2011.
2. Kaushik Roy, “Low Power CMOS VLSI Circuit Design”, Wiley- Inter science, 2012.
3. Kiat-Seng Yeo and Kaushik Roy, “Low-Voltage, Low-Power VLSI Subsystems”, TATA Mc Graw Hill Edition, 2009.
4. “Ivan Suderland,BobSproull and D. Harris, Logical Efforts: Designing Fast CMOS Circuits”, Morgan Kaufmann, 2012.
5. G. De Micheli.Synthesis and optimization of digital circuits, 1st Edition, 1994.

19EC45E	BIO-MEDICAL ELECTRONICS	L	T	P	C	QP
		3	0	0	3	A

COURSE OUTCOMES

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

- CO 1 :Explain human psychology, bio-electric potential and bio-chemical measurements (K2)
- CO 2 : Explain various diagnostic and Therapeutic equipment’s.(K2)
- CO 3 : Describe different radiological and nuclear equipment’s for diagnosis. (K2)
- CO 4 : Describe different medical imaging equipment and electrical safety.(K2)
- CO 5 :Explore the wireless communication technology for bio-telemetry and telemedicine. (K2)

UNIT I BIO-POTENTIAL AND BIO-CHEMICAL MEASUREMENTS 9

Sources of Bio-electric potentials, Electrode Theory, Bio-potential Electrodes, Bio-chemical Transducers, Bio-electric amplifiers, Electrocardiograph – ECG waveform, standard lead systems and ECG Machine. Electro encephalograph. Blood Gas Analyzer - pH, pO2, pCO2 measurement, Colorimeter, Auto analyzer.

UNIT II CLINICAL DIAGNOSIS AND THERAPEUTIC EQUIPMENTS 9

Blood flow meter, Cardiac Output Measurement, Blood cell counters, Pacemakers,Defibrillators, Hemodialysis Machine, Heart-Lung machine.

UNIT III RADIOLOGY AND NUCLEAR EQUIPMENTS FOR DIAGNOSIS 9

Basis of Diagnostic Radiology, Nature of X-rays, Production of X-rays, X-ray Machine,Visualization of X-rays, X-ray Computed Tomography, Radio-isotopes in MedicalDiagnosis, Physics of Radioactivity, Radiation Detectors, Single Photon EmissionComputed Tomography, Positron Emission Tomography.

UNIT IV BIO MEDICAL EQUIPMENTS AND RISK MANAGEMENT 9

Magnetic Resonance Imaging, Ultrasonic Imaging, Thermal Imaging, Laser in Medicine, Physiological Effects of Electrical Current, Shock Hazards from Electrical Equipment, Methods of Accident Prevention.

UNIT V BIO-TELEMETRY AND TELEMEDICINE 9

Introduction to Bio-telemetry, Physiological Parameters Adaptable to Bio-telemetry, Components of a Bio-telemetry System, Single Channel and Multi-Channel Wireless Telemetry Systems, Multi-patient Telemetry, Implantable Telemetry systems, Telemedicine.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Lesile Cromwell, "Bio-medical instrumentation and measurement", Prentice Hall of India, New Delhi, 2nd Edition Reprint, 2017.
2. Khandpur, R.S., "Handbook of Bio-medical Instrumentation", Tata McGraw-Hill, New Delhi, 3rd Edition, 2014.

REFERENCES

1. A.P.F. Turner, I. Karube & G.S. Wilson, "Bio-sensors: Fundamentals & Applications", Oxford University Press, Oxford, 1st Edition, Reprint 2015.
2. John G.Webster, "Medical Instrumentation Application and Design", John Wiley and Sons,(Asia) Private Limited, 4th Edition, Reprint 2016.
3. B. H. Brown et. Al, "Medical Physics and Biomedical Engineering", Overseas Press India Private Limited, 1st Edition, Reprint 2015.
4. Metin Akay, "Biomedical Signal Processing", Academic Press Inc., 1st Edition, Reprint 2016.

19EC46E	POWER ELECTRONICS	L	T	P	C	QP
		3	0	0	3	A

COURSE OUTCOMES

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

CO1: Illustrate various types of power semiconductor devices. (K2)
CO2: Explain the operation of phase controlled rectifiers. (K2)
CO3: Summarize the basic topologies of DC-DC and DC-AC converters. (K2)
CO4: Explain the operation of AC voltage controller and Cycloconverter. (K2)
CO5: Infer the applications of Power Electronics in Electric Drives and Power system. (K2)

UNIT I POWER SEMICONDUCTOR DEVICES 9

Basic Structure and Characteristics of BJT, SCR, TRIAC, DIAC - Structure and Characteristics of Power MOSFET and IGBT- Firing and commutation circuits for SCR - Gate/Base driver circuits - Protection and cooling.

UNIT II AC TO DC CONVERTERS 9

Operation and analysis of Single phase and three phase controlled rectifiers with R, RL and back EMF load - effect of source inductance, freewheeling effect, power factor control for phase controlled rectifiers- Dual converter

UNIT III CONVERTERS 9

Buck, Boost and Buck-Boost Converters – Time ratio control and current limit control - Single phase and three phase inverters (120ºmode and 180º mode) – PWM techniques: Single PWM - Multiple PWM - Sinusoidal PWM, modified sinusoidal PWM –– Voltage and harmonic control – Series resonant inverter.

UNIT IV AC TO AC CONVERTERS 9

Single phase AC voltage controllers - Introduction to Integral cycle control – Single phase and three phase Cycloconverter – step up and step down converter

UNIT V APPLICATIONS9

Uninterrupted power supply topologies- Induction motor Drives– Stator voltage, Frequency and V/F control- HVDC Transmission principle and Links - Solar PV inverter and types - Energy storage - Heat sink design.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Rashid M.H., "Power Electronics: Circuits, Devices and Applications", Pearson Education, PHI, New Delhi, 3rd Edition, 2004.
2. Bimbra P.S., "Power Electronics", Khanna Publishers, 3rd Edition, 2003.

REFERENCES

1. Singh M. D. and Khanchandani K.B., "Power Electronics" Tata McGraw-Hill Publishing Company Limited, New Delhi, 3rd Edition, 2008.
2. Ashfaq Ahmed, "Power Electronics for Technology", Pearson Education, Indian reprint, 2003.
3. Philip T. Krein, "Elements of Power Electronics", Oxford University Press, 2004.
4. Ned Mohan, Tore M. Undeland, William P. Robbins, "Power Electronics: Converters, Applications and Design", John Wiley and sons, 3rd Edition, 2003.

19EC47E	HIGH SPEED ELECTRONICS	L	T	P	C	QP
		3	0	0	3	A

COURSE OUTCOMES

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

CO 1 :Describe the concepts involved in RF design (K2)
CO 2 :Compare the structure and characteristics of different passive devices (K2)
CO 3 :Classify different power amplifiers (K2)
CO 4 :Explain the principle of mixers and oscillators for high speed applications (K2)
CO 5 :Choose appropriate tool for RF design (K2)

UNIT I TRANSMISSION LINES AND BASIC CONCEPTS IN RF DESIGN 9

Transmission line theory (basics) crosstalk and non-ideal effects; signal integrity, General Considerations in RF design, Effects of Non-linearity- Harmonic Distortion, Gain Compression, Cross Modulation, Inter- modulation -Sensitivity and Dynamic range, Scattering Parameters.

UNIT II PASSIVE DEVICES 9

General Considerations-Inductors, Basic Structure, Inductor Geometries, Inductance Equations, Parasitic Capacitances, Loss Mechanisms, Inductor Modelling, Alternative Inductor Structures – Transformers-Transformer Structures, Effect of Coupling Capacitance, Transformer Modelling -Transmission Lines-T-Line Structures – Varactors - Constant Capacitors, MOS Capacitors, Metal-Plate Capacitors.

UNIT III RF AMPLIFIER DESIGN 9

Low Noise Amplifiers-LNA Topologies, Gain Switching, Band Switching – Power Amplifiers –General Considerations-Effect of high currents, Efficiency, Linearity, Single ended and differential Power amplifiers, Classification of Power Amplifiers, Class A,B,C, High efficiency power amplifiers,

UNIT IV MIXERS AND OSCILLATORS 9

Mixers – Performance parameters, Mixer Noise Figures, Single balanced and double balanced mixers, Passive down conversion Mixers, Active Down Conversion Mixers, Oscillators – Basic Principles, Cross Coupled and Three point oscillators, VCOs, Phase Noise, PLL-Type I and Type II.

UNIT V PRODUCT DESIGN 9

PCB basics- Standard fabrication. Board Assembly: Surface Mount Technology, Through Hole Technology, Process Control and Design challenges.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Stephen H. Hall, Garrett W. Hall, James A. McCall "High-Speed Digital System Design: A Handbook of Interconnect Theory and Design Practices", August 2016, Wiley-IEEE Press.
2. Behzad Razavi, "RF Microelectronics", 2nd Edition, Prentice-Hall 2013,
3. Thomas H. Lee, "The Design of CMOS Radio-Frequency Integrated Circuits",2nd Edition, Cambridge University Press, 2012.

REFERENCES

1. R.G. Kaduskar and V.B.Baru, "Electronic Product design", Wiley India, 2011
2. Peter J.W.Noble "Printed circuit board assembly the complete works" Open University Press Robotics Series, Springer 2013.
3. Kai Chang, "RF and Microwave Wireless systems", Wiley, 2009.

19EC48E MEASUREMENTS AND INSTRUMENTATION L T P C QP
3 0 0 3 A

COURSE OUTCOMES

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

CO1: Describe the principles of various measurement techniques.(K2)
CO2: Analyze the transducers and its impact. (K3)
CO3: Explain about the signal conditioning system and signal analyzers.(K2)
CO4: Illustrate the digital measurement equipments.(K2)
CO5: Emphasize the need for data acquisition, recording and display systems (K2)

UNIT I SCIENCE OF MEASUREMENT 9

Measurement System – Instrumentation – Characteristics of measurement systems – Static and Dynamic – Errors in Measurements – Calibration and Standards.

UNIT II TRANSDUCERS 9

Classification of Transducers – Variable Resistive transducers – Strain gauges , Thermistor, RTD-Variable Inductive transducers- LVDT, RVDT,- Variable Capacitive Transducers – Capacitor microphone- Photo electric transducers – Piezo electric transducers – Thermocouple – IC sensors - Fibre optic sensors – Smart/intelligent sensors

UNIT III SIGNAL CONDITIONING AND SIGNAL ANALYZERS 9

DC and AC bridges – Wheatstone, Kelvin, Maxwell, Hay and Schering. Pre- amplifier – Isolation amplifier – Filters – Data acquisition systems. Spectrum Analyzers – Wave analyzers – Logic analyzers

UNIT IV DIGITAL INSTRUMENTS 9

Digital Voltmeters – Millimeters – automation in Voltmeter – Accuracy and Resolution in DVM - Guarding techniques – Frequency counter- Data Loggers – Introduction to IEEE 488/GPIB Buses.

UNIT V DATA DISPLAY RECORDING AND SYSTEMS 9

Dual trace CRO – Digital storage and Analog storage oscilloscope. Analog and Digital Recorders and printers. Virtual Instrumentation - Block diagram and architecture – Applications in various fields. Measurement systems applied to Micro and Nanotechnology

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Albert D.Helfrick and William D. Cooper, "Modern Electronic Instrumentation and Measurement Techniques", Prentice Hall of India, 2007.
2. Ernest o Doebelin, Dhanesh N Manik, "Measurement Systems", McGraw-Hill, 5th Edition, 2007.

REFERENCE

1. Albert D.Helfrick and William D. Cooper, "Modern Electronic Instrumentation and Measurement Techniques", Prentice Hall of India, 2nd Edition, 2008.

19EC49E PCB DESIGN AND FABRICATION L T P C
2 0 2 3

COURSE OUTCOMES

CO1: To understand the basics, industry standards organizations related to the design and fabrication of PCBs.(K2)
CO2: To understand the signal integrity problems in PCB design. (K2)
CO3: To understand the transmission line issues in PCB design (K2)
CO4: To explore PCB software flow using ECAD tool. (K3)
CO5: To design and fabricate simple PCBs for the given application circuits.(K3)

UNIT I BASICS OF PCB DESIGN, TOOLS & INDUSTRY STANDARDS 10

Electronic components: Active components and Passive components-Integrated circuits-PCB fabrication process-Layer stack up-Function of the Layout in the PCB Design Process. Design Files Created by Layout - Layout format files, Postprocess (Gerber) files, PCB assembly layers and files. Introduction to the Standards Organizations, Classes and Types of PCBs, Introduction to Standard Fabrication Allowances, PCB Dimensions and Tolerances, Copper Trace and Etching Tolerances, Standard Hole Dimensions, Solder mask Tolerance.

UNIT II PCB DESIGN FOR SIGNAL INTEGRITY 10

Signal propagation on transmission lines- Circuit Design Issues Not Related to PCB Layout, Issues Related to PCB Layout -PCB Routing -Making and editing capture parts, The Capture Part Libraries, Types of Packaging, Pins, Part Editing Tools, Constructing Capture Parts, making and editing layout footprints.

UNIT III TRANSMISSION LINES AND CROSSTALK 10

Transmission line characteristic impedance-Propagation velocity-Propagation delay-Time delay-Reflection coefficient-PCB Electrical Characteristics –Microstrip and strip lines-CPW layout-Significance of Transmission line in Board design, Types of Transmission lines. Crosstalk: The crosstalk in transmission lines-Crosstalk control in PCB design parts,

planes, tracks, connectors, terminations-Minimization of crosstalk. Thermal issues: Thermal mapping of design

UNIT IV PCB DESIGN FLOW USING ECAD TOOL 10

Overview of Electronic Computer Aided Design tool-Package standards-Bill of materials (BOM) - Project structures and the layout toolset- Project Setup and Schematic Entry Details, the Layout Environment and Tool Set. Creating a Circuit Design with Capture-Starting a new project placing parts, Wiring (connecting) the parts, creating the Layout netlist in Capture. Designing the PCB with Layout- Starting Layout and importing the netlist, Performing a design rule check, Making a board outline, Placing the parts, Auto routing the board Manual routing, Cleanup Locking traces, Post processing the board design for manufacturing. Setting up a user account, Submitting Gerber files and requesting a quote, Annotating the layer types and stack-up, Receipt inspection and testing, Nonstandard Gerber files.

UNIT V PCB DESIGN PRACTICE MODULES 20

1. Generation of Schematic for the application circuits
2. Converting schematic into PCB layout
3. Selecting dimension of PCB layout
4. Placement of components in PCB layout
5. Routing of components in PCB layout based on required width
6. Generating Gerber file for the schematic

L: 40; P: 20 TOTAL: 60 PERIODS

REFERENCES

1. Kraig Mitzner, “Complete PCB Design Using OrCad Capture and Layout”, Newness, 1st Edition, 2009.
2. Simon Monk, “Make Your Own PCBs with EAGLE: From Schematic Designs to Finished Boards”, McGraw-Hill Education TAB; 2nd Edition, 2017.
3. Douglas Brooks, “Signal Integrity Issues and Printed Circuit Board Design”, Prentice Hall PTR, 2003.
4. Lee W. Ritchey, John Zasio, Kella J. Knack, “Right the First Time: a Practical Handbook on High Speed PCB and System Design”, Speeding Edge, 2003.

19EC56E WIRELESS SENSOR NETWORKS L T P C QP
3 0 0 3 A

COURSE OUTCOMES

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

CO 1: Describe the challenges and architecture of WSN. (K2)
CO 2: Analyze the physical layer design requirements of WSN. (K3)
CO 3: Explain the MAC layer protocols of WSN.(K2)
CO 4: Explain the Routing layer protocol of WSN. (K2)
CO 5: Analyze the QoS requirements of WSN node design. (K3)

UNIT I BASICS OF WSN 9

Challenges for Wireless Sensor Networks, Enabling Technologies for WSN, Single node

architecture – Energy consumption of sensor nodes - Network architecture – Sensor network scenarios - Optimization Goals and Figures of Merit - Design principles for WSN.

UNIT II PHYSICAL LAYER 9

Introduction, wireless channel and communication fundamentals – frequency allocation, modulation and demodulation, wave propagation effects and noise, channels models, spread spectrum communication, packet transmission and synchronization, quality of wireless channels and measures for improvement, Physical layer and transceiver design consideration in wireless sensor networks: Energy usage profile, choice of modulation schemes, Antenna Considerations.

UNIT III MAC LAYER 9

MAC protocols – fundamentals of wireless MAC protocols, Low duty cycle protocols: STEM, S-MAC - wakeup concepts, contention-based protocols: CSMA, PAMAS - Schedule-based protocols: SMACS - IEEE 802.15.4 low rate WPAN.

UNIT IV NETWORK LAYER 9

Geographic routing, Hierarchical Routing – LEACH, PEGASIS, Location Based Routing – GAF, GEAR, Data aggregation – Various aggregation techniques.

UNIT V INFRASTRUCTURE ESTABLISHMENT AND CASE STUDY 9

Topology Control - Localization and Positioning - Target detection tracking, Medicine and Health Care, Environmental disaster monitoring.

L:45; TOTAL:45 PERIODS

TEXT BOOKS

1. Holger Karl, Andreas willig, “Protocol and Architecture for Wireless SensorNetworks”, John Wiley Publication, 2006.
2. K.Akkaya and M.Younis, “A Survey of routing protocols in wireless sensornetworks”, Elsevier Adhoc Network Journal, Vol.3, no.3, pp. 325-349,2005.

REFERENCES

1. KazemSohraby, Daniel Minoli and TaiebZnati, “Wireless SensorNetworks Technology- Protocols and Applications”, John Wiley & Sons, 2007.
2. Feng Zhao, Leonidas Guibas, “Wireless Sensor Networks: an information processing approach”, Elsevier Publication, 2004.
3. C.S.Raghavendra Krishna, M.Sivalingam and Taribznati, “Wireless Sensor Networks”, Springer Publication, 2004.
4. C. Siva Ram Murthy and B. S. Manoj, “Adhoc Wireless Networks Architectures and Protocols”, Prentice Hall, PTR, 2004
5. Philip Levis, “Tiny OS Programming”, 2006 – www.tinyos.net.
6. Jamal N. Al-karaki, Ahmed E. Kamal, “Routing Techniques in Wireless sensor networks: A survey”, IEEE wireless communication, December 2004, 6 – 28.

19EC57E MOBILE ADHOC NETWORKS L T P C QP
3 0 0 3 A

COURSE OUTCOMES

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

CO 1: Explain the challenges in the design of wireless Ad hoc networks. (K2)
CO 2: Categorize and analyze the MAC layer protocols of Ad hoc networks (K2)
CO 3: Analyze the challenges in routing layer protocol of Ad hoc Networks. (K3)
CO 4: Analyze the attacks pertaining to transport layer protocol. (K3)
CO 5: Elaborate the QoS requirements and Energy Management schemes of Ad hoc Networks. (K2)

UNIT I INTRODUCTION 9

Introduction to adhoc networks – Definition - Characteristics features, applications. Characteristics of Wireless channel, adhoc Mobility Models: - Indoor and outdoor models. IEEE standards: 802.11a, 802.11b, 802.11g, 802.11p, 802.11ac, 802.15. HIPERLAN.

UNIT II MEDIUM ACCESS PROTOCOLS 9

MAC Protocols: design issues, goals and classification. Contention based protocols- with reservation, scheduling algorithms, protocols using directional antennas.

UNIT III NETWORK LAYER PROTOCOLS 9

Routing Protocols: Design issues, goals and classification. Proactive Vs reactive routing, Unicast routing algorithms, Hybrid routing algorithm, Hierarchical Routing – Tree-Based and Mesh-Based Multicast routing algorithms.

UNIT IV TRANSPORT LAYER PROTOCOLS 9

Transport layer: Issues in designing- Transport layer classification, adhoc transport protocols. Security issues in adhoc networks: issues and challenges, network security attacks, secure routing protocols.

UNIT V QUALITY OF SERVICE AND ENERGY MANAGEMENT SCHEMES9

Introduction - Issues and Challenges in providing QoS in Adhoc Wireless Networks-Classifications of QoS Solutions. MAC Layer Solutions-Network Layer Solutions-QoS Frameworks-Need for Energy Management-Classification of Energy Management Schemes-Battery, Transmission Power, System Power Management Schemes.

L:45 TOTAL: 45 PERIODS

TEXT BOOKS

1. C.Siva Ram Murthy and B.S.Manoj, “Adhoc Wireless NetworksArchitectures and protocols”, Pearson Education, 2nd Edition, 2007 reprint2018.
2. Charles E. Perkins, “Adhoc Networking”, Addison - Wesley, 1st Edition,2008.

REFERENCES

1. Stefano Basagni, Marco Conti, Silvia Giordano and Ivan Stojmenovic,“Mobile Adhoc Networking”, Wiley India Edition, 2013.
2. Mohammad Ilyas, “The handbook of ADHOC wireless networks”, CRC press, 2017.
3. Fekri M. Abduljalil and Shrikant K. Bodhe, “A survey of integrating IPmobility protocols and Mobile Adhoc networks”, IEEE communication Survey and tutorials, v9.no.1, 2007.
4. Jonathan Loo, Jaime Lloret Mauri, “Mobile Adhoc Networks: Current status and Future Trends”, CRC Press, 1st Edition, 2016.

19EC58E CRYPTOGRAPHY AND NETWORK SECURITY L T P C QP
3 0 0 3 A

COURSE OUTCOMES

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

CO1: Describe the need for security and the various security techniques. (K2)
CO2: Explain the various symmetric and asymmetric key algorithms. (K2)
CO3: Apply suitable authentication functions to ensure authentication. (K3)
CO4: Analyze the different types of security services used in various applications. (K3)
CO5: Explain the solutions for security at the system level. (K2)

UNIT I INTRODUCTION 9

OSI Security Architecture - Security Goals - Types of Attacks - Passive attack, active attack - Security services – Overview of Cryptography - Classical Encryption techniques – Substitutional Ciphers, Transposition Ciphers – Steganography

UNIT II SYMMETRIC AND ASYMMETRIC KEY ALGORITHMS 9

Block Ciphers - Data Encryption Standard - Block Cipher Design Principles and Modes of Operation – Advanced Encryption Standard – Triple DES, Stream Cipher-RC4. Public Key Cryptography and RSA – Diffie-Hellman key Exchange.

UNIT III AUTHENTICATION AND HASH FUNCTION 9

Authentication requirements – Authentication functions – Message Authentication Codes - Hash functions- SHA-1-Digital signatures: Digital signature standards - Entity Authentication: Biometrics, Key management Techniques.

UNIT IV NETWORK SECURITY 9

Authentication Applications: Kerberos – X.509 Authentication Service – Electronic Mail Security – PGP – S/MIME - IP Security – Web Security.

UNIT V SYSTEM LEVEL SECURITY 9

Intrusion detection – password management – Viruses and related Threats – Virus Counter measures – Firewall Design Principles – Trusted Systems.

L:45 TOTAL: 45 PERIODS

TEXT BOOKS

1. William Stallings, “Cryptography and Network Security – Principles and Practices”, Pearson Education, 7th Edition, 2017.
2. Behrouz A. Foruzan, “Cryptography and Network Security”, Tata McGrawHill, 2007.

REFERENCES

1. Bruce Schneier, “Applied Cryptography”, John Wiley & Sons Inc, 2nd Edition, 2001.
2. Charles B. PFleeger, Shari Lawrence P Fleeger, “Security in Computing”, Pearson Education, 3rd Edition, 2003.
3. Wade Trappe and Lawrence C. Washington, “Introduction to Cryptographywith coding theory”, Pearson Education, 2nd Edition, 2007.
4. Wenbo Mao, “Modern Cryptography Theory and Practice”, Pearson Education, 3rd reprint, 2008.
5. Thomas Calabrese, “Information Security Intelligence: Cryptographic Principles and Applications”, Thomson Delmar Learning, 2006.
6. AtulKahate, “Cryptography and Network Security”, Tata McGraw-Hill, 8th reprint, 2006.

19EC59E FUNDAMENTALS OF CYBER SECURITY L T P C QP
3 0 0 3 A

Prerequisites: Computer Networks

COURSE OUTCOMES

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

CO1: Describe the challenges of securing information and identify the security threats (K2)

CO2: Clarify the importance of Application, Host, and Data Security (K2)

CO3:Enhance the security by applying network technologies and administration principles (K3)

CO4: Express the solutions for securing Wireless network and Mobile Computing (K3)

CO5: Explore the practical drive to secure cloud environments. (K3)

UNIT I SECURITY AND ATTACKS 9

Introduction to Security –Threats -Malware and Social Engineering Attacks – Application and Network Based Attacks - Basics of Cryptography.

UNIT II APPLICATION, DATA AND HOST SECURITY 9

Securing the Host - Securing the operating system (OS) software - Securing with Antimalware - Securing Static Environments - Application Security - Application Development Security - Securing Data

UNIT III ADMINISTERING A SECURE NETWORK 9

Security through Network Devices - Security through Network Technologies - Security through Network Design Elements - Network Protocols - Network Administration Principles - Securing Network Applications

UNIT IV WIRELESS AND MOBILE SECURITY 9

Wireless Attacks - Vulnerabilities of IEEE 802.11 Security - Wireless Security Solutions - Mobile Device Security - Mobile Device Risks, Securing Mobile Devices – IoT and Operational Technology (OT) Threats.

UNIT V CLOUD SECURITY 9

Cloud Computing Principles and Concepts - Overview of Cloud Native Security – Cloud Security - Cloud provider security, Infrastructure security - Cluster Security – Container Security – Code Security - Cloud security Solutions.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Mark Ciampa, “Security+ Guide to Network Security Fundamentals”, Course Technology, Cengage Learning, 4th Edition, 2012.
2. Chris Dotson, “Practical Cloud Security A Guide for Secure Design and Deployment”, O’Reilly Media, 1st Edition, 2019.

REFERENCES

1. Kimberly Graves, “CEH: Certified Ethical Hacker Study Guide”, Wiley Publishing Inc., 2010.
2. Rafay Baloch, “Ethical Hacking and Penetration Testing Guide”, CRC Press (Taylor & Francis Group), 2015.
3. Patrick Engebretson, “The Basics of Hacking and Penetration Testing - Ethical Hacking and Penetration Testing Made Easy”, Syngress, 2011.
4. https://kubernetes.io/docs/concepts/security/overview/

19EC60E PRINCIPLES OF OPERATING SYSTEM L T P C QP
3 0 0 3 A

Pre-Requisites: Fundamentals of Computers

COURSE OUTCOMES

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

CO1: Conceptualize the components involved in designing a contemporary OS and determine the various ways of structuring an operating system. (K2)

CO2: Discuss Handle processes, threads, and their communication and solve some of the common operating systems problems such as deadlock and synchronization. (K2)

CO3: Explore various techniques of allocating memory to processes and realize the role of virtual memory. (K2)

CO4: Evaluate disk scheduling algorithms and interpret the mechanisms adopted for file accessing in distributed applications. (K2)
CO5: Express the methods used to implement virtualization and general structure of distributed operating systems. (K3)

UNIT I OPERATION SYSTEM AND STRUCTURES 9

Introduction - Computer-System Organization, Computer-System Architecture, Operating-System Structure, Operating-System Operations, Operating system, Protection and Security - Kernel Data Structures - Computing Environments - Open-Source Operating Systems, Operating-System Structures–Operating-System Services, System Calls, System Programs, Operating-System Design and Implementation.

UNIT II PROCESS MANAGEMENT 9

Processes– Process Scheduling, Operations on Processes, Inter-process Communication, Communication in Client– Server Systems, Threads - Multithreading Models, Process Synchronization - The Critical-Section Problem, Peterson's Solution, Semaphores, and Classic Problems of Synchronization, CPU Scheduling - Scheduling Algorithms, Thread Scheduling, Deadlocks - Methods for Handling Deadlocks, Deadlock Prevention, Avoidance and Detection, Recovery from Deadlock.

UNIT III MEMORY MANAGEMENT 9

Main Memory– Swapping, Contiguous Memory Allocation, Segmentation, Paging, Segmentation with paging, Structure of the Page Table, Virtual Memory - Demand Paging, Page Replacement, Allocation of Frames, Thrashing.

UNIT IV STORAGE MANAGEMENT 9

Mass-Storage Structure - Disk Structure, Disk Attachment, Disk Scheduling, Disk Management, File-System Interface - Access Methods, Directory and Disk Structure, File-System Implementation - File-System Structure and Implementation, Directory Implementation, Allocation Methods.

UNIT V ADVANCED OPERATING SYSTEM 9

Virtual Machines – Building Blocks, Types of Virtual Machines and Their Implementations, Virtualization and Operating-System Components, Distributed Systems - Types of Network-based Operating Systems, Network Structure, Communication Structure and Protocols.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. G. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne Operating System Concepts, 9th Edition, John Wiley & Sons Private Limited, 2013.
2. Operating Systems: Internals and Design Principles, 8th Edition, William Stallings, Pearson Education Limited, 2015.

REFERENCES

1. Andrew S. Tanenbaum, Modern Operating System, 4th Edition, Pearson Education Limited, 2014.
2. Operating System: A Design-oriented Approach, 2nd Edition, Charles Crowley, Irwin Publishing, 2011.
3. Design of the Unix Operating Systems, 8th Edition by Maurice Bach, Prentice-Hall of India, 2006.
4. Understanding the Linux Kernel, 3rd Edition, Daniel P. Bovet, Marco Cesati, O'Reilly and Associates, 2008.

19EC61E SCIENTIFIC COMPUTING L T P C QP
3 0 0 3 A

COURSE OUTCOMES

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

CO1 : Understand the sources of approximations (K2)
CO2 : Discuss the system of linear and non-linear equations (K2)
CO3: Discuss the characteristics of Linear and Non-linear squares and optimization(K2)
CO4 : Describe the methods for computation of eigen vectors (K2)
CO5 : Describe the methods for initial value problems for ODES (K2)

UNIT I INTRODUCTION 9

Sources of Approximations, Data Error and Computational, Truncation Error and Rounding Error, Absolute Error and Relative Error, Sensitivity and Conditioning, Backward Error Analysis, Stability and Accuracy, Floating Point Numbers, Normalization, Properties of Floating Point System, Rounding, Machine Precision, Subnormal and Gradual Underflow, Exceptional Values, Floating-Point Arithmetic, Cancellation

UNIT II SYSTEM OF LINEAR AND NON-LINEAR EQUATIONS 9

Linear Systems, Solving Linear Systems, Gaussian elimination, Pivoting, Gauss Jordan, Norms and Condition Numbers, Symmetric Positive Definite Systems and Indefinite System, Iterative Methods for Linear Systems. Nonlinear equations: Fixed Point Iteration, Newton's Method, Inverse Interpolation Method

UNIT III LINEAR LEAST SQUARES AND OPTIMIZATION 9

Linear least squares: Data Fitting, Linear Least Squares, Normal Equations Method, Orthogonalization Methods, QR factorization, Gram-Schmidt Orthogonalization, Rank Deficiency, and Column Pivoting Optimization: One-Dimensional Optimization, Multidimensional Unconstrained Optimization, Nonlinear Least Squares

UNIT IV EIGEN VALUES AND EIGEN SPACES 9

Eigen values and singular values: Eigen values and Eigenvectors, Methods for Computing All Eigen values, Jacobi Method, Methods for Computing Selected Eigen values, Singular Values Decomposition, Application of SVD

UNIT V INITIAL VALUE PROBLEMS 9

Initial Value Problems for ODES, Euler's Method, Taylor Series Method, Runga-Kutta Method, Extrapolation Methods, Boundary Value Problems For ODES, Finite Difference Methods, Finite Element Method, Eigen value Problems.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Heath Michael T., "Scientific Computing: An Introductory Survey", McGraw-Hill, 2nd Edition, 2019.
2. Press William H., Saul A. Teukolsky, Vetterling William T and Brian P.Flannery, "Numerical Recipes: The Art of Scientific Computing", Cambridge University Press, 3rd Edition, 2007.

REFERENCES

1. Xin-she Yang (Ed.), "Introduction To Computational Mathematics", World Scientific Publishing Co., 2nd Edition, 2008.
2. Kiryanov D. and Kiryanova E., "Computational Science", Infinity Science Press, 1st Edition, 2007

3. Bertil Gustafsson, “Fundamentals of Scientific Computing”, Springer Verlag, 2011
4. Mark H. Holmes,” Introduction to Scientific Computing and Data Analysis”, Springer, 2016

19EC62E EDGE ANALYTICS AND INTERNET OF THINGS L T P C QP
3 0 0 3 A

COURSE OUTCOMES

Upon completion of this course, student will be able to

CO1: Explain the foundational concepts in Edge Analytics. (K2)
CO2: Demonstration of IOT protocols in cloud environment. (K2)
CO3: Describe the principles of Machine Learning and Artificial Intelligence.(K2).
CO4: Analysis of various unsupervised learning algorithm. (K3)
CO5: Deployment of Edge devices and its challenges.(K3)

UNIT I INTRODUCTION TO EDGE ANALYTICS 9

Introduction to IOT - Importance and Need for IOT - Application and Use cases of IOT - Overview of Industrial IOT - Intersection of IOT and Edge Analytics.

UNIT II IOT PROTOCOLS AND SYSTEMS 9

IOT protocols and standards - Cloud IOT Infrastructure - Setup and program IOT device- Data Collection from IOT device.

UNIT III MACHINE LEARNING AND ARTIFICIAL INTELLIGENCE 9

Introduction to Machine Learning and Artificial Intelligence - Overview of Deep Learning and Neural Networks- Introduction to Convolution Neural Networks.

UNIT IV AUTO ENCODERS AND ITS PROGRAMMING 9

Introduction to Recurrent Neural Networks- Introduction to Auto Encoders- Programming Practice: Build Image Classifier, Build Anomaly Detector

UNIT V EDGE ANALYTICS 9

Challenges with Edge Devices and Deployment - Need for Model Quantization Quantization Aware Training- Post Model Quantization- Programming Practice: Model quantization, deploying model on Edge Devices

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Honbo Zhou, “The Internet of Things in the Cloud: A Middleware Perspective”, CRC Press, 2012.
2. P.Flach, Machine learning: The art and science of algorithms that make sense of datall, Cambridge University Press, 2012.

REFERENCES

1. AnirudhKoul, Siddha Ganju, MeherKasam, “Practical Deep Learning for Cloud, Mobile, and Edge” O'Reilly Media, 2019.
2. Dieter Uckelmann, Mark Harrison, Florian Michahelles, “Architecting the Internet of Things”, Springer, 2011.

19EC63E MACHINE LEARNING TECHNIQUES L T P C QP
3 0 0 3 A

COURSE OUTCOMES

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

CO1: Describe the basic concepts of machine learning. (K2)
CO2: Describe supervised learning and classification techniques. (K2)
CO3: Apply the concept of unsupervised learning and Clustering for applications. (K3)
CO4: Describe the concept of Dimensionality Reduction. (K2)
CO5: Explain theoretical and practical aspects of reinforcement learning (K2)

UNIT I INTRODUCTION TO MACHINE LEARNING 9

Introduction to Data Science and Artificial Intelligence, Future of Artificial Intelligence – Characteristics of Intelligent Agents–Typical Intelligent Agents. Machine Learning - Examples of machine learning applications- Types of machine learning –Model selection and generalization.

UNIT II SUPERVISED LEARNING 9

Classification - Decision Trees – Univariate Tree –Multivariate Tree - Pruning – Perceptron – Multilayer Perceptron - Back Propagation – Cross Validation and resampling Methods. Case Study: Implementation of Back propagation algorithm for problems in financial domain.

UNIT III UNSUPERVISED LEARNING 9

Clustering- Mixture densities -K-means - EM Algorithm – Supervised Learning After Clustering- Hierarchical Clustering. Case Study: Implementation of clustering algorithm for problems in health care domain.

UNIT IV DIMENSIONALITY REDUCTION 9

The Curse of Dimensionality –Subset Collection - Principal Component Analysis - Factor Analysis – Linear Discriminant Analysis. Case Study: Implementation of LDA for problems in financial/insurance/health care domain.

UNIT V REINFORCEMENT LEARNING 9

Single State Case – Elements of Reinforcement Learning - Model Based Learning – Temporal Difference Learning –Generalization in Reinforcement Learning - Policy Search. Case Study: Implementation of reinforcement learning for problems in automotive domain.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Ethem Alpaydin, “Introduction to Machine Learning”, MIT Press, 2014.
2. Christopher M. Bisho, “Pattern Recognition and Machine Learning”, Springer (India) Private Limited, 2013.

REFERENCES

1. Tom M Mitchell, Machine Learning, First Edition, McGraw Hill Education, 2013.
2. Richard S. Sutton and Andrew G. Barto: Reinforcement Learning: An Introduction. MIT Press, 2014.

19EC64E INTRODUCTION TO INTERNET OF THINGS L T P C QP

3 0 0 3 A

COURSE OUTCOMES

Upon completion of this course, the student will be able to

CO1: Understand basic building blocks of internet of things. (K2)
CO2: Choose suitable sensors and actuators used for specific IoT applications based on the performance. (K2)
CO3: Discuss web technologies suitable for IoT client device. (K2)

CO4: Understand fundamentals of technologies such as Node.JS, REST protocol and JSON which are used at IoT servers. (K2)

CO5: Understand the architecture of Raspberry pi and methodology to configure it as a IoT device. (K2)

UNIT I FUNDAMENTALS OF IOT 9

IoT& Web Technology: The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization, Recommendations on Research Topics.

UNIT II SENSORS AND ACTUATORS 9

Classification of Sensors and Actuators - General Requirements for Interfacing - Units and Measures - Transfer function - Impedance and Impedance matching - Range, Span, Resolution, Accuracy, Errors, Repeatability, Sensitivity and Sensitivity analysis, frequency response & bandwidth, temperature sensor, pressure sensor,optical sensors and actuators, DC motor, STEP motor.

UNIT III FRONT END WEBTECHNOLOGIES FOR IOT 9

Client Server Communication, World wide web, URL, HTTP request & response, Web Clients, Web Servers, HTML - Elements, Forms with post and get methods, Cascade Style sheet, JavaScript - functions and objects.

UNIT IV BACK END WEB TECHNOLOGIES FOR IOT 9

Introduction to Node.JS, Node package manager, callback concept, event loop, buffers, streams, file system, global object, utility module, web modules, Express framework, RESTful API, JSON

UNIT V SINGLEBOARD COMPUTER & WEB PROGRAMMING 9

Introduction to Raspberry Pi, Architecture, Compatible Peripherals, Add-Ons, and Accessories, Operating System for Raspberry Pi, Setting up Raspberry Pi, Node.JS as webserver, returning sensor data as JSON.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1) Shriram K Vasudevan, Abhishek S Nagarajan, RMD Sundaram, "Internet of Things", Wiley, 2016.
2) Nathan Ida, “Sensors, Actuators and their Interfaces”, Scitech publishing, 2013.
3) Dominique D. Guinard, Vlad M. Trifa, "Building the Web of Things with Examples in Node.JS AND RASPBERRY PI", Manning Publications Co., 2016

REFERENCES

1) Arshdeep Bahga, Vijay Madisetti, “Internet of Things, A Hands-on-Approach”, 1st Edition, Universities press Pvt. Ltd., India, 2015.
2) Rajkumar Buyya, Amir Vahid Dastjerdi, “Internet of Things: Principles and Paradigms”, 1st Edition, Elsevier, USA, 2016

3) Charles Bell, "Beginning Sensor Networks with Arduino and Raspberry Pi", 1st Edition, Apress Publishers, USA, 2013.
4) Patranabis D, "Sensor and Actuators", Prentice Hall of India (Pvt) Ltd. 2005.

WEB REFERENCES

1) https://www.raspberrypi.org/
2) https://www.w3schools.com/nodejs/

19EC65E DATABASE MANAGEMENT SYSTEM FOR IOT L T P C QP
3 0 0 3 A

COURSE OUTCOMES

Upon completion of this course, the student will be able to

CO1: Understand basic concepts of database management system, relational model and E-R model. (K2)
CO2: Describe the importance of good database design and optimize database design using normalization rules. (K2)
CO3: Simulate various MySQL command for schema creation and data manipulation. (K3)
CO4: Comprehend query evaluation plan and optimization to reduce complexity. (K2)
CO5: Write program to access MySQL database using Node.JS environments. (K3)

UNIT I FUNDAMENTALS OF DATABASE MANAGEMENT SYSTEM 9

Purpose of Database System, Views of data, Database Languages, Database System Architecture, Database users and Administrator, Structure of relational databases, database schema, schema diagrams, relational algebra, Entity-Relationship Model, Developing ER diagram

UNIT II DATABASE DESIGN CONCEPTS 9

Good database design, functional dependency, closure of functional dependency set, closure of attributes, dependency preservation, decomposition using functional dependency, Need for Normalization, I Normal form, II Normal form, III Normal form, Higher level Normal forms, Design improvement

UNIT III MY SQL COMMANDS 9

Introduction to MySQL, Literal values, schema object name, keywords and reserved words, Datatypes, Function and operators, Data definition commands, data manipulation commands, select queries with conditional restrictions, arithmetic operators, logical operators, special operators, ordering, grouping, joining tables, sub queries, Insert, Update and Delete queries, Introduction to Advanced SQL - Functions and Procedures, Triggers.

UNIT IV QUERY PROCESSING AND OPTIMIZATION 9

Query Processing - Measures of Query Cost - Selection– Sorting - Join Operation – Other Operations - Evaluation of Expressions – Query Tuning - Query Optimization - Transformation of Relational Expressions - Estimating Statistics of Expression Results - Choice of Evaluation Plans – Materialized Views.

UNIT V NODE.JS & MYSQL FOR IOT APPLICATIONS 9

Three Tier Architecture, MySQL driver for Node.JS, Connection establishment, Programming with data definition and manipulation commands, Time series database, SQLite, JSON data parsing, calling stored procedure and views, case study: Temperature and humidity monitoring system, live GPS location tracking system.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1) Abraham Silberschatz, Henry F.Korth, S.Sudharshan, "Database System Concepts", Sixth Edition, Tata McGraw Hill, 2013.
2) Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Pearson Education, 7th Edition, 2016.
3) C.J.Date, A.Kannan, S.Swamynathan, "An Introduction to Database Systems", Pearson Education, 8th Edition, 2012.

REFERENCES

1) Thomas Cannolly and Carolyn Begg, "Database Systems, A Practical Approach to Design, Implementation and Management", Pearson Education, 5th Edition, 2009.
2) S.K.Singh, —Database Systems Concepts, Design and Applications-ll, 1st Edition, Pearson Education, 2006.
3) Peter Membrey, "Mongo DB Basics", Apress; 1st Edition, 2014.
4) Raghu Ramakrishnan, Johannes Gehrke, "Database Management Systems", McGraw Hill, Third Edition, 2004

WEB REFERENCES

1) https://www.w3schools.com/nodejs/nodejs_mysql.asp
2) https://www.mysqltutorial.org/

		L	T	P	C
19EC66E	**IOT: ARCHITECTURE, STANDARDS AND PROTOCOLS**	**3**	**0**	**0**	**3**

COURSE OUTCOMES

Upon completion of this course, the student will be able to

CO1: Comprehend evolution of internet technology, need for IoT and architecture of IoT systems. (K2)
CO2: Analyze suitable components required to design IoT application. (K3)
CO3: Discuss security issues in IoT and resolving techniques. (K2)
CO4: Describe hardware and software specifications for IoT. (K2)
CO5: Understand industrial 4.0 and industrial IoT evolution. (K2)

UNIT I IOT ARCHITECTURE AND EVOLUTION 9

IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards, M2M and IoT Technology Fundamentals- Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service(XaaS), M2M and IoT Analytics, Knowledge Management

UNIT II TRANSPORT & SESSION LAYER PROTOCOLS 9

Transport Layer: TCP, UDP, DCCP, SCTP- TLS, DTLS - Session Layer HTTP, CoAP, XMPP, AMQP, MQTT

UNIT III IOT SECURITY 9

Need for encryption, standard encryption protocol, light weight cryptography, Quadruple Trust Model for IoT-A – Threat Analysis and model for IoT-A, Cloud security

UNIT IV IOT HARDWARE & SOFTWARE 9

Characteristics IoT sensor nodes, Edge computer, cloud and peripheral cloud, Hardware for the IoT - Classes of Constrained Devices, Arduino, Intel Galileo, Software for the IoT – Open WSN, Tiny OS, Free RTOS, TI-RTOS, RIOT, Contiki OS. Cloud services – AWS. Case study: IoT for smart cities, health care, agriculture, smart meters

UNIT V INDUSTRIAL IOT 9

Industry 4.0 - Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Industrial IoT-Introduction, Business Models & Reference Architecture, Layers: IIoT Sensing, IIoT Processing, IIoT Communication, IIoT Networking

L:45; TOTAL: 45 PERIODS

TEXT BOOKS

1) Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis Karnouskos, Stefan Avesand, David Boyle, “From Machine to Machine to Internet of Things”, Elsevier Publications, 2014.
2) Simone Cirani, Gianluigi Ferrari, Marco Picone, and Luca Veltri, "Internet of Things Architectures, Protocols and Standards", John Wiley & Sons Ltd., 2019.
3) Alasdair Gilchrist, “Industry 4.0: The Industrial Internet of Things”, Apress, 2017.

REFERENCES

1. Alessandro Bassi, Martin Bauer, Martin Fiedler, Thorsten Kramp, Rob van Kranenburg, Sebastian Lange, Stefan Meissner, “Enabling things to talk – Designing IoT solutions with the IoT Architecture Reference Model”, Springer Open, 2016.
2. Bernd Scholz-Reiter, Florian Michahelles, “Architecting the Internet of Things”, ISBN 978-3-642- 19156-5 e-ISBN 978-3-642-19157-2, Springer, 2016.
3. Daniel Minoli, “Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications”, ISBN: 978-1-118-47347-4, Willy Publications, 2016.
4. Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat, “Industrial Internet of Things: Cyber manufacturing Systems”, Springer, 2017.

19EC67E	**WIRELESS TECHNOLOGIES FOR IOT**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OUTCOMES

Upon completion of this course, the student will be able to

CO1: Describe the fundamentals of wireless communication system. (K2)
CO2: Discuss various wireless standards and protocols used in IoT. (K2)
CO3: Explain concepts and applications of Narrow Band (NB) IoT with MQTT protocol

(K2)

CO4: Understand green communication in IoT. (K2)

CO5: Understand wireless IoT applications such as RFID and wireless sensor node. (K2)

UNIT I FUNDAMENTALS OF WIRELESS NETWORKS 9

Network Topologies, Types of networks, Role of Wireless Standards in IoT, OSI reference model, TCP/IP reference model, IEEE 802 Reference model, Layered model for IoT, Spectrum planning, Multiple Access, Narrow band, Wide band and Ultra Wide Band technologies for IoT.

UNIT II WIRELESS STANDARDS AND PROTOCOLS 9

Bluetooth, Z-Wave, Zigbee, Wi-Fi, LORA - Qualitative analysis: Protocol stack, transceiver model, channel and spectrum, network topology, access and spread spectrum, data rate, error correction strategy.

UNIT III LTE CELLULAR NARROW BAND INTERNET OF THINGS (NB-IOT) 9

3GPP standardization, 4G and 5G system, LTE cellular NB IoT, NB-IoT sensors and actuators, NB-IoT core network, MQTT implementation in NB-IoT - publish/subscribe model, topic and subscription, retained message, Quality of Service levels, AT commands

UNIT IV GREEN IOT 9

Focus of Green IoT, Green communication components - RFID Tags, wireless sensor network, cloud computing, data centers, Green M2M, Key technologies, applications, challenges & problems

UNIT V WIRELESS IOT APPLICATIONS 9

Radio Frequency Identification - RFID in IoT, operation and components, Electronic Product Code - Architecture and Framework, RFID Middleware, Benefits, opportunities & Risk.

Wireless Sensor Networks - Characteristics and design challenges, WSN Layers, WSN Middle ware, use of Zigbee and IEEE 802.15.4 in WSN, Future Trends

L:45; TOTAL: 45 PERIODS

TEXT BOOKS

1) Daniel Chew, "The Wireless Internet of Things - A Guide to the Lower Layers", IEEE Press, Wiley, 2019.

2) Hossam Fattah, "5G LTE Narrowband Internet of Things (NB-IoT)", CRC Press, Taylor & Francis Group, 2019.

REFERENCES

1) OlofLiberg, Marten Sundberg, Y.P. Eric Wang, Johan Bergman and Joachim Sachs, "Cellular Internet of Things Technologies, Standards, and Performance", Academic Press, Elsevier Ltd., 2018.

2) William Stallings, “Wireless Communication Network and Systems”, Pearson Education Asia, 2016.

3) Simon Haykin, Michael Moher and David Koilpillai, “Modern Wireless Communication”, 1stEdition, Pearson Education, 2015.

4) Christopher Siu, "IoT and Low Power Wireless Circuits, Architectures and Techniques", CRC Press, Taylor & Francis Group, 2018

WEB REFERENCES

1) https://www.3gpp.org/
2) https://lora-alliance.org/

19EC68E	IOT BIG DATA ANALYTICS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

Upon completion of this course, the student will be able to

CO1: Understand integration of IoT and big data for analytics. (K2)
CO2: Discuss processing methodologies for IoT real time data and linked stream data. (K2)
CO3: Comprehend processing of IoT big data using Apache Hadoop. (K2)
CO4: Understand the multimedia big data computing for IoT. (K2)
CO5: Understand the implementation of big data analytics in Smart IoT systems through several case studies. (K2)

UNIT I INTRODUCTION TO IOT BIG DATA ANALYTICS 9

Introduction to IoT data and Big data – Challenges of IoT analytics applications – IoT analytics life cycle and techniques –Searching the Internet of Things: Introduction - Search Architecture for Social and Physical Sensors - Local Event Retrieval - Using Sensor Metadata Streams to Identify Topics of Local Events in the City – Venue Recommendation

UNIT II IOT SEMANTICS AND DATA STREAMING ANALYTICS 9

Introduction – Linking data - Real-time & Linked Stream Processing - Semantic-based Distributed Reasoning – Cross Domain Recommender Systems - Semantic Analytics - Semantic Modelling and Validation Tools - Data Reasoning - Ethical IoT

UNIT III IOT BIG DATA ANALYTICS USING HADOOP 9

Apache Hadoop, Employing Hadoop Map Reduce - Creating the components of Hadoop Map Reduce jobs - Distributing data processing across server farms –Executing Hadoop Map Reduce jobs - Monitoring the progress of job flows

UNIT IV MULTIMEDIA BIGDATA COMPUTING FOR IOT 9

Introduction - Definition and Characteristics – Relationship between IoT and Multimedia Big Data(MMBD) – Multimedia Big Data LifeCycle - MMBD for IoT Applications - Data Collection – Technologies used - Analysis of Various Techniques - Opportunities, Issues, and Challenges

UNIT V CASE STUDIES OF IOT DATA ANALYTICS 9

Precision Agriculture and its Cyber-Physical Management, IoT implementation for smart cities and future Challenges, IoT based Intelligent Transportation System for Global Perspective, IoT based implementations for smart buildings

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1) John Soldatos, “Building Blocks for IoT Analytics”, River Publishers Series In Signal, Image and Speech Processing, 2017.
2) Sudeep Tanwar, Sudhanshu Tyagi, Neeraj Kumar, “Multimedia Big Data Computing for IoT Applications: Concepts, Paradigms and Solutions”, Springer, 2020

REFERENCES

1) Andrew Minteer, "Analytics for the Internet of Things (IoT)", Packt publishing Ltd., 2017.
2) Stackowiak, R., Licht, A., Mantha, V., Nagode, L.,” Big Data and The Internet of Things Enterprise Information Architecture for A New Age”, Apress, 2015.
3) NilanjanDey, Aboul Ella Hassanien, Chintan Bhatt, Amira S. Ashour, Suresh Chandra Satapathy, “Internet of Things and Big Data Analytics Toward Next-Generation Intelligence”, Springer International Publishing, 2018.

WEB REFERENCES

1) https://www.edureka.co/blog/iot-tutorial/
2) https://data-flair.training/blogs/data-analytics-tutorial/

19EC69E BLOCKCHAIN AND ITS APPLICATIONS L T P C QP

2 0 2 3 A

COURSE OUTCOMES

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

CO1: To learn the basics of Blockchain and components. (K2)
CO2: To comprehend hashing algorithms, wallets in blockchain. (K2)
CO3: To identify the consensus methods for an application. (K2)
CO4: To interpret blockchain solution, use case and blockchain instance. (K3)
CO5: To sketch various blockchain in industry application. (K3)

UNIT I HISTORY OF BLOCKCHAIN 10

Terminologies in Blockchain- Analogy of Block chain - Centralised vs Decentralised Systems - Types of Blockchain – working of blockchain - Ingredients of Blockchain – Blockchain Vs Cryptocurrency. Case study: Survey report on various block chain for real time use case.

UNIT II WORKING OF BLOCKCHAIN 10

Hashing algorithms-SHA-256 algorithm-Application of SHA algorithm.Wallets, Digital Signature and Protocols – Bit coin - Blockchain over traditional technologies and comparison.

UNIT III CONSENSUS METHODS 10

Introduction to Consensus Methods - Proof of Work (PoW) - Proof of Stake (PoS) - Proof of Burn (PoB) - Proof of Activity (PoA) - Proof of Elapsed Time (PoET) - Simplified Byzantine fault Tolerance - mining. Case study : Consensus methods for financial transaction.

UNIT IV BLOCKCHAIN TECHNOLOGY STACK 10

Blockchain Architecture – Forming own blockchain solution – use case identity – design integration – identify the platform – creating blockchain instance – application program interface.

UNIT V CASE STUDIES IN BLOCKCHAIN 20

Industry challenges in Blockchain – attacks over blockchain – blockchain in health care industry – blockchain in media and entertainment – blockchain in finance. Program to practice: Bit coin, crypto currency, blockchain in finance.

L: 40; P: 20; TOTAL: 60 PERIODS

TEXTBOOKS

1. Brojo Kishore Mishra, Sanjay Kumar Kuanar "Handbook of IoT and Blockchain: Methods, Solutions, and Recent Advancements (Internet of Everything (IoE)) ", CRC Press; 1st Edition, November 2020.
2. Jai Singh Arun , Jerry Cuomo , Nitin Gaur Blockchain for Business- For Understanding transformation, growth and new models of Business, 1st Edition Published by Pearson Paperback, 12 December 2019.

REFERENCES

1. https://iabtechlab.com/wp-content/uploads/2018/07/Blockchain-Technology-Primer.pdf
2. https://www.blockchain-council.org/blockchain/the-best-blockchain-business-models/

E – Book

1. https://www.researchgate.net/publication/337649428_Handbook_of_IoT_and_Blockchain_-_Methods_Solutions_and_Recent_Advancements

MOOC

1. https://www.coursera.org/learn/blockchain-business-models
2. https://www.udemy.com/course/the-complete-blockchain-professional-course/
3. https://www.udemy.com/course/build-your-own-proof-of-stake-blockchain/
4. https://www.udemy.com/course/build-your-own-cryptocurrency-in-48-hours/

19EC70E PROFESSIONAL READINESS FOR INNOVATION, EMPLOYABILITY AND ENTREPRENEURSHIP

L	T	P	C
0	0	6	3

COURSE OBJECTIVES

- To empower students with overall Professional and Technical skills required to solve a real world problem.
- To mentor the students to approach a solution through various stages of Ideation, Research, Design Thinking, workflows, architecture and building a prototype in keeping with the end-user and client needs.
- To provide experiential learning to enhance the Entrepreneurship and employability skills of the students.

COURSE OUTCOMES

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

CO1: Upskill in emerging technologies and apply to real industry-level use cases
CO2: Understand agile development process
CO3: Develop career readiness competencies, Team Skills / Leadership qualities
CO4: Develop Time management, Project management skills and Communication Skills
CO5: Use Critical Thinking for Innovative Problem Solving
CO6: Develop entrepreneurship skills to independently work on products

TABLE 1: ACTIVITIES

Activity Name	Activity Description	Time (weeks)
Choosing a Project	Selecting a project from the list of projects categorized various technologies & business domains	2
Team Formation	Students shall form a team of 4 Members before enrolling to a project. Team members shall distribute the project activities among themselves.	1
Hands on Training	Students will be provided with hands-on training on selected technology in which they are going to develop the project.	2
Project Development	Project shall be developed in agile mode. The status of the project shall be updated to the mentors via appropriate platform	6
Code submission, Project Doc and Demo	Project deliverables must include the working code, project document and demonstration video. All the project deliverables are to be uploaded to cloud based repository such as GitHub.	3
Mentor Review and Approval	Mentor will be reviewing the project deliverables as per the milestone schedule and the feedback will be provided to the team.	1
Evaluation and scoring	Evaluators will be assigned to the team to evaluate the project deliverables, and the scoring will be provided based on the evaluation metrics	1
TOTAL		**16 WEEKS**

Essentially, it involves 15 weeks of learning and doing, and one week for evaluation. The evaluation will be carried out to assess technical and soft skills as given in Table 2.

TABLE 2: EVALUATION SCHEMA

TECHNICAL SKILLS		**SOFT SKILLS**	
Criteria	***Weightage***	***Criteria***	***Weightage***
Project Design using Design Thinking	10	Teamwork	5
Innovation & Problem Solving	10	Time Management	10
Requirements Analysis using Critical Thinking	10	Attendance and Punctuality	5
Project Planning using Agile Methodologies	5	Project Documentation	5
Technology Stack (APIs, tools,	5	Project Demonstration	5

Platforms)			
Coding & Solutioning	15		
User Acceptance Testing	5		
Performance of Product / Application	5		
Technical Training & Assignments	5		
Total	**70**	**Total**	**30**
Total Weightage		**100**	
Passing Requirement		**50**	
Continuous Assessment Only			

P: 90; TOTAL: 90 PERIODS

19EC71E WEB APPLICATION DEVELOPMENT L T P C
1 0 2 2

COURSE OUTCOMES

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

CO1: Explore the fundamentals of Java Script. (K2)
CO2: Develop dynamic web page with validation using Java Script (K3)
CO3: Build Interactive data driven based web application using Node JS(K3)
CO4: Use express framework to develop interactive web applications (K3)
CO5: Build No-SQL applications using Mongo-DB (K3)

UNIT I INTRODUCTION TO JAVASCRIPT 9

JavaScript Fundamentals- Variables, Data Types,Properties, Methods, Built-in Objects-Conditions, Arrays, Loops and Iterators, Scopes- Functions and Higher Order Functions-JavaScript Objects- Working with JSON.

UNIT II INTRODUCTION TO ASYNCHRONOUS JAVASCRIPT 9

Asynchronous JavaScript- CallBack, Problem with CallBack-Hell, Promises and Aync-Await.

UNIT III INTRODUCTION TO NODE.JS AND NPM 9

Introduction to Node.js - Core Modules- Reading and Writing files synchronously and Asynchronously- Creating a Web Server- Routing- Building an API-Parsing variable from URLs - NPM and package. json- Node.js Event Loop-Events and Event Driven Architecture-Streams.

UNIT IV EXPRESS FRAMEWORK 9

Introduction to Express.js-Setting up Express and Routing-APIs and RESTful Design-Handling GET, POST, PATCH and DELETE requests- Middleware - Serving Static Resources

UNIT V DATA ACCESS IN NODE.JS 9

Data Access in Node.js-Access SQL Server using Node.js -Introduction to MongoDB – Installing MongoDB – CRUD Operations in MongoDB- Connecting to MongoDB with Mongoose-MongoDB Data modelling

L: 15; P:30 TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Installing Node, Node Hosting Environments

2. Exploring Node Building Blocks
    i. Global and Process objects, buffers, Typed arrays and Strings, Streams
    ii. Event Handling- Event Queue, Event Emitter, Event Loop and Timers, Nested Callback
3. Creating and Publishing Node Modules
    i. Installation and configuration of Node Package Manager
    ii. Program development using built-in Node Modules
    iii. Commander and Underscore
    iv. OAuth configuration
4. Develop a web application which involves database operations using NodeJS
5. Develop a web application which involves database operations using Express
6. Create a RESTful service with Node, Express and MongoDB.
7. Advanced MongoDB: geospatial Queries, aggregation pipeline, and operators

TEXT BOOKS

1. David Thompson, "Getting Started with GEO, CouchDB, and Node.js", O'Reilly Media, Inc., 1st Edition, 2011.
2. Peter Membrey, "MongoDB Basics", Apress; 1st Edition, 2014.

REFERENCES

1. Simon Holmes, - Getting MEAN with Mongo, Express, Angular, and Node, Second Edition, Manning, 2016.
2. Shelley Powers, - Learning Node – Moving to the Server Side, Second Edition, O'Reilly, 2016.
3. Basarat Ali Syed, — Beginning Node.js, APress, 2014

19EC72E CYBER CRIME INVESTIGATIONS AND DIGITAL FORENSICS L T P C
3 0 0 3

Pre-Requisites: Fundamentals of Cyber Security

COURSE OUTCOMES

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

CO 1. Explain the fundamentals of cybercrime and issues.
CO 2. Describe the different investigation tools for cybercrime.
CO 3. Explain the basics of Forensic Technology and Practices.
CO 4. Analyze different laws, ethics and evidence handling procedures.
CO5. Explain the laws and acts in cybercrime

UNIT I INTRODUCTION TO CYBER CRIME 9

Introduction and Overview of Cyber Crime, Nature and Scope of Cyber Crime, Types of Cyber Crime: Social Engineering, Categories of Cyber Crime, Property Cyber Crime. Unauthorized Access to Computers, Computer Intrusions, White collar Crimes.

UNIT II CYBER CRIME ISSUES 9

Viruses and Malicious Code, Internet Hacking and Cracking, Virus Attacks, Pornography, Software Piracy, Intellectual Property, Mail Bombs, Exploitation, Stalking and Obscenity in Internet, Digital laws and legislation, Law Enforcement Roles and Responses.

UNIT III INVESTIGATION 9

Introduction to Cyber Crime Investigation, Investigation Tools, eDiscovery, Digital Evidence Collection, Evidence Preservation, E-Mail Investigation, E-Mail Tracking, IP Tracking, E-Mail Recovery, Hands on Case Studies. Encryption and Decryption Methods, Search and Seizure of Computers, Recovering Deleted Evidences, Password Cracking.

UNIT IV DIGITAL FORENSICS 9

Introduction to Digital Forensics, Forensic Software and Hardware, Analysis and Advanced Tools, Forensic Technology and Practices, Forensic Ballistics and Photography, Face, Iris and Fingerprint Recognition, Audio Video Analysis, Windows System Forensics, Linux System Forensics, Network Forensics.

UNIT V IDENTIFICATION OF DATA 9

Timekeeping, Forensic Identification and Analysis of Technical Surveillance Devices, Reconstructing Past Events: How to Become a Digital Detective, Useable File Formats, Unusable File Formats, Converting Files, Investigating Network Intrusions and Cyber Crime, Network Forensics and Investigating logs, Investigating network Traffic, Investigating Web attacks, Router Forensics. Cyber forensics tools and case studies.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Nelson Phillips and Enfinger Steuart, “Computer Forensics and Investigations”, Cengage Learning, New Delhi, 2009.
2. Kevin Mandia, Chris Prosise, Matt Pepe, “Incident Response and Computer Forensics”, Tata McGraw -Hill, New Delhi, 2006.

REFERENCES

1. Robert M Slade,” Software Forensics”, Tata McGraw - Hill, New Delhi, 2005.
2. Bernadette H Schell, Clemens Martin, “Cybercrime”, ABC – CLIO Inc, California, 2004.
3. “Understanding Forensics in IT “, NIIT Ltd, 2005

19EC73E VULNERABILITY ANALYSIS L T P C
3 0 0 3

Pre-Requisites: Fundamentals of Cyber Security

COURSE OUTCOMES

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

CO1: Describe the availability of tools to support an ethical hack.
CO2: Interpret the results of a controlled attack
CO3: Explain the role of politics, inherent and imposed limitations
CO4: Explain the metrics for planning of a test
CO5: Comprehend the dangers associated with penetration testing.

UNIT I INTRODUCTION TO ETHICAL HACKING 9

Introduction: Hacking Impacts, The Hacker Framework: Planning the test, Sound Operations, Reconnaissance, Enumeration, Vulnerability Analysis, Exploitation, Final Analysis, Deliverable, Integration. Information Security Program: The Process of Information Security, Component Parts of Information Security Program, Risk Analysis and Ethical Hacking.

UNIT II THE BUSINESS PERSPECTIVE 9

Business Objectives, Security Policy, Previous Test Results, Business Challenges. Planning for a Controlled Attack: Inherent Limitations, Imposed Limitations, timing is Everything, Attack Type, Source Point, Required Knowledge, Multi-Phased Attacks, Teaming and Attack Structure, Engagement Planner, The Right Security Consultant, The Tester, Logistics, Intermediates, Law Enforcement.

UNIT III PREPARING FOR A HACK 9

Technical Preparation, Managing the Engagement. Reconnaissance: Social Engineering, Physical Security, Internet Reconnaissance.

UNIT IV ENUMERATION 9

Enumeration Techniques, Soft Objective, Looking Around or Attack, Elements of Enumeration, Preparing for the Next Phase. Exploitation: Intutive Testing, Evasion, Threads and Groups, Operating Systems, Password Crackers, RootKits, applications, Wardialing, Network, Services and Areas of Concern.

UNIT V DELIVERABLE 9

The Deliverable, The Document, Overal Structure, Aligning Findings, Presentation. Integration: Integrating the Results, Integration Summary, Mitigation, Defense Planning, Incident Management, Security Policy, Conclusion.

L: 45 TOTAL: 45 PERIODS

TEXT BOOK

1. James S. Tiller, "The Ethical Hack: A Framework for Business Value Penetration Testing", Auerbach Publications, CRC Press, 3rd Edition, 2020.

REFERENCES

1. EC-Council, "Ethical Hacking and Counter measures Attack Phases", Cengage Learning, 2nd Edition 2016
2. Michael Simpson, Kent Backman, James Corley, "Hands-On Ethical Hacking and Network Defense", Cengage Learning. 2nd Edition 2019

19EC74E MALWARE ANALYSIS AND THREAT HUNTING L T P C

2 0 2 3

Pre-Requisites: Fundamentals of Cyber Security

COURSE OUTCOMES

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

CO1 Explain the concept of malware and reverse engineering.

CO2 Implement tools and techniques of malware analysis.

CO3 Apply proactive and defensive measures to deter and repel potential threat

CO4 Explain and know about malware and kernel debugging
CO5 Explain Memory Forensics and Volatility

UNIT I INTRODUCTION TO MALWARE ANALYSIS 9

Introduction to key MA tools and techniques, Understanding Malware Threats, Malware indicators, Malware Classification, Introduction to MA Sandboxes Capturing and Analyzing Network Traffic, Internet simulation using INetSim, Using Deep Freeze to Preserve Physical Systems, Using FOG for Cloning and Imaging Disks.

UNIT II REVERSE ENGINEERING MALWARE 9

Behavioural Analysis vs. Code Analysis, Resources for Reverse-Engineering Malware (REM) - Examining Clam AV Signatures, Creating Custom Clam AV Databases, Using YARA to Detect Malware Capabilities.

UNIT III MALWARE FORENSICS 9

Using TSK for Network and Host Discoveries, Using Microsoft Offline API to Registry Discoveries , Identifying Packers using PEiD, Registry Forensics with Reg Ripper Plugins:, Bypassing Poison Ivy's Locked Files, Bypassing Conficker's File System ACL Restrictions, Detecting Rogue PKI Certificates.

UNIT IV MALWARE AND KERNEL DEBUGGING 9

Opening and Attaching to Processes, Configuration of JIT Debugger for Shellcode Analysis, Controlling Program Execution, Setting and Catching Breakpoints, Debugging with Python Scripts and Py Commands, DLL Export Enumeration, Execution, and Debugging, Debugging a VMware Workstation Guest (on Windows), Debugging a Parallels Guest (on Mac OS X).

UNIT V MEMORY FORENSICS AND VOLATILITY 9

Memory Dumping with MoonSols Windows Memory Toolkit, Accessing VM Memory Files Overview of Volatility, Investigating Processes in Memory Dumps, Code Injection and Extraction, Detecting and Capturing Suspicious Loaded DLLs, Finding Artifacts in Process Memory, Identifying Injected Code with Malfind and YARA.

LIST OF EXPERIMENTS

1. Configure a virtual machine for malware analysis.
2. Virtual Machines as Malware Sandboxes.
3. Dynamic Analysis: Monitoring Malware Behavior.
4. File Identification and Hashing.
5. Study of PE Structure.
6. Static Analysis: Analyzing Embedded Strings.
7. Static Analysis: Understanding the PE Header.
8. PE Header Analysis Tools.
9. Reverse engineering using Olly Debug / Ghidra.
10. Malware detection using Yara signature writing tool.

L: 40; P: 20; TOTAL: 60 PERIODS

TEXTBOOKS

1. Michael Sikorski, Andrew Honig, Practical Malware Analysis: The Hands-On Guide to Dissecting Malicious Software publisher William Pollock, 2012.
2. Michael Hale Ligh, Andrew Case, Jamie Levy, AAron Walters, The Art of Memory Forensics: Detecting Malware and Threats in Windows, Linux, and Mac Memory, 1st Edition, 2014.

REFERENCES

1. Monnappa K A, "Learning Malware Analysis_ Explore the concepts, tools, and techniques to analyze and investigate Windows malware", Packt Publishing, 2018.
2. Digit Oktavianto, Iqbal Muhardianto,"Cuckoo Malware Analysis", Packt Publishing, 2013.
3. http://fumalwareanalysis.blogspot.com/2011/08/malware-analysis-tutorialreverse.html.

19EC75E HARDWARE MODELLING USING VERILOG HDL L T P C
2 0 2 3

PRE-REQUISITES: Basic concepts in digital circuit design.
Familiarity with a programming language like C.

COURSE OUTCOMES

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

CO1 Explain the overview of Verilog HDL language for Digital System Design.
CO2 Explain the hierarchical modelling concepts for Digital System Design.
CO3 Describe the verilog modelling concepts for Digital System Design.
CO4 Write a verilog code for digital circuits and perform simulation of the design.
CO5 Write a verilog code for system level blocks and perform simulation of the design.

UNIT I OVERVIEW OF VERILOG HDL 4

Evolution of CAD-Emergence of HDLs-Typical HDL-based Design flow-Trends in HDLs

UNIT II HIERARCHICAL MODELLING CONCEPTS 12

Top down and bottom up design methodology-Differences between Modules and Module Instances-Parts of a Simulation-Module definition-Port declaration-Connecting ports-Data types-System tasks and functions- Design block-Stimulus block

UNIT III MODELLING TECHNIQUES 12

Gate level Modelling: Basic verilog gate primitives-Rise,Fall and Turn off delays-Min, Max and Typical delays-Data flow modelling: Continuous Assignments-Delay Specification-Expressions-Operators-Operands-Behavioural Modelling: initial and always statements-Blocking and Non-blocking statements-Delay control-Event control-Sequential and Parallel blocks

UNIT IV VERILOG PROGRAMMING FOR COMBINATIONAL AND SEQUENTIAL LOGIC CIRCUITS 12

Combinational Logic: Adder/Subtractor-MUX-DEMUX-Decoder-Priority Encoder-Magnitude Comparator-Sequential Logic: Latches-FFs-Counters-Shift Registers-FIFO-LIFO-Sequence Detector-Verilog Test benches.

PRACTICALS **20**

Design and Simulation of Adder/Subtractor, MUX-DEMUX-Decoder-Priority Encoder-Magnitude Comparator-Sequential Logic: Latches-FFs-Counters-Shift Registers-FIFO-LIFO-Sequence Detector.

CASE STUDIES USING VERILOG HDL

HDL coding for UART,SPI& HDMI protocols- Arithmetic Logic Unit-Event driven architecture using Verilog-Processor design using Verilog-Base band transmission using FPGA.

PRACTICALS

Design and Simulation of UART and SPI protocols and 8-bit ALU.

L: 40; P:20 ; TOTAL: 60 PERIODS

REFERENCES

1. S.Palnitkar,Verilog HDL:A Guide to Digital Design and Synthesis,Prentice Hall, 2nd Edition, 2003.
2. Vaibbhav Taraate, “Digital Logic Design Using Verilog: Coding and RTL Synthesis”, Springer, 2016.
3. S.Ramachandran, “Digital VLSI Systems Design”, Springer International Edition, 2011.
4. Zainal abedin Navabi, “Verilog Digital System Design”, 2nd Edition, Tata Mc Graw Hill, 2008.
5. Nazeith M.Botros, “HDL Programming: VHDL and Verilog”, Dream Tech Press, 2006.
6. G. De Micheli.Synthesis and optimization of digital circuits, 1st Edition, 1994.

19EC76E DESIGN AND VERIFICATION USING SYSTEM VERILOG L T P C
3 0 0 3

PRE-REQUISITES: A basic understanding of digital hardware design and verification
A working knowledge of Verilog

COURSE OUTCOMES

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

CO1 Use the System Verilog RTL design and synthesis features.
CO2 Apply the Verilog language rules for new hierarchy and connectivity features, and interfaces.
CO3 Apply the SystemVerilog verification features, including classes, strings, queues and dynamic arrays.
CO4 Explore verification enhancements such as object-oriented design, assertions and randomization.

UNIT I SYSTEM VERILOG RTL DESIGN AND SYNTHESIS FEATURES 15

Data types-literals-procedural blocks-statements-operators-relaxation of Verilog language rules- fixes for synthesis issues-enhancements to tasks and functions-new hierarchy and connectivity features- User-Defined Data Types and Structures-Static Arrays-Tasks and Functions-Interfaces

UNIT II SYSTEM VERILOG VERIFICATION FEATURES 15

Classes-constrained random stimulus-coverage-strings-queues-dynamic arrays- Simple Verification Features-Clocking Blocks-Random Stimulus-Basic Classes-Polymorphism and Virtuality-Class-Based Random Stimulus-Interfaces in Verification-Cover group Coverage-Queues and Dynamic and Associative Arrays (QDA)

UNIT III OBJECT-ORIENTED DESIGN, ASSERTIONS AND RANDOMIZATION 15

Introduction to Assertion-Based Verification (ABV)- Introduction to SystemVerilog Assertions (SVA)-Direct Programming Interface (DPI)-Interprocess Synchronization

L: 45; TOTAL: PERIODS

REFERENCES

1. Chris Spear, Greg Tumbash, “SystemVerilog for Verification: A Guide to Learning the Testbench Language Features”, Third Edition, Springer, 2012.
2. Stuart Sutherland, Simon Davidmann, Peter Flake, and P.Moorby, “SystemVerilog for Design: A Guide to Using SystemVerilog for Hardware Design and Modeling”, Second Edition, Springer, 2010.
3. Basavaraj Hakari, “System Verilog for Verification”, Notion Press, 2021.
4. Mike Mintz, Robert Ekendahl, “Hardware Verification with System Verilog”, Springer, 2010.
5. S.Palnitkar,Verilog HDL:A Guide to Digital Design and Synthesis, Prentice Hall, 2nd Edition, 2003.

19EC77E VLSI PHYSICAL DESIGN L T P C
3 0 0 3

PREREQUISITES: Basic concepts in digital circuit design.

COURSE OUTCOMES

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

CO1 Explain the importance of physical design automation in the VLSI Design cycle.
CO2 Describe the different types of routing algorithms and routing problems in the design cycle.
CO3 Analyze the various timing issues and the different ways to enhance the performance of the circuit.
CO4 Analyze the various clocking issues and provide the appropriate solutions.
CO5 Analyze the noise performance, layout compaction and physical verification.

Introduction - Design Representation - VLSI Design Styles - VLSI Physical Design Automation.

Partitioning-Floorplanning-Floor planning Algorithms-Pin Assignment-Placement- Grid Routing- Global Routing- Detailed Routing- Power and ground routing- Some Case studies.

Time Closure- Timing Driven Placement- Timing Driven Routing- Miscellaneous Approaches to Timing Optimization.

Clock Design- Clock network synthesis- Clock network synthesis- Some Case studies.

Physical Synthesis- Performance-Driven Design Flow- Interconnect Modeling- Design Rule Check- Layout Compaction- Testing of VLSI Circuits-Fault Modeling- Fault Simulation- Test Pattern Generation-Design for Testability- Boundary Scan Standard-Built-in Self-Test- Low Power VLSI Design-Techniques to Reduce Power-Gate Level Design for Low Power- Other Low Power Design Techniques-Algorithmic Level Techniques for Low Power Design.

L: 45; TOTAL: PERIODS

REFERENCES

1. A.B. Kahing, J.Lienig, I.L.Markov, and J.Hu, “VLSI Physical Design: From graph partitioning to timing closure”, Springer 2011.
2. M.L.Bushnell and V.D.Agarwal, “Essentials of Electronic Testing”, Kluwer Academic Publishers, 2000.
3. S.M.Sait and H.Youssef, “VLSI Physical Design Automation: Thoery and Practice”, World Scientific Publishers, 1999.
4. N.A.Sharwani, “Algorithms for VLSI Design Automation”, Kluwer Academic Publishers, 1999.

19EC78E DESIGN FOR TESTABILITY (DFT) L T P C
3 0 0 3

PRE-REQUISITES: Basic Knowledge in Digital Logic Design.

COURSE OUTCOMES

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

- CO1 Explain the Basic Concepts of DFT in Semiconductor IC Design.
- CO2 Explore the Various Schemes of DFT for Semiconductor IC Design.
- CO3 Apply the DFT Algorithm(s) for Testing the Semiconductor ICs.
- CO4 Explain the JTAG architecture and its uses.
- CO5 Apply the Boundary Scan Architecture for the Board Level Semiconductor ICs Testing.

UNIT I BASICS OF DFT 12

Challenges in VLSI Testing-DFT Design flow-DFT Guidelines and Rules-Stuck-at-Faults-Other Faults-Testability Measurement-Controllability-Observability-Usage of Testability Measures-Testability Measurement-Testability Analysis: SCOAP Algorithm-Importance of Testability Measures.

UNIT II DESIGN FOR TESTABILITY 12

Benefits of DFT-Adhoc Techniques-Test Point Insertion-Serial Scan Rules-Serial Scan Testing-Random Access Scan-Scan Cell Design-LSSD Scan Cell-Clocking Scheme of LSSD-Analysis of Sequential Circuits-Broadcast Scan Chains-Hardware Architecture-Logic BIST-Memory BIST

UNIT III DFT ALGORITHMS 9

Fault Detection using Path Sensitization Algorithm- Fault cover table Algorithm-PODEM Algorithm-Butterfly Algorithm-MARCH Algorithm

UNIT IV JTAG BOUNDARY SCAN ARCHITECTURE 6

Boundary Scan Cell-Architectural diagram-Instruction Register-Data Register-Bypass Register-Test Access Port Controller

UNIT V BSA INSTRUCTIONS AND TIMING DIAGRAMS 6

Public instructions-Private instructions-Timing diagrams-Testing of board level ICs using JTAG boundary scan architecture.

L: 45; TOTAL: 45 PERIODS

REFERENCES

1. M.L.Bushnell and V.D Agrawal, “Essential of Electronic Testing for Digital, Memory, and Mixed Signal VLSI Circuits”, Springer, 2005
2. D.D. Gajski, N.D. Dutt,A.C.-H. Wu and S.Y.-L. Lin, High Level Synthesis: Introduction to Chip and System Design, Springer, 1st Edition, 1992.
3. Gordon Roberts, Friedrich Taenzler, and Mark Burns, “An Introduction to Mixed-Signal IC Test and Measurement”, Second Edition, Oxford University Press, 2012.
4. Mark Burns and Gordon W.Roberts, “An Introduction to Mixed-Signal IC Test and Measurement”, Oxford University Press, 2001.
5. Laung-Terng Wang, Cheng-Wen Wu, and Xiaoqing Wen, “VLSI Test Principles and Architectures Design for Testability”, Elsevier, 2006.

19EC79E ANALOG IC DESIGN L T P C

3 0 0 3

PRE-REQUISITES: Circuit Theory, Signals and Systems, Analog Circuits

COURSE OUTCOMES

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

CO1 Explain the advanced concepts in analog circuit design specifically relevant to CMOS IC design.

CO2 Explain the circuit noise and mismatch, their analysis, and their impact on CMOS OpAmp design.

CO3 Design and analyze the cascode amplifier using opamp at the transistor level.

CO4 Design and analyze the negative feedback amplifier using opamp at the transistor level.

CO5 Design and analyze the differential amplifier using opamp at the transistor level

Simple MOSFET Circuits-MOSFET Current Mirrors-Cascode Amplifiers-MOSFET in Integrated Circuits-MOSFET Capacitances.

Noise-Noise of Simple Circuits-Systematic Mismatch-Random Mismatch- Differential Amplifiers

Folded-Cascode OpAmp- Single stage opamp realization-Two stage miller compensated opamp-Two stage miller compensated opamp-Two and three stage miller compensated opamps; Feedforward compensated opamp- Two Stage Opamp-Two Stage Opamp; Three Stage and Triple Cascade Opamps- Common Mode Rejection Ratio ; Example.

Negative Feedback-Stability of Negative Feedback Systems-Dominant Pole-Compensation - Active Load-One Stage OpAmps- Negative feedback amplifier-Step response, sinusoidal steady state response- Loop gain and unity loop gain frequency; Opamp- Opamp realization using controlled sources; Delay in the loop-Negative feedback amplifier with ideal delay-small delays-Negative feedback amplifier with ideal delay-large delays- Negative feedback amplifier with parasitic poles and zeros-Negative feedback amplifier with parasitic poles and zeros; Nyquist criterion-Phase margin.

Differential Amplifiers Offset-One Stage OpAmps - Noise & Offset-One Stage OpAmps - Slew Rate-One Stage OpAmps – Datasheet- Fully differential single stage opamp-Common mode feedback-Fully differential single stage opamp – 2-Fully differential two stage opamp; Fully differential versus pseudo-differential.

L: 45; TOTAL: PERIODS

REFERENCES

1. Behzad Razavi, “Design of Analog CMOS Integrated Circuits”, Second Edition, McGraw Hill Education, 2017.
2. Kenneth Martin, Chan Carusone and David Johns, “Analog Integrated Circuit Design”, Second Edition, Wiley Publication, 2013.
3. Philip E.Allen and Douglas R.Holberg, “CMOS Analog Circuit Design”, Third Edition, Oxford University Press, 2013.
4. Meyer Gray and Hurst Lewis, “Analysis and Design of Analog Integrated Circuits”, Fifth Edition, Wiley Publication, 2009.

19EC80E THEORY AND APPLICATIONS OF BLOCKCHAIN L T P C
2 1 2 4

COURSE OUTCOMES

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

CO1: Explain the basics of block chain
CO2: Describe the concepts of Distributed computing and cryptographic primitives.
CO3: Recognize the basic security and its significance in Bit coin
CO4: Compare Bit coin scripting vs. Ethereum Smart Contracts
CO5: Explain the Privacy and Security issues in Block chain

UNIT I INTRODUCTION TO BLOCK CHAIN 9

Need for Distributed Record Keeping, Modeling faults and adversaries,Byzantine Generals problem Consensus algorithms and their scalability problems, Nakamoto with Blockchain based cryptocurrency, Technologies Borrowed in Blockchain – hash pointers, consensus, byzantine fault-tolerant distributed computing, digital cash

UNIT II BIT COIN BASED BLOCKCHAIN NETWORK 9

Atomic Broadcast, Consensus, Byzantine Models of fault tolerance Hash functions, Puzzle friendly Hash, Collison resistant hash, digital signatures, public key crypto, verifiable random functions, Zero-knowledge systems

UNIT III BLOCKCHAIN 1.0 AND BLOCKCHAIN 2.0 9

Bitcoin blockchain, the challenges, and solutions, proof of work, Proof of stake, alternatives to Bitcoin consensus, Bitcoin scripting language and their use.

UNIT IV ETHEREUM AND SMART CONTRACTS 9

Smart Contract Languages and verification challenges, Using smart contracts to enforce legal contracts, comparing Bitcoin scripting vs. Ethereum Smart Contracts

UNIT V PRIVACY AND SECURITY ISSUES IN BLOCKCHAIN 9

Pseudo-anonymity vs. anonymity, Zcash and Zk-SNARKS for anonymity preservation, attacks on Blockchains – such as Sybil attacks, selfish mining, 51% attacks - advent of algorand, and Sharding based consensus algorithms.s

Tutorials

1. Ethereum

Assignments

Assignment 1: Operation with Merkel tree
Assignment 2: Basic Ehereum Transactions
Assignment 3: Implementing a Dapp using Solidity

L: 45; P: 15; TOTAL: 60 PERIODS

TEXT BOOKS

1. Mastering Blockchain: A deep dive into distributed ledgers, consensus protocols, smart contracts, DApps, cryptocurrencies, Ethereum, and more, 3rd Edition, Imran Bashir, Packt Publishing, 2020, ISBN: 9781839213199
2. Brojo Kishore Mishra, Sanjay Kumar Kuanar “Handbook of IoT and Blockchain: Methods, Solutions, and Recent Advancements (Internet of Everything (IoE)) “, CRC Press; 1st Edition, November 2020.
3. Jai Singh Arun, Jerry Cuomo, Nitin Gaur Blockchain for Business- For Understanding transformation, growth and new models of Business, 1st Edition Published by Pearson Paperback, 12 December 2019.

REFERENCES

1.https://iabtechlab.com/wp-content/uploads/2018/07/Blockchain-Technology- Primer.pdf
2. https://www.blockchain-council.org/blockchain/the-best-blockchain-business-models/

E – Book

1. https://www.researchgate.net/publication/337649428_Handbook_of_IoT_and_Blockchain_-_Methods_Solutions_and_Recent_Advancements

MOOC

1. https://www.coursera.org/learn/blockchain-business-models
2. https://www.udemy.com/course/the-complete-blockchain-professional-course/
3. https://www.udemy.com/course/build-your-own-proof-of-stake-blockchain/

B. E. – ELECTRONICS AND COMMUNICATION ENGINEERING

ONE CREDIT ELECTIVE COURSES

19EC01L	BASIC DEVICE DRIVER PROGRAMMING	L	T	P	C
	PRACTICE	0	0	2	1

COURSE OUTCOME

Upon completion of this course, the student will be able to

CO1: Write character type Device Driver programs for the given onchip peripherals (K3)

EXPERIMENTS

1. Theoretical introduction about the significance and different types of Device driver
2. Device driver program to perform on-board LEDS glow using GPIO logic block
3. Device driver program to perform on-board LEDS glow using Timer0 logic block
4. Device driver program to perform LCD interface using SPI logic block
5. Device driver program to perform SPI communication using SPI logic blocks of two different LPC 2148 Boards
6. Device driver program to perform serial data communication using UART logic block
7. Device driver program to perform GSM interface using UART logic block
8. Device driver program to perform DC Motor interface using UART and SPI logic blocks.
9. Device driver program to perform ToF interface using I2C logic blocks of different processor families

P: 30 TOTAL: 30 PERIODS

REFERENCES

1. Tammy Noergaard, “Embedded Systems Architecture”, Elsevier Inc, 2005
2. SreekrishnanVenkateswaran, “Essential Device Driver”, Prentice Hall, 2008
3. www.arm.com
4. www.embeddedrelated.com
5. www.embeddedarm.com

19EC02L	IMAGE PROCESSING PRACTICE USING OPENCV	L	T	P	C
		0	0	2	1

COURSE OUTCOME

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

CO1: Perform the Image Processing operations using OPENCV (K3).

LIST OF EXPERIMENTS

1. Program to Read, Load and Display the given images.
2. Program to perform Negative, Logarithmic transformation of different images.
3. Develop Histogram equalization algorithm and display the Histogram equalized image.
4. Program to perform filtering operation in spatial domain on noisy image corrupted by both Gaussian noise and Salt Pepper noise.
5. Program to perform Translation and rotation operations.
6. Program to perform Sharpening of two different images using Filters.
7. Program to perform segmentation on bi-level images using histogram method.
8. Program to perform Morphological operations Erosion and Dilation.
9. Program to perform Geometric transformations scaling and shearing.
10. Program to perform Face detection in images using Raspberry Pi.

P:30 TOTAL: 30 PERIODS

19EC03L INTRODUCTION TO OFDM

L	T	P	C
1	0	0	1

COURSE OUTCOMES

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

CO 1: Understand modulation and demodulation process of OFDM. (K2)
CO 2: Comprehend the effect of offset errors and compensation techniques (K2)
CO 3: Describe the channel estimation for time varying channels (K2)
CO 4: Understand various PAPR reduction techniques. (K2)

UNIT I FUNDAMENTALS OF OFDM **4**

Single-Carrier vs. Multi-Carrier Transmission, OFDM Modulation and Demodulation, OFDM Guard Interval, OFDM Guard Band, BER of OFDM Scheme

UNIT II SYNCHRONIZATION FOR OFDM **4**

Effect of STO, CFO, and Sampling Clock Offset, Estimation Techniques for STO and CFO.

UNIT III CHANNEL ESTIMATION **4**

Pilot Structure, Training Symbol-Based Channel Estimation, DFT-Based Channel Estimation, Decision-Directed Channel Estimation, Channel Estimation in Fast Time-Varying Channels

UNIT IV PAPR REDUCTION **3**

Introduction to PAPR, PAPR Reduction Techniques **-** Clipping and Filtering, PAPR Reduction Code, Selective Mapping, Partial Transmit Sequence, DFT Spreading

L: 15; TOTAL:15 PERIODS

REFERENCES

1. Aditya K. Jagannatham, “Principles of Modern Wireless Communication - Theory and Practice”, McGraw Hill Education (India) Private Limited, 2016.
2. Yong Soo Cho, Jaekwon Kim, Won Young Yang and Chung G. Kang, “MIMO-OFDM Wireless Communications with MATLAB”, IEEE Press, John Wiley & Sons Pvt. Ltd., 2010.
3. Andrea Goldsmith, “Wireless Communications”, Cambridge University Press, 2005.
4. Richard van Nee, Ramjee Prasad, “OFDM for Wireless multimedia communications”, Artech House, 2000.
5. R. E. Blahut, Algebraic Codes for Data Transmission, Cambridge University Press, 2002.

19EC04L WIRELESS COMMUNICATION SYSTEM DESIGN USING SDR

L	T	P	C
0	0	2	1

COURSE OUTCOMES

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

CO1: Design a wireless transceiver using PSK/QAM Modem with channel estimation (K3)

CO2: Implement a wireless transceiver using PSK/QAM Modem with channel estimation (K3)

PRE-REQUISITES:

Before starting this course the students should have the knowledge on

- Fundamentals of Digital Communication and Wireless communication
- Programming using virtual instrumentation simulation toolbox
- Architecture of Universal Software Radio Peripheral (USRP)

LIST OF EXPERIMENTS

1. Study of virtual instrumentation engineering workbench for communication system design.
2. Device Driver for Universal Software Radio Peripheral (USRP).
3. PSK/QAM transceiver using pulse shaping filters and shaping and matched filtering, synchronization.
4. Frame synchronization, frame detection and frequency offset correction in QAM transceiver.
5. Channel estimation and equalization for QAM transceiver.

REFERENCES

1. Robert W. Heath Jr., Digital Wireless Communication, Physical Layer Exploration Lab Using the NI USRP, National Technology and Science Press, 2012.
2. Bruce A. Black, Introduction to Communication Systems - Lab Based Learning with NI USRP and LabVIEW Communications, National Instruments, 2014.
3. Rapid Prototyping of Real-Time Wireless Systems, National Instruments, 2013
4. An Introduction to Software Defined Radio with LabVIEW Communications System Design Software and NI USRP, Version 2.0, National Instruments, 2015.

WEB REFERENCES

1. http://www.ni.com/en-in/innovations/white-papers/14/overview-of-the-ni-usrp-rio-software-defined-radio.html
2. http://www.ni.com/en-in/innovations/white-papers/11/what-is-ni-usrp-hardware-.html

19EC05L OFDM SYSTEM DESIGN USING SDR L T P C
0 0 2 1

COURSE OUTCOME

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

CO1: Design a wireless transceiver using OFDM. (K3)
CO 2 : Implement a wireless transceiver using OFDM (K3)

PRE-REQUISITES

Before starting this course the students should have the knowledge on

- Fundamentals of Digital Signal Processing and Wireless communication
- Concepts of Orthogonal Frequency Division Multiplexing (OFDM)
- Programming using virtual instrumentation simulation toolbox
- Architecture of Universal Software Radio Peripheral (USRP)

EXPERIMENTS

1) Baseband OFDM modulation& demodulation with PSK/QAM mapping and cyclic prefix
2) Lattice type pilot insertion in OFDM symbol, channel estimation and equalization

3) ML Estimation of Time and Frequency Offset (Van De Beek Algorithm)

REFERENCES

1. Robert W. Heath Jr., Digital Wireless Communication, Physical Layer Exploration Lab Using the NI USRP, National Technology and Science Press, 2012.
2. Bruce A. Black, Introduction to Communication Systems -Lab Based Learning with NI USRP and LabVIEW Communications, National Instruments, 2014.
3. Rapid Prototyping of Real-Time Wireless Systems, National Instruments, 2013.
4. An Introduction to Software Defined Radio with LabVIEW Communications System Design Software and NI USRP, Version 2.0, National Instruments, 2015.

WEB REFERENCES

1. http://www.ni.com/en-in/innovations/white-papers/14/overview-of-the-ni-usrp-rio-software-defined-radio.html
2. http://www.ni.com/en-in/innovations/white-papers/11/what-is-ni-usrp-hardware-html
3. http://www.ni.com/tutorial/13878/en/
4. http://www.ni.com/en-in/innovations/white-papers/06/ofdm-and-multi-channel-communication-systems.html

19EC06L	SPREADING CODES IN SPREAD SPECTRUM MODULATION	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

Upon completion of this course, the student will be able to,

CO1: Identify the popular spreading codes in communication.(K2)
CO2: Explain the various code generation methods.(K2)
CO3: Analyze and select code for spreading. (K2)
CO4: Explain the applications of spreading codes. (K2)

UNIT I DESCRIPTION OF POPULAR CODES 3

Maximal length sequences code, Gold code, and Kasami code

UNIT II CODES GENERATION 4

Binary Shift Register concept for generation of PN sequence: balance property, run length property, and Correlation Property, generation of Gold code set, generation of Kasami code set.

UNIT III CODE SELECTION FOR SPREADING 4

Comparison of auto correlation and cross correlation of various codes such as PN sequence code, M-Sequence code, Gold code, Kasami code.

UNIT IV APPLICATIONS OF THE SPREADING CODES 4

Applications of spreading code to cellular communication systems, Second and third generation CDMA systems/ standards, Design examples of IS-95, GPRS, Bluetooth, W-CDMA, Wi-Fi.

L: 15 TOTAL: 15 PERIODS

REFERENCES

1. John Proakis and MasoudSalehi, Digital Communications, McGraw-Hill, 5th Edition, 2007.
2. T. S.Rappaport, Wireless Communications: Principles and Practice (2nd Edition),

Prentice Hall, 2001.
3. R.L. Peterson, R. L Ziemer, D. E Borth, “Introduction to Spread Spectrum Communications”, Upper Saddle River: NJ, Prentice Hall, 1995.
4. E. H. Dinanve B. Jabbari, "Spreading codes for direct sequence CDMA and wideband CDMA cellular networks", IEEE Communications Magazine, vol. 36, pp.48-54, September 1998.

19EC07L MEMORY BUILT IN SELF TEST (MBIST)

L	T	P	C	QP
1	0	0	1	C

COURSE OUTCOMES

Upon completion of this course, the student will be able to,

CO1: Explain the different types of Memory and the faults associated with the memory. (K2)
CO2: Explain the operation of MBIST Architecture. (K2)
CO3:Analyze the various algorithms involved in MBIST architecture.(K3)

UNIT I INTRODUCTION TO MEMORY **3**

Basic memory Architecture- Different Types of Memory (RAM, ROM, Serial Access memory, Content addressable memory)-MOSFET RAM structures(6T-cell SRAM & DRAM)

UNIT II FAULTS IN MEMORY **4**

Fault models: Basic state diagrams, Stuck at faults, Transition faults, coupling faults, neighbourhood pattern sensitive fault, Address decoder faults.

UNIT III MEMORY BUILT IN SELF TEST ARCHITECTURE **4**

Basic Mbist architecture-Types of collars (parallel, dedicated, sequential)-MbistControllers(hardwired based, Microcode based, Processor based)

UNIT IV ALGORITHMS FOR MBIST **4**

Types of algorithms for MBIST patterns (classical, March based)- Walking, GALPAL, Checkerboard, Sliding diagonal, Butterfly, MARCH algorithm

L: 15 TOTAL: 15 PERIODS

REFERENCES

1. Adams. R. Dean, “High performance memory testing - Design principles, Fault modeling and self-test”, Adams Kluwer Academic Publishers, 2003.
2. Charles. E.Stroud, “A Designer’s guide to Built-in Self-test”, Kluwer Academic Publishers, 2002.
3. A.J.Van De GOOR and C.A.Verruijt, “An overview of Deterministic Functional RAM chip testing”, ACM Publishers, 2007.
4. Sachdev**,** Manoj, “Defect oriented testing for CMOS analog and digital circuits” Springer Science publications, 1999.
5. Tegze.P.Haraszti, “CMOS memory Circuits”, Kluwer Academic Publications, 2000

19EC08L JOINT TEST ACTION GROUP (JTAG)

L	T	P	C
1	0	0	1

COURSE OUTCOMES

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

CO1:Describe the basic concept of JTAG Architecture (K2)

UNIT I INTRODUCTION TO JTAG 1
Basics of Testing, Why testing, why JTAG

UNIT II JTAG STRUCTURE 4
TAP - TAP controller - TAP logic control - TMP controller - Instruction register.

UNIT III JTAG TEST DATA REGISTER STRUCTURE 4
Basic design - Boundary scan register - Device ID – ECID – TMP status ID - Bypass register

UNIT IV JTAG INSTRUCTIONS 4
Public instruction - private instruction – INTEST – EXTEST – BYPASS – SAMPLE – PRELOAD - HIGHZ-RUNBIST- CLAMP – IDCODE – USERCODE - Timing diagrams.

UNIT V JTAG SPECIAL INSTRUCTIONS 2
Special instructions (from 2013 standard)-Timing diagrams

L: 15 TOTAL: 15 PERIODS

REFERENCES

1. IEEE-1149.1-2013 standard-IEEE Standard for Test Access Port and Boundary-Scan Architecture, IEEE Computer Society.
2. IEEE-1149.1-2001 standard-IEEE Standard for Test Access Port and Boundary-Scan Architecture, IEEE Computer Society.

		L	T	P	C
19EC09L	**NETWORK TRAFFIC ANALYSIS USING WIRESHARK LABORATORY**	**0**	**0**	**2**	**1**

COURSE OUTCOME

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

CO1: Analyze the performance of TCP/IP protocol suite and detect security breaches on the network (K3)

PRE-REQUISITES

- OSI Layers and formation and deformations of TCP / IP Packets
- Sound knowledge of TCP/IP protocols
- Prior hands-on experience in Linux operating system
- Exposure to networking protocols and technologies such as DNS, DHCP, ICMP, FTP, HTTP, SMTP, and ARP.

EXPERIMENTS

1. Study the installation, packet capturing and protocol analysis functions of Wireshark.
2. Generate ping command and analyse several aspects of ICMP Protocol.
3. Analyze the trace of Transmission Control Protocol (TCP) segments.
4. Investigate the Address Resolution Protocol (ARP).
5. Examine the Dynamic Host Configuration Protocol (DHCP) packets captured by a host.

6. Explore the HTTP Protocol: The Basic Get/Response Interaction.
7. Customize Wireshark for investigating malicious network traffic.
8. Discover the malicious traffic and analyzing security problems.

P: 30 TOTAL: 30 PERIODS

REFERENCES

1. Yoram Orzach - Network Analysis Using Wireshark Cookbook, Packt Publishing, 2013.
2. Chris Sanders, PRACTICAL PACKET ANALYSIS - Using Wireshark to Solve Real-World Network Problems, No Starch Press, Inc. 2007.
3. Laura Chappell - Troubleshooting with Wireshark - Locate the Source of Performance Protocol Analysis Institute, Inc, 2004.

19EC10L **INTRUSION DETECTION SYSTEM USING SNORTLABORATORY**

L	T	P	C
0	0	2	1

COURSE OUTCOME

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

CO1: Implement Intrusion Detection / Prevention system and rules using Snort (K3)

PRE-REQUISITES

- OSI Layers and formation and deformations of TCP / IP Packets
- Sound knowledge of TCP/IP protocols
- Prior hands-on experience in Linux operating system

EXPERIMENTS

1. Basic Commands in Linux - Study Experiment.
2. Installation and Configuration of Linux OS and Virtual Box.
3. Creation of Virtual Machine - IDS/IPS machine.
4. Creation of Virtual Machine - Attacker machine.
5. Understanding the snort architecture and Snort configuration.
6. Working with Snort Rules.
7. Ping and its Detection.
8. Alert for Browsing on Facebook.
9. Hacking attempt with Metasploit and its Detection using Snort.

P: 30 TOTAL: 30 PERIODS

REFERENCES

1. Security Configuration Guide: Unified Threat Defense, Cisco, 2018
2. Rafeeq Ur Rehman - Intrusion Detection Systems with Snort, Pearson Education, Inc, 2003.
3. Charlie Scott, Bert Hayes, Paul Wolfe - Snort for Dummies, Wiley Publishing, Inc, 2004.

19EC11L **VULNERABILITY ASSESSMENT AND PENETRATION TESTING LABORATORY**

L	T	P	C
0	0	2	1

Prerequisites: Computer Networks

COURSE OUTCOMES

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

CO1: Assess the security posture of an organization with the same approach as malicious hackers use and identify the weaknesses (K3)

1. Study Experiment on Ethical Hacking and understanding ethical hacking terminology.
2. Study Experiment on Gathering Target Information: Reconnaissance, Foot printing, and Social Engineering
3. Study Experiment on Gathering Network and Host Information: Scanning and Enumeration
4. System Hacking: Password Cracking, Escalating Privileges, and Hiding Files
5. Gathering Data from Networks: Sniffers
6. Performing Social Engineering attacks
7. Denial of Service and Session Hijacking
8. Bypassing Network Security: Evading IDS, Firewalls, and Honeypots

9. Web Hacking: Google, Web Servers, Web Application Vulnerabilities - OWASP, and Web-Based Password Cracking Techniques
10. Attacking Applications: SQL Injection and Buffer Overflows
11. CSRF – Cross-site request forgery
12. XSS – Cross-site scripting
13. Study of Cloud computing concepts
14. Cloud−Based Threats and attacks
15. IoT Threats and Operational Technology (OT) Attacks
16. Cloud Security techniques and tools

P: 30 TOTAL: 30 PERIODS

REFERENCES

1. Kimberly Graves, “CEH: Certified Ethical Hacker Study Guide”, Wiley Publishing Inc., 2010.
2. Rafay Baloch, “Ethical Hacking and Penetration Testing Guide”, CRC Press (Taylor & Francis Group), 2015.
3. Patrick Engebretson, “The Basics of Hacking and Penetration Testing – Ethical Hacking and Penetration Testing Made Easy”, Syngress, 2011.
4. EC-Council Press, “Investigating Network Intrusions and Cybercrime”, Course Technology, Cengage Learning, 11th Edition, 2010.

		L	T	P	C
19EC12L	**MALWARE ANALYSIS AND REVERSE ENGINEERING LABORATORY**	**0**	**0**	**2**	**1**

COURSE OUTCOMES

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

CO1:Infer the behavior of malware using dynamic and static analysis and to detect the malware using signatures. (K3)

PRE-REQUISITE : Computer Networks

LIST OF EXPERIMENTS

1. Configure a virtual machine for malware analysis.
2. Virtual Machines as Malware Sandboxes.
3. Dynamic Analysis: Monitoring Malware Behavior.
4. File Identification and Hashing.
5. Study of PE Structure.
6. Static Analysis: Analyzing Embedded Strings.
7. Static Analysis: Understanding the PE Header.
8. PE Header Analysis Tools.
9. Reverse engineering using Olly Debug / Ghidra.
10. Malware detection using Yara signature writing tool.

P: 30 TOTAL: 30 PERIODS

REFERENCES

1. Michael Sikorski, Andrew Honig, “Practical Malware Analysis: The Hands-On Guide to Dissecting Malicious Software”, No Starch Press, 2012.
2. Monnappa K A, “Learning Malware Analysis_ Explore the concepts, tools, and techniques to analyze and investigate Windows malware”, Packt Publishing, 2018.
3. Digit Oktavianto, Iqbal Muhardianto,“Cuckoo Malware Analysis”, Packt Publishing, 2013.

4. http://fumalwareanalysis.blogspot.com/2011/08/malware-analysis-tutorial-reverse.html.

19EC13L	CYBER SECURITY: GOVERNANCE, RISK AND COMPLIANCE	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

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

CO1: Realize the accountability for designing and maintaining securityinfrastructure within an organization. (K2)

UNITI INFORMATION SECURITY GOVERNANCE AND RISK MANAGEMENT

Introduction to Cyber Security, Introduction to Governance, Risk and Compliance, Regulations, standards and best practices, Risk assessment and risk management

UNIT II INFORMATION SECURITY - AUDITS AND ASSESSMENTS

ISO 27001 Overview, Security Architecture and Design, Business continuity management, Legal, Regulations, Compliance, and Investigations

L: 15 TOTAL: 15 PERIODS

REFERENCES

1. Shon Harris, "ALL IN ONE CISSP EXAM GUIDE", Sixth Edition, McGraw Hill, 2013.
2. James Michael Stewart, "CISSP Certified Information Systems Security Professional Study Guide", Seventh Edition, John Wiley & Sons, 2015

19EC14L	PROGRAMMING IN JAVA	L	T	P	C
		0	0	2	1

COURSE OUTCOMES

Upon completion of this course, students will be able to

CO 1: Explain JAVA language features (K2)

CO 2: Develop a program in object-oriented way. (K3)

UNIT I FUNDAMENTALS OF JAVA 5

Introduction to JAVA - BYTE code, JDK, JVM, JRE, JVM. Modules and packagesintroduction. Variables, Data types, Operators, Basics of Input/Output, Condition and Looping structures.

UNIT II OOPS IN JAVA 5

OOPs introduction – Advantage of OOP, Method overloading, Constructors, Inheritance, Interface and Abstract classes.

UNIT III 5

JAVA Data structures – Introduction to Generics and collection classes framework. Sorting and Searching, Strings, Recursive functions, Exception handling, File Handling.

P: 30 TOTAL: 30 PERIODS

TEXT BOOKS

1. Balagurusamy.E., “Programming with Java”, Fourth Edition, TMH,2009
2. Paul Deitel, Harvey Deitel, “Java How to program”, Eighth Edition, PHI, 2010

REFERENCES

1. Java – The complete reference By Herbert Schildt, McGraw Hill
2. Cay S. Horstmann and Gary Cornell, “Core Java: Volume I – Fundamentals”, Ninth Edition, Sun Microsystems Press, 2012.
3. Hortsmann and Cornell, “Core Java 2 Advanced Features”, Vol-II, Pearson Education, 2002

JAVA LABORATORY

1. Simple Applications (Using data types –including arrays and strings, control structures and loops)
2. Applications using classes and interfaces
3. Threading/Exception handling/Filehandling

19EC15L	PROGRAMMING IN PYTHON	L	T	P	C
		0	0	2	1

COURSE OUTCOMES

Upon completion of this course, student will be able to

CO1: Explain programming language features. (K2)

CO2: Develop a program in python in object-oriented way. (K3)

UNIT I PYTHON FUNDAMENTALS 5

Introduction to Python, Software development environment Interactive shell, Interactive/script mode, Python character set, Tokens, Literals, Operators, operator precedence, Delimiters, Variables and assignments, Data types, Decision Making Constructs

UNIT II OOPS IN PYTHON 5

Loops, Functions, Strings, File operations, Object oriented programming-Classes, Inheritance and Polymorphism

UNIT III PYTHON DATA STRUCTURES AND ALGORITHMS 5

Collection classes - Lists, Tuples, Sets, Dictionaries, searching and sorting.

P: 30 TOTAL: 30 PERIODS

TEXT BOOKS

1. “Think Python: How to Think Like a Computer Scientist”, by Allen B. Downey, O'Reilly Media, Inc., 2016
2. “A Practical Introduction to Python Programming”, Brian Heinold, Mount St.Mary‟s University, 2012.
3. “Learning to Program with Python”, Richard L. Halterman, 2019, E-book
4. Dive into Python, Mark Pilgrim, Apress, 2012.

REFERENCES

1. “Exploring Python”, Timothy A.Budd, Mc-Graw Hill Education (India) Private Limited, 2015.
2. “Introduction to Computer Science using python: A Computational Problem-solving Focus, Charles Dierbach, Wiley India Edition, 2015. NATIONAL ENGINEERING COLLEGE, KOVILPATTI (An Autonomous Institution, Affiliated to Anna University, Chennai) 15

3. "Practical Programming: An Introduction to Computer Science using Python 3.6", Paul Gries, Jennifer Campbell and Jason Montojo, Second edition, Pragmatic Programmers, LLC, 2018.
4. "Introduction to Programming in Python: An Inter-disciplinary Approach", Robert Sedgewick, Kevin Wayne, Robert Dondero, Pearson India Education Services Pvt. Ltd, 2016.

19EC16L	CONSUMER ELECTRONICS	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

Upon completion of this course, student will be able to

CO1:Understand the working of audio system (K2)
CO2:Describe the principles involved in communication gadgets (K2)
CO3:Identify the developments in domestic appliances (K2)

UNIT I AUDIO SYSTEM COMPONENTS 5

Introduction to wave motion – Interference and superposition of waves – Beats, Resonance, Echos –characteristics of microphones – types of microphone – wireless microphones – types of headphones –Types of loudspeakers – Multi speaker systems – Acoustic Insulation and acoustic design. Stereo systems and multiway systems.

UNIT II COMMUNICATION AND CONSUMER GADGETS 5

Radio system – VHF and UHF – Types of mobile phones – Facsimile machine – electronic calculators – digital clocks – Automobile computers – Antilock Braking Systems, Safety Belt System, Navigation System – Microwave Ovens and TV Remote.

UNIT III CONSUMER APPLICATIONS 5

Washing Machines – electronic controller, fuzzy logic, Hardware and Software development – Air Conditioners – Components, Remote Controls, Unitary and central air conditioner systems – Bar Coders – Bar codes, scanner and decoder – Set Top Box – Types, firmware development, Interactive program guides. Video on demand.

L: 15TOTAL: 15 PERIODS

TEXTBOOKS

1. S.P.Bali, Consumer Electronics, Pearson Education, 2005.
2. B.R.Gupta, V.singhal, Consumer Electronics, S.K.Kataria& Sons, 2013

REFERENCES

1. C.A.Schuler and W.L.McNamee, Modern Industrial Electronics, McGrawHill, 2002.
2. D.J.Shanefield, Industrial Electronics for Engineers, Chemists andTechnicians, Jaico Publishing House, 2007.

19EC17L	COMPUTATIONAL ELECTROMAGNETICS LABORATORY	L	T	P	C
		0	0	2	1

COURSE OUTCOMES

Upon completion of this course, student will be able to

CO1:Design and simulate planar antennas for the given specifications usingelectromagnetic (EM) tool (K2)
CO2:Simulate microwave transmission lines using EM tool (K2)
CO3: Simulate Microwave passive components and demonstrate using microwave bench set up (K2)

LIST OF EXPERIMENTS

1. Study of High Frequency Structural Simulator (HFSS)
2. Study of Microwave transmission lines and its equivalent circuit analysis
3. Simulation of Microwave components: Isolator, Circulator, Couplers
4. Simulation of Microwave tees
5. Design and simulation of wire antennas
6. Design and simulation of Microstrip patch antenna using various types of substrate
7. Demonstration of basic bench set up using microwave oscillators and passive components and to study about mode characteristics of reflex klystron oscillator

P: 30 TOTAL: 30 PERIODS

19EC18L ADVANCED COMMUNICATION SYSTEMS LABORATORY L T P C
0 0 2 1

COURSE OUTCOMES

Upon completion of this course, the students will be able to
CO1: Calculate the S parameters of various microwave components.(K2)
CO2: Measure the parameters of different microwave antennas.(K3)
CO3: Measure various parameters of optical fibers (K3)
CO4: Analyze the fundamentals of Software defined radio (SDR). (K3)

LIST OF EXPERIMENTS

1. Study of various parameters of Optical Fibers.
2. Setting up a fiber optic analog and digital communication links.
3. Study of Microwave components and determining its S-Matrix.
4. Study the characteristics of Reflex Klystron Oscillator.
5. Radiation Pattern of Microwave antennas.
6. Performance measure of microwave components such as directional coupler, circulator and waveguide tees.
7. Study of Labview Communication Design Suite for SDR
8. Transmission of a single tone signal and spectrum sensing using SDR
9. Wireless AM transmitter and receiver using SDR.

P: 30 TOTAL: 30 PERIODS

19EC19L MACHINE LEARNING TECHNIQUES LABORATORY L T P C
0 0 2 1

COURSE OUTCOMES

Upon completion of this course, the students will be able to
CO1: Analyze the preprocessing the data, prediction tasks and performance for machine Learning. (K3)
CO2: Demonstrate suitable machine learning algorithms for clustering tasks and reduce the dimensionality of the training data (K3)

LIST OF EXPERIMENTS

1. Basics of python and Introduction to Anaconda-Spyder / Google colab Interface
2. Prepare data for machine learning
3. Demonstrate linear Regression for a prediction task
4. Apply Multiple Linear Regression and evaluate its performance
5. Build a Binary Classifier using Decision Tree Algorithm
6. Use the Tensor Flow library to build and train neural nets
7. Apply k-means algorithm for clustering task
8. Perform feature selection using Backward Elimination Algorithm
9. Demonstrate Dimensionality Reduction using PCA Algorithm
10. Apply Factor Analysis technique for feature extraction

P: 30 TOTAL: 30 PERIODS

REFERENCES

1. EthemAlpaydin, “Introduction to Machine Learning”, MIT Press, 2014.
2. Christopher M. Bisho, “Pattern Recognition and Machine Learning”, Springer (India) Private Limited, 2013.

19EC20L	WEB OF THINGS LABORATORY	L	T	P	C
		0	0	2	1

COURSE OUTCOME

Upon completion of this course, the student will be able to

CO1: Develop web server application using single board computer for real time IoT implementation. (K3)

List of Experiments

1. Installation Node.JS in single board computer.
2. Study of Node Package Manager
3. Creating web page with CSS and Java script.
4. Creating web forms and request through post & get method.
5. Creating modules using Node.js
6. Creating, reading and writing JSON file using Node.js
7. Development of dashboard
8. Study of RESTFul API

P: 30 TOTAL: 30 PERIODS

19EC21L	IOT DATABASE MANAGEMENT SYSTEMS LABORATORY	L	T	P	C
		0	0	2	1

COURSE OUTCOME

Upon completion of this course, the student will be able to

CO1: Design database and access it remotely using single board computer for real time IoT implementation. (K3)

LIST OF EXPERIMENTS

1. Installation of MySQL in single board computer.
2. Creation of database schema using DDL.
3. Perform various data manipulation commands, aggregate functions and sorting concept on all created tables.
4. Solving queries using the concept of sub query.
5. Joining data from multiple tables.

6. Implementation of procedures, functions and views
7. Deployment of Asset Management System using single board computer.
8. Study of cloud database with timeseries using NoSQL.

P: 30 TOTAL: 30 PERIODS

		L	T	P	C
19EC22L	**INTERNET OF THINGS LABORATORY**	**0**	**0**	**2**	**1**

COURSE OUTCOME

Upon completion of this course, the student will be able to

CO1: Design and develop IoT applications using wireless standards. (K4)

List of Experiments

1. Interconnection of sensors, actuators and display units with embedded processor
2. Integration of Bluetooth with embedded processor
3. Integration of Wi-Fi with embedded processor
4. Integration of LORA with embedded processor
5. Implementation of MQTT protocol with publish and subscribe using Mosquito Broker.
6. Design MQTT dashboard and DB storage
7. Cloud based temperature monitoring system using Wi-Fi & MQTT
8. Implementation of live GPS tracking and cloud storage using LORA

P: 30 TOTAL: 30 PERIODS

B. E. – ELECTRONICS AND COMMUNICATION ENGINEERING

OPEN ELECTIVE COURSES

19EC01N	BASICS OF COMMUNICATION SYSTEMS	L	T	P	C	QP
		3	0	0	3	A

PRE-REQUISITE: Basic Knowledge on Signals and Systems

COURSE OUTCOMES

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

CO1: Describe various analog modulation schemes (K2)
CO2: Describe Digital Communication methods for high bit rate transmission (K2)
CO3: Understand the concepts of source and line coding techniques for enhancing rating of transmission of minimizing the errors in transmission. (K2)
CO4: Understand the MAC used in communication systems for enhancing the number of users. (K2)
CO5: Describe the various media for digital communication (K2)

UNIT I ANALOG COMMUNICATION (Qualitative only) 9

AM – Frequency spectrum – vector representation – power relations – generation of AM – DSB, DSB/SC, SSB, VSB AM Transmitter & Receiver; FM and PM – frequency spectrum – power relations : NBFM & WBFM, Generation of FM and DM, Amstrong method & Reactance modulations : FM & PM frequency

UNIT II DIGITAL COMMUNICATION (Qualitative only) 9

Pulse modulations – concepts of sampling and sampling theormes, PAM, PWM, PPM, PTM, quantization and coding: DCM, DM, slope overload error. ADM, DPCM, OOK systems – ASK, FSK, PSK, BSK, QPSK, QAM, MSK, GMSK, applications of Data communication.

UNIT III SOURCE CODES, LINE CODES & ERROR CONTROL (Qualitative only) 9

Primary communication – entropy, properties, BSC, BEC, source coding: Shaum, Fao, Huffman coding : noiseless coding theorum, BW – SNR trade off codes: NRZ, RZ, AMI, HDBP, ABQ, MBnBcodes : Efficiency of transmissions, error control codes and applications: convolutions & block codes.

UNIT IV MULTIPLE ACCESS TECHNIQUES 9

SS&MA techniques: FDMA, TDMA, CDMA, SDMA application in wire and wireless communication: Advantages of Multiple Access Techniques

UNIT V SATELLITE, OPTICAL FIBER – POWERLINE, SCADA 9

Orbits: Types of satellites: frequency used link establishment, MA techniques used in satellite communication, earth station; aperture actuators used in satellite – Intelsat and Insat: fibers – types: sources, detectors used, digital filters, optical link: power line carrier communications: SCADA

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. H Taub, D L Schilling, G Saha, “Principles of Communication Systems” 4th Edition, McGraw Hill Education, 2013.
2. S. Haykin “Digital Communications” 1st Edition, John Wiley, 2013.

REFERENCES

1. B.P.Lathi, “Modern Digital and Analog Communication Systems”, 3rd Edition, Oxford University Press, 2007
2. H P Hsu, Schaum Outline Series – “Analog and Digital Communications” TMH 2006
3. B.Sklar, Digital Communications Fundamentals and Applications”, 2nd Edition, Pearson Education, 2007.

19EC02N	OVERVIEW OF COMMUNICATION SYSTEMS	L	T	P	C	QP
		3	0	0	3	A

PRE-REQUISITE: Basic Knowledge on Signals and Systems

COURSE OUTCOMES

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

CO1: Describe various analog modulation schemes (K2)
CO2: Describe various Pulse modulation and Digital Modulation schemes (K2)
CO3: Explain the basics of Microwave and satellite communication (K2)
CO4: Illustrate the need for optical communication and classify different optical fiber cables (K2)
CO5: Describe the basic concept of mobile communication (K2)

UNIT I ANALOG MODULATION SYSTEMS 9

Need for modulation - Amplitude modulation – Frequency spectrum of AM wave – Representation of AM – Power relation –Frequency modulation – Frequency spectrum of FM wave – AM transmitter – FM transmitter – Super heterodyne AM receiver –FM receivers.

UNIT II PULSE AND DIGITAL MODULATION SYSTEMS 9

Principles of pulse modulation – sampling theorem, PAM – PWM – PPM–Generation of PAM, PPM and PWM waves – Demodulation of PAM, PWM, PPM – An introduction to digital modulation systems – PCM, ASK, FSK and PSK

UNIT III MICROWAVE AND SATELLITE COMMUNICATION SYSTEMS 9

Microwave communication systems: advantage, block diagram of a microwave radio system, microwave radio stations- Terminal station and repeater station. Satellite Communication system: Satellite Orbits, launch vehicles, look angles, satellite parameters, satellite link model, personal communication systems- GPS services.

UNIT IV FIBER OPTICAL COMMUNICATION SYSTEMS 9

Need for fiber optics, introduction to optical fiber, principle of light transmission through a fiber, fiber characteristics and classification, various fiber losses- Light sources and photo detectors, Block diagram of a fiber optic system- Power budget analysis for a optical link- Recent applications of fiber optics.

UNIT V CELLULAR MOBILE COMMUNICATION 9

Cellular concept, basic cellular concept and its operation, uniqueness of mobile radio environment- Performance metrics in cellular system-Elements of cellular mobile radio- Handoff- Frequency management and channel assignment- Introduction to various cellular standards like AMPS, GSM, GPRS, IS-95A, IS-95B, CDMA-2000 and WCDMA.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Kennedy Davis, “Electronic Communication Systems”, Tata McGraw Hill Publishing Company Limited, New Delhi, 4th Edition, 2008.
2. Wayne Tomasi, “Electronic Communication Systems”, Pearson education Private Limited, Delhi, 5th Edition, 2008.

REFERENCES

1. Roddy D and Coolen J, “Electronic Communications”, Prentice Hall of India Private Limited, Fourth Edition, 2008.
2. William C.Y.Lee, “Mobile Cellular Telecommunication Systems”, McGraw Hill International Edition, Second Edition, 2006.
3. Gerd Keiser, “Optical fiber Communications”, McGraw Hill International Edition, Fourth Edition, 2006.

19EC03N	CMOS TECHNOLOGY AND CHIP TESTING	L	T	P	C	QP
		3	0	0	3	A

COURSE OUTCOMES

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

CO1: Explain MOS transistor theory and CMOS process technology. (K2)
CO2: Explain the different types of CMOS families (K2)
CO3: Describe the various IC Testing Techniques.(K2)
CO4: Design and analyze the various features of CAD tools used for IC testing. (K3)
CO5: Analyze the concept of DFT. (K3)

UNIT I IC MANUFACTURING PROCESS AND CMOS TECHNOLOGY 9

Introduction to IC manufacturing process – wafer formation, epitaxial growth, oxidation, photolithography, Ion implantation, Isolation techniques - MOS Transistor Theory – Ideal I-V Characteristics of MOS Transistor.DC Transfer Characteristics of CMOS Inverter, n well, p well, twin tub and SOI CMOS processes- Lambda based design Rules. Manufacturing Issues.

UNIT II CMOS FAMILIES AND CIRCUIT CHARACTERIZATION 9

CMOS circuit Families- Static CMOS, Ratioed circuits ,Pseudo NMOS , Dynamic CMOS and Pass Transistor Logic. Comparision of CMOS families. Delay Estimation and Logic Effort of CMOS circuits. Static and Dynamic Power dissipation of CMOS. Interconnect Impact .

UNIT III INTRODUCTION TO SEMICONDUCTOR IC TESTING 9

Design and manufacturing cycle of an IC –Logic Verification – Manufacturing defects in an IC – Manufacturing test – Need for CHIP testing – Types of CHIP testing – Engineering testing, production testing, QA testing, Customer inspection testing. – Automated Test Equipment– ATE subsystems – Common accessories of an ATE-Architecture of a mixed signal ATE-.DC parametric Tests of IC- AC Parametric Test.

UNIT IV TEST DATA ANALYSIS USING CAD TOOLS AND ESD PROTECTION 9

Introduction to data analysis– Data visualization tools – Data logs – Lot summaries – Wafer map – shmoo plots – Histograms – Statistical process control – Standard deviation – Mean – Process capability Index – Six sigma quality – Reproducibility – Introduction to ESD – Sources of ESD – ESD models

UNIT V FAULT MODELS AND PRINCIPLES OF DESIGN FOR TESTABILITY 9

Fault models – Simple examples with stuck at and bridging faults – Controllability and observability – Principles of DFT – Scan based Techniques – Boundary scan test – Built in self test – Memory BIST.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Mark burns & Gordon W Roberts, "An Introduction to mixed signal IC testing and measurement", Oxford University Press, 1st Edition, 2000.
2. Weste and Harris, "CMOS VLSI DESIGN: A Circuit and Systems Perspective", 4th Edition, Pearson Education, 2009.

REFERENCES

1. Michael L. Bushnell & Vishwani D. Agrawal, "Essentials of electronic testing" Kluwer academic publishers, 2000.
2. A Text book on semiconductor IC testing using Automatic Test Equipment, Tessolve Services Private circulation manual.
3. William J.Greig, "Integrated Circuit Packaging, Assembly and Interconnections", Springer, 2007.
4. Artur Balasinki, "Semiconductors: Integrated Circuit Design foe Manufacturability", CRC Press, 1st Edition, 2011.

19EC04N	AUTOMOTIVE ELECTRONICS	L	T	P	C	QP
		3	0	0	3	A

COURSE OUTCOMES

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

CO1: Know the importance of emission standards in automobiles.(K2)

CO2:Understand the electronic fuel injection/ignition components and their function. (K2)

CO3: Choose and use sensors and equipment for measuring mechanical quantities, temperature and appropriate actuators.(K2)

CO4 : Diagnose electronic engine control systems problems with appropriate diagnostic tools.(K2)

CO5: Analyses the chassis and vehicle safety system.(K2)

UNIT I INTRODUCTION 8

Evolution of electronics in automobiles – emission laws – introduction to Euro I, Euro II, Euro III, Euro IV, Euro V standards – Equivalent Bharat Standards.Automotive standards for EMI/EMC – CISPR12, CISPR25. Charging systems: Working and design of charging circuit diagram – Alternators – Requirements of starting system - Starter motors and starter circuits.

UNIT II IGNITION AND INJECTION. SYSTEMS 10

Ignition systems: Ignition fundamentals - Electronic ignition systems - Programmed Ignition – Distribution less ignition - Direct ignition – Spark Plugs. Electronic fuel Control: Basics of combustion – Engine fuelling and exhaust emissions – Electronic control of carburetion – Petrol fuel injection – Diesel fuel injection.

UNIT III SENSOR AND ACTUATORS 7

Working principle and characteristics of Airflow rate, Engine crankshaft angular position, Hall effect, Throttle angle, temperature, exhaust gas oxygen sensors – study of fuel injector, exhaust gas recirculation actuators, stepper motor actuator, vacuum operated actuator.

UNIT IV ENGINE CONTROL SYSTEMS 10

Control modes for fuel control-engine control subsystems – ignition control methodologies – different ECU's used in the engine management – block diagram of the engine management system. In vehicle networks: CAN standard, format of CAN standard – diagnostics systems in modern automobiles.

UNIT V CHASSIS AND SAFETY SYSTEMS 10

Traction control system – Cruise control system – electronic control of automatic transmission – antilock braking system – electronic suspension system – working of airbag and role of MEMS in airbag systems – centralized door locking system – climate control of cars.

L: 45; TOTAL: 45 PERIODS

The students will be able to use advanced sensors and actuators in the upgradation of automobiles.

TEXT BOOKS

1. William Ribbens, "Understanding Automotive Electronics An Engineering perspective", 8th Edition, Elsevier, Indian Reprint, 2017
2. Tom Denton, "Automobile Electrical and Electronics Systems", 5th Edition, Edward Arnold Publishers, 2017.

REFERENCES

1. Barry Hollembeak, "Automotive Electricity, Electronics & Computer Controls", 6th Edition, Cengage Learning, 2015.
2. Richard K. Dupuy, "Fuel System and Emission controls Classroom Manual", Check Chart Publication, 2000.
3. Ronald. K. Jurgon, "Automotive Electronics Handbook", McGraw-Hill, 1999.

		L	T	P	C	QP
19EC05N	**ELECTRONICS AND MICROPROCESSORS**	**3**	**0**	**0**	**3**	**A**

COURSE OUTCOMES

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

CO1: Describe the behavior of semiconductor devices and various rectifier circuits and voltage regulators. (K2)

CO2 :Explain the different biasing techniques to operate the transistor and FET. (K2)

CO3 :Analyze the structure of various number systems and the combinational building blocks. (K3)

CO4: Describe the architecture and different modes of operations of a typical Microprocessor (K2)

CO5 :Explain the interfacing concepts and programming of microprocessor. (K3)

UNIT I SEMICONDUCTORS AND RECTIFIERS 9

Classification of solids based on energy band theory-Intrinsic semiconductors-Extrinsic semiconductors-P type and N type-PN junction-Zenor effect-Zenor diode characteristics-Half wave and full wave rectifiers -Voltage regulation

UNIT II TRANSISTORS AND AMPLIFIERS 9

Bipolar junction transistor- CB, CE, CC configuration and characteristics-Biasing circuits-Class A, B and C amplifiers- Field effect transistor-Configuration and characteristic of FET amplifier-SCR, Diac, Triac, UJT-Characteristics and simple applications-Switching transistors-Concept of feedback-Negative feedback-Application in temperature and motor speed control.

UNIT III DIGITAL ELECTRONICS 9

Binary number system - AND, OR, NOT, NAND, NOR circuits-Boolean algebra-Exclusive OR gate - Flip flops-Half and full adders-Registers-Counters-A/D and D/A conversion.

UNIT IV 8085 MICROPROCESSOR 9

Block diagram of microcomputer-Architecture of 8085-Pin configuration-Instruction set-Addressing modes-Simple programs using arithmetic and logical operations.

UNIT V INTERFACING AND APPLICATIONS OF MICROPROCESSOR 9

Basic interfacing concepts - Interfacing of Input and Output devices-Applications of microprocessor: Temperature control, Stepper motor control, traffic light control.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Milman and Halkias, “Integrated Electronics”, Tata McGraw-Hill publishers, 2nd Edition (New), 2011.
2. Ramesh Goankar, “Microprocessor Architecture”, Programming and Applications with 8085, Wiley Eastern, 6th Edition, 2013.

REFERENCES

1. Malvino and Leach, “Digital Principles and Applications”, Tata McGraw-Hill, 8th Edition, 2015
2. Dougles V.Hall, “Microprocessor and Interfacing”, Programming and Hardware, Tata McGraw-Hill, 3rd Edition, 2012

19EC06N	**ARM PROCESSOR ANDPROGRAMMING**	**L**	**T**	**P**	**C**	**QP**
		3	**0**	**0**	**3**	**A**

COURSE OUTCOMES

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

CO 1 : Describe the different ARM processor families.(K2)
CO 2 : Explain LPC2148 Microcontroller details. (K2)
CO 3 : Explain LPC2148 system control details (K2)
CO 4 : Write simple Embedded C programs using GPIO. (K3)
CO 5 : Write Embedded C code for Timer, ADC, DAC and UART. (K3)

UNITI INTRODUCTION TO ARM PROCESSOR 9

Introduction to embedded system and ARM Processor, ARM related Companies and its opportunities, ARM processor family, Application of ARM Processor, Compiler, Emulation and Debugging, Difference between RISC & CISC.

UNITII LPC2148 ARCHITECTURE 9

LPC2148 ARM 7 microcontroller, Features of LPC2148, Block diagram of LPC2148, Pin diagram of LPC2148, Architectural overview, On-chip flash program memory, On-chip static RAM.

UNITIII SYSTEM CONTROL 9

Crystal Oscillator, PLL, Reset and Wake-up Timer, Brownout detector, Code Security, External Interrupt input, Memory Mapping Control, Power Control.

UNITIV GENERAL PURPOSE INTERFACING 9

Pin Connect Block, General Purpose Parallel I/O: Features, 8 Bit LED's and Switches, Relay and Buzzer, Seven Segment LEDs, Keypad, LCD – Interfacing

UNITV SPECIAL PURPOSE INTERFACING 9

General purpose timer / External event counters: Features, Interfacing Timer and CounterOperation, 10-bit ADC: Features, Interfacing Temperature Sensor LM35, 10-bit DAC: Features, Interfacing DAC, UARTs: Features, Serial Communication, Interrupt Controller, Interrupt Sources, External Interrupt.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Steve Furber, "ARM System-on-chip architecture", Pearson Education, 2nd Edition, 2005
2. ARM System-on-Chip Architecture, Second Edition, bySteve Furber, PEARSON, 2013

REFERENCES

1. Andrew N. Sloss, Dominic Symes, Chris Wright, "ARM System Developer's Guide
2. Designing and Optimizing System Software", Morgan Kaufmann, 2004.
3. www.arm.com
4. ARM System Developers Guide, Designing andOptimizing System Software, by Andrew N. SLOSS,Dominic SYMES and Chris WRIGHT, ELSEVIER, 3004
5. Operating Systems, 5th Edition, By William Stallings

19EC07N	FUNDAMENTALS OF DIGITAL SIGNAL PROCESSING	L	T	P	C	QP
		3	0	0	3	A

COURSE OUTCOMES

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

CO1 : Classify and analyze the types of signals, their responses and properties. (K2)
CO2 : Perform frequency transformation for the signals. (K2)
CO3 : Design analog and digital IIR filters and realize them. (K3)
CO4 : Design digital FIR filters and realize them. (K3)
CO5 : Explain the concepts of Multi rate signal processing. (K2)

UNIT I SIGNALS AND SYSTEMS 9

Introduction to Continuous-Time and Discrete-time signals Elementary signals: Step, ramp, impulse, pulse and step, Basic operations on signals – scaling, shifting, System classification – Linearity, causality, Time-invariance, dynamic system

UNIT II FREQUENCY TRANSFORMATIONS 9

Introduction to DFT – Properties of DFT – Circular Convolution – Filtering methods based on DFT – FFT Algorithms – Decimation – in – time Algorithms, Decimation – in – frequency Algorithms – Use of FFT in Linear Filtering.

UNIT III IIR FILTER DESIGN 9

Review of design of analog Butterworth Filters, Frequency transformation in analog domain - Design of IIR digital filters using impulse invariance technique - Design of digital filters using bilinear transform – pre warping.

UNIT IV FIR FILTER DESIGN 9

Structures of FIR – Linear phase FIR filter – Fourier Series – Filter design using windowing techniques (Rectangular Window, Hamming Window, Hanning Window), Frequency sampling techniques

UNIT V MULTIRATE SIGNAL PROCESSING 9

Introduction to Multirate signal processing – Decimation-Interpolation Polyphase implementation of FIR filters for interpolator and decimator - Multistage implementation of sampling rate conversion- Applications: Sub band coding, Quadrature Mirror filter.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. John G Proakis and Manolakis, “Digital Signal Processing Principles, Algorithms and Applications”, Pearson Education, 4th Edition, 2014.
2. Alan. V. Oppenheim, R. Schafer, “Digital Signal Processing”, Pearson Education, 1st Edition, 2015.

REFERENCES

1. E.C. Ifeachor and B.W. Jervis, “Digital signal processing - A practical approach”,

Pearson, 2nd Edition, 2002.
2. S.K. Mitra, "Digital Signal Processing- A Computer Based approach", Tata McGraw-Hill, 4th Edition, 2013.
3. S.Salivahanan, "Digital Signal Processing", Tata McGraw Hill, 4th Edition, 2019.
4. Johny R. Johnson, "Introduction to Digital Signal Processing", PHI, 2006.
5. Lonnie C.Ludeman, "Fundamentals of Digital Signal Processing", Wiley, 1st Edition, 2009.

19EC08N	EMBEDDED AND REALTIME SYSTEMS	L	T	P	C	QP
		3	0	0	3	A

COURSE OUTCOMES

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

CO1 : Understand the fundamental concepts of embedded system. (K2)
CO2 : Explain the Interfacing schemes K2)
CO3 : Describe realtime system and its characteristics.(K2)
CO4 : Understand the basic properties of arealtime operating system. (K2)
CO5 : interpret the services of UCOS III operating system (K2)

UNIT I INTRODUCTIONTO EMBEDDED SYSTEM 9

Definition: Embedded system, Intelligent system, Expert System–Embedded system-classification –Embedded system design process–ARM Processor–CPU: Programming input and output–Supervisor mode, exception and traps-concept of interrupts in ARM processor family-.Embedded System design Example.

UNIT II PERIPHERAL INTERFACING 9

I/O devices – Component interfacing – Memory mapped I/O – I/O mapped I/O – Development and Debugging – Program design–Model of programs–Basic compilation techniques – Assembly and Linking,--simple program for I/O devices.

UNIT III REALTIME SYSTEM 9

Definition: Real-time and real time systems–real time system Model-real time system characteristics–High reliability achievement ways in real time system-Hardware considerations for real time system–Examples for real time system.

UNIT IV PROCESS AND OPERATING SYSTEMS 9

Definition: Multi-tasking and multi-processing –Context Switching–Operating Systems Scheduling policies: Rate monotonic, EDF, Comparison example –Inter Process Communication mechanisms – Message Mailboxes – Message Queues – Evaluating operating system performance.

UNIT V TASK MANAGEMENT AND MEMORY MANAGEMENT OF UCOS III 9

Introduction to UCOS III Features, Services and variants. Task Management: Task creation, task stacks, stack checking, task priority, task suspending, task deletion program

example for Multitasking. Memory management: Creating partition in memory, memory control block, obtaining and returning memory control block functions program example for memory management implementation-Synchronization techniques

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Wayne Wolf, “Computers as Components Principles of Embedded Computer System Design”, Morgan Kaufmann, 2nd Edition, 2008.
2. Philip A.Laplante, “Real time systems design and analysis”, Wiley India Edition, 3rd Edition, 2006.

REFERENCES

1. Jean J.Labrosse, “Micro C/OS-III: The Real Time Kernal”, CMP Books, 2010.
2. David E-Simon, “An Embedded Software Primer”, Pearson Education, 2007.
3. K.V.K.K.Prasad, “Embedded Real-Time Systems: Concepts, Design&Programming”, Dream tech Press, 2005.
4. Tammy Noergaard, “Embedded Systems Architecture”, Elsevier, 2006.