HINDUSTHAN EDUCATIONAL AND CHARITABLE TRUST

HICET

HINDUSTHAN

COLLEGE OF ENGINEERING AND TECHNOLOGY

(An Autonomous Institution)
Coimbatore – 641032

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
Curriculum and ODD Semesters Syllabus for the Batch
2024 – 2028 (R2022)
2023 – 2027 (R2022)
2022 – 2026 (R2022)
2021 – 2025 (R2019 with Amendments)

(Board of Studies held on 15.06.2024)
(Academic Council Meeting held on 21.06.2024)

HINDUSTHAN COLLEGE OF ENGINEERING AND TECHNOLOGY
(An Autonomous Institution, Affiliated to Anna University, Chennai
Approved by AICTE, New Delhi& Accredited by NAAC with 'A ++' Grade)
Valley Campus, Pollachi Highway, Coimbatore, Tamil Nadu

HINDUSTHAN
EDUCATIONAL AND CHARITABLE TRUST

HICET

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

R-2022 Curriculum and Syllabus for ODD Semester

2024-2028 Batch

Academic Year 2024-2025

Institution Vision and Mission

Vision

To become a premier institution by producing professionals with strong technical knowledge, innovative research skills and high ethical values.

Mission

M1: To provide academic excellence in technical education through novel teaching methods.

M2: To empower students with creative skills and leadership qualities.

M3: To produce dedicated professionals with social responsibility.

VISION OF THE DEPARTMENT

DV: To achieve excellence in Electronics and Communication Engineering keeping in pace with evolving technologies through quality education instilling employability skills and ethical values in graduates for the betterment of society.

MISSION OF THE DEPARTMENT

DM1: To expand frontiers of knowledge through provision of inspiring learning environment

DM2: To develop intellectual skills towards employability by fostering innovation, and creativity in learning.

DM3: To inculcate professional ethics, values and entrepreneurial attitude addressing industrial and societal demands.

PROGRAMME OUTCOMES

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 considerations for the public health and safety, and the cultural, societal and environmental consideration.

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 modelling 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 environment.

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.

PROGRAMME SPECIFIC OUTCOMES

PSO1: Graduates will be able to analyze, design and develop solutions for real-time challenges, facilitating the creation of quality products in the Electronics and Communication industry.

PSO2: Graduates will exhibit resilience in embracing emerging technologies, nurturing innovation in Signal Processing, Communication Systems, Embedded Systems, IoT, Networking, and VLSI to address contemporary demands.

PROGRAMME EDUCATIONAL OBJECTIVES

PEO1: To prepare the graduates to solve, analyze and develop real time engineering products by providing strong foundation in the fundamentals of Electronics and Communication Engineering.

PEO2: To prepare the graduates to succeed in multidisciplinary dimensions by providing adequate trainings and exposure to emerging technologies.

PEO3: To prepare the graduates to become a successful leader and innovator following ethics with the sense of social responsibility for providing engineering solutions.

CURRICULUM
R2022

Curriculum under R2022

(for the batch admitted during 2024 – 2025)

SEMESTER I

S. NO	COURSE CODE	COURSE TITLE	COURSE CATEGORY	L	T	P	C	TCP	CIA	ESE	TOTAL
THEORY											
1	22MA1101	MATRICES AND CALCULUS	BSC	3	1	0	4	4	40	60	100
THEORY WITH LAB COMPONENT											
2	22CY1153	CHEMISTRY FOR ELECTRICAL SCIENCES	BSC	2	0	2	3	4	50	50	100
3	22HE1151	ENGLISH FOR ENGINEERS	HSC	2	0	2	3	4	50	50	100
4	22EC1152	FUNDAMENTALS OF ELECTRONICS AND COMMUNICATION ENGINEERING (New Course)	BSC	2	0	2	3	4	50	50	100
5	22IT1151 R	PYTHON PROGRAMMING AND PRACTICES	ESC	2	0	2	3	4	50	50	100
EEC COURSES (SE/AE)											
6	22HE1072	ENTREPRENEURSHIP & INNOVATION (Common to all branches)	AEC	1	0	0	1	1	100	0	100
7	22HE1073	INTRODUCTION TO SOFT SKILLS (Common to all branches)	SEC	2	0	0	0	1	100	0	100
MANDATORY COURSE											
8	22MC1093/ 22MC1094	தமிழர்மரபு / HERITAGE OF TAMIL	MC	2	0	0	1	2	40	60	100
9	22MC1095	UNIVERSAL HUMAN VALUES (Common to all branches)	MC	2	0	0	0	2	100	0	100
		TOTAL CREDITS		**18**	**1**	**8**	**18**	**26**	**580**	**320**	**900**

SEMESTER II

S. NO	COURSE CODE	COURSE TITLE	COURSE CATEGORY	L	T	P	C	TCP	CIA	ESE	TOTAL
THEORY											
1	22MA2102	DIFFERENTIAL EQUATIONS AND LAPLACE TRANSFORM	BSC	3	1	0	4	4	40	60	100
2	22CY2101	ENVIRONMENTAL STUDIES	ESC	2	0	0	2	3	40	60	100
THEORY WITH LAB COMPONENT											
4	22PH2151	PHYSICS FOR ENGINEERS	BSC	2	0	2	3	4	50	50	100
5	22HE2151	EFFECTIVE TECHNICAL COMMUNICATION	HSC	2	0	2	3	4	50	50	100
6	22EC2251	PROGRAMMING USING C++	PCC	2	0	2	3	4	50	50	100
7	22EC2252	ELECTRON DEVICES AND CIRCUITS (New Course)	ESC	2	0	2	3	4	50	50	100

PRACTICAL											
8	22ME2001	ENGINEERING PRACTICES	ESC	0	0	4	2	2	60	40	100
EEC COURSES (SE/AE)											
8	22HE2071	DESIGN THINKING	AEC	2	0	0	2	2	100	0	100
9	22HE2072	SOFT SKILLS AND APTITUDE (Common to all branches)	SEC	1	0	0	1	1	100	0	100
MANDATORY COURSES											
10	22MC2094/ 22MC2095	தமிழரும் தொழில்நுட்பமும் / TAMILS AND TECHNOLOGY	MC	2	0	0	1	2	100	0	100
11	22MC2093	NCC */NSS / YRC / SPORTS / CLUBS / SOCIETY SERVICE - ENROLLMENT (COMMON)	MC	All students shall enroll, on admission, in anyone of the personality and character development programmes and undergo training for about 80 hours							
			TOTAL CREDITS	**18**	**1**	**12**	**24**	**30**	**640**	**360**	**1000**

SEMESTER III

S.NO	COURSECODE	COURSETITLE	COURSE CATEGORY	L	T	P	C	TCP	CIA	ESE	TOTAL
THEORY											
1	22MA3102	COMPLEX ANALYSIS AND TRANSFORMS (common to ECE, EEE, EIE)	BSC	3	1	0	4	4	40	60	100
2	22EC3201	ELECTRONIC CIRCUITS	PCC	3	1	0	4	4	40	60	100
3	22EC3202	SIGNALS AND SYSTEMS	PCC	3	1	0	4	4	40	60	100
4	22EC3203	DIGITAL ELECTRONICS	PCC	3	1	0	3	4	40	60	100
THEORY WITH LAB COMPONENT											
5	22EC3251	OOPS USING JAVA	ESC	2	0	2	3	3	50	50	100
PRACTICAL											
6	22EC3001	ELECTRONIC CIRCUITS LABORATORY	PCC	0	0	3	1.5	3	60	40	100
7	22EC3002	DIGITAL ELECTRONICS LABORATORY	PCC	0	0	3	1.5	3	60	40	100
EEC COURSES (SE/AE)											
9	22HE3071	SOFT SKILLS -2	SEC	1	0	0	1	1	100	0	100
10	22EC3901	MINI PROJECT 1	AEC	0	0	0	2	1	100	0	100
			TOTAL CREDITS	**17**	**1**	**8**	**24**	**27**	**610**	**390**	**1000**

SEMESTER IV												
S.NO	COURSE CODE	COURSE TITLE	COURSE CATEGORY	L	T	P	C	TCP	CIA	ESE	TOTAL
THEORY											
1	22HE4101	IPR AND START-UPS (Common)	HSC	2	0	0	2	2	40	60	100
2	22EC4201	ELECTRO MAGNETIC FIELDS	PCC	3	1	0	4	4	40	60	100
3	22EC4202	ANALOG COMMUNICATION	PCC	3	0	0	3	3	40	60	100
4	22EC4203	LINEAR INTEGRATED CIRCUITS	PCC	3	0	0	3	3	40	60	100
5	22EC4205	CONTROL SYSTEMS	PCC	3	1	0	4	4	50	50	100
THEORY WITH LAB COMPONENT											
6	22EC4253	DATA COMMUNICATION AND NETWORKS	PCC	2	0	2	3	4	50	50	100
PRACTICAL											
7	22EC4001	LINEAR INTEGRATED CIRCUITS LAB	PCC	0	0	3	1.5	4	60	40	100
8	22EC4002	ANALOG COMMUNICATION LAB	PCC	0	0	3	1.5	4	60	40	100
EEC COURSES (SE/AE)											
9	22HE4071	SOFT SKILLS -3	SEC	1	0	0	1	1	100	0	100
			TOTAL CREDITS	19	0	10	23	31	400	500	900

SEMESTER V											
S.NO	COURSE CODE	COURSE TITLE	COURSE CATEGORY	L	T	P	C	TCP	CIA	ESE	TOTAL
THEORY											
1.	22EC5201	DIGITAL COMMUNICATION	PCC	3	0	0	3	3	40	60	100
2.	22EC5204	TRANSMISSION LINES AND WAVEGUIDES	PCC	3	1	0	4	3	40	60	100
3.	22EC5203	MICROPROCESSORS AND MICROCONTROLLERS	PCC	3	0	0	3	3	40	60	100
4.	22EC53XX	PROFESSIONAL ELECTIVE-1	PEC	3	0	0	3	3	40	60	100
5.	22EC53XX	PROFESSIONAL ELECTIVE-2	PEC	3	0	0	3	3	40	60	100
THEORY WITH LAB COMPONENT											
6.	22EC5252	VLSI DESIGN	PCC	2	0	2	3	4	50	50	100
PRACTICAL											
7	22EC5001	MICROPROCESSORS AND MICROCONTROLLERS LAB	PCC	0	0	3	1.5	3	60	40	100
8	22EC5002	DIGITAL COMMUNICATION LAB	PCC	0	0	3	1.5	3	60	40	100
EEC COURSES (SE/AE)											
9	22HE5071	SOFT SKILLS -4 / FOREIGN LANGUAGES	SEC	1	0	0	1	1	100	0	100
			TOTAL CREDITS	19	1	6	23	25	440	460	900

SEMESTER VI												
S.NO	COURSE CODE	COURSE TITLE	COURSE CATEGORY	L	T	P	C	TCP	CIA	ESE	TOTAL
THEORY											
1	22HS6101	PROFESSIONAL ETHICS (COMMON)	HSC	3	0	0	3	3	40	60	100
2	22EC6201	ANTENNA AND WAVE PROPAGATION	PCC	3	3	0	3	3	40	60	100
3	22EC63XX	PROFESSIONAL ELECTIVE-3	PEC	3	0	0	3	3	40	60	100
4	22EC63XX	PROFESSIONAL ELECTIVE-4	PEC	3	0	0	3	3	40	60	100
5	22EC64XX	OPEN ELECTIVE – 1*	OEC	3	0	0	3	3	40	60	100
6	22EC64XX	OPEN ELECTIVE – 2*	OEC	3	0	0	3	3	40	60	100
THEORY WITH LAB COMPONENT											
7	22EC6253	DIGITAL SIGNAL PROCESSING	PCC	2	0	2	3	4	50	50	100
EEC COURSES (SE/AE)											
8	22EC6901	MINI PROJECT 2	AEC	0	0	0	2	1	100	0	100
			TOTAL CREDITS	19	1	6	23	26	400	400	800

SEMESTER VII											
S.NO	COURSE CODE	COURSE TITLE	COURSE CATEGORY	L	T	P	C	TCP	CIA	ESE	TOTAL
THEORY											
1	22EC7201	WIRELESS COMMUNICATION NETWORKS	PCC	3	0	0	3	3	40	60	100
2	22EC73XX	PROFESSIONAL ELECTIVE-5	PEC	3	0	0	3	3	40	60	100
3	22EC74XX	OPEN ELECTIVE – 3*	OEC	3	0	0	3	3	40	60	100
4	22EC74XX	OPEN ELECTIVE – 4*	OEC	3	0	0	3	3	40	60	100
THEORY WITH LAB COMPONENT											
5	22EC7001	EMBEDDED SYSTEMS AND IOT	PCC	2	0	2	3	4	50	50	100
6	22EC7002	OPTICAL COMMUNICATION AND MICROWAVE ENGINEERING	PCC	2	0	2	3	4	50	50	100
EEC COURSES (SE/AE)											
7	22EC7901	INTERNSHIP	AEC	-	-	-	2	1	100	0	100
			TOTAL CREDITS	19	0	4	20	23	360	340	700

SEMESTER VIII											
S.NO	COURSE CODE	COURSE TITLE	COURSE CATEGORY	L	T	P	C	TCP	CIA	ESE	TOTAL
EEC COURSES (SE/AE)											
1	22EC8901	PROJECT WORK/GRANTED PRODUCT PATENT	AEC	0	0	20	10	20	100	100	200
			TOTAL CREDITS	0	0	20	10	20	100	100	200

SEMESTER WISE CREDIT DISTRIBUTION

B.E. / B.TECH. PROGRAMMES										
S.No.	Course Area	Credits per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	HSC	3	3	-	2	-	3	-	-	**11**
2	BSC	10	7	4	-	-	-	-	-	**20**
3	ESC	3	7	3	-	-	-	-	-	**15**
4	PCC	-	3	14	20	16	6	9	-	**64**
5	PEC	-	-	-	-	6	6	3	-	**18**
6	OEC	-	-	-	-	-	6	6	-	**12**
7	EEC	1	3	3	1	1	2	2	10	**25**
8	MC	1	1							
Total		**18**	**24**	**24**	**23**	**23**	**23**	**20**	**10**	**165**

Credit Distribution R2022

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	18	24	24	23	23	23	20	10	**165**

PROFESSIONAL ELECTIVES

Vertical 1 Electronic System Design	Vertical 2 Communication Systems	Vertical 3 Wireless Networks	Vertical 4 Signal and Image Processing	Vertical 5 Biomedical Technologies	Vertical 6 Diversified Courses
Foundation Skills in Integrated Product Development	Satellite Communication	Network Security	Digital Image Processing	Medical Electronics	App Development
Measurements and Instrumentation	Global Positioning Systems	Wireless Sensors and Networks	Audio Signal Processing	Medical Informatics	Web Technologies
IoT Based System Design	Under Water Communication	High Speed Networks	Machine Vision	Medical Image Processing	Ethical Hacking
PCB Design	RF System Design	Cloud Computing	Artificial Intelligence and Machine Learning	Biometric Systems	Cryptocurrency and Blockchain Technologies
ASIC Design	Software Defined Radio	Wireless Broad Band Networks	Neural Networks and Deep Learning	Medical Robotics	3D Printing and Design
Introduction to PLC Programming	Radar Technologies	Cyber Forensics	Virtual Reality and Augmented Reality	Human Computer Interface	4G/5G Communication Networks

PROFESSIONAL ELECTIVE COURSES: VERTICALS

Vertical 1
Electronic System Design

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1.	22EC5301	Foundation Skills in Integrated Product Development	PEC1	3	0	0	3	3
2.	22EC5302	Measurements and Instrumentation	PEC2	3	0	0	3	3
3.	22EC5303	IoT Based System Design	PEC3	3	0	0	3	3
4.	22EC6301	PCB Design	PEC4	3	0	0	3	3
5.	22EC6302	ASIC Design	PEC5	3	0	0	3	3
6.	22EC7301	Introduction to PLC Programming	PEC6	3	0	0	3	3

Vertical 2
Communication Systems

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1.	22EC5304	Satellite Communication	PEC1	3	0	0	3	3
2.	22EC5305	Global Positioning	PEC2	3	0	0	3	3

		Systems						
3.	22EC5306	Under Water Communication	PEC3	3	0	0	3	3
4.	22EC6303	RF System Design	PEC4	3	0	0	3	3
5.	22EC6304	Software Defined Radio	PEC5	3	0	0	3	3
6.	22EC7302	Radar Technologies	PEC6	3	0	0	3	3

Vertical 3

Wireless Networks

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1.	22EC5307	Network Security	PEC1	3	0	0	3	3
2.	22EC5308	Wireless Sensors and Networks	PEC2	3	0	0	3	3
3.	22EC5309	High Speed Networks	PEC3	3	0	0	3	3
4.	22EC6305	Cloud Computing	PEC4	3	0	0	3	3
5.	22EC6306	Wireless Broad Band Networks	PEC5	3	0	0	3	3
6.	22EC7303	Cyber Forensics	PEC6	3	0	0	3	3

Vertical 4

Signal and Image Processing

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1.	22EC5310	Digital Image Processing	PEC1	3	0	0	3	3
2.	22EC5311	Audio Signal Processing	PEC2	3	0	0	3	3
3.	22EC5312	Machine Vision	PEC3	3	0	0	3	3
4.	22EC6307	Artificial Intelligence and Machine Learning	PEC4	3	0	0	3	3
5.	22EC6308	Neural Networks and Deep Learning	PEC5	3	0	0	3	3
6.	22EC7304	Virtual Reality and Augmented Reality	PEC6	3	0	0	3	3

Vertical 5

Biomedical Technologies

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1.	22EC5311	Medical Electronics	PEC1	3	0	0	3	3

2.	22EC5312	Medical Informatics	PEC2	3	0	0	3	3
3.	22EC5313	Medical Image Processing	PEC3	3	0	0	3	3
4.	22EC6309	Biometric Systems	PEC4	3	0	0	3	3
5.	22EC6310	Medical robotics	PEC5	3	0	0	3	3
6.	22EC7305	Human Computer Interface	PEC6	3	0	0	3	3

Vertical 6

Diversified courses

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1.	22EC5314	App Development	PEC1	3	0	0	3	3
2.	22EC5315	Web Technologies	PEC2	3	0	0	3	3
3.	22EC5316	Ethical Hacking	PEC3	3	0	0	3	3
4.	22EC6311	Cryptocurrency and Blockchain Technologies	PEC4	3	0	0	3	3
5.	22EC6312	3D Printing and Design	PEC5	3	0	0	3	3
6.	22EC7306	4G/5G Communication Networks	PEC6	3	0	0	3	3

OPENELECTIVE I AND II (EMERGINGTECHNOLOGIES)

To be offered for the students other than CSE, IT, AI&ML, ECE & BIOMEDICAL

S NO.	COURSE CODE	COURSETITLE	CATEGORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AI6401	Artificial intelligence and Machine Learning Fundamentals	OEC	2	0	2	4	3
2	22CS6401	Blockchain Technology	OEC	2	0	2	4	3
3	22EC6401	Cyber Security	OEC	2	0	2	4	3
4	22EC6402	IoT Concepts and Applications	OEC	2	0	2	4	3
5	22IT6401	Data Science and Analytics	OEC	2	0	2	4	3
6	22BM6401	Augmented and Virtual Reality	OEC	2	0	2	4	3

OPEN ELECTIVE I AND II

To be offered for the students other than AUTO, AERO, AGRI, MECH, MCTS, CIVIL, EEE, CHEMICAL, FOOD TECH, E&I

S NO.	COURSE CODE	COURSETITLE	CATEGORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AE6401	Space Science	OEC	3	0	0	3	3
2	22MT6401	Introduction to Industrial Engineering	OEC	3	0	0	3	3

3	22MT6402	Industrial Safety and Environment	OEC	3	0	0	3	3
4	22CE6401	Climate Change and its Impact	OEC	3	0	0	3	3
5	22CE6402	Environment and Social Impact Assessment	OEC	3	0	0	3	3
6	22ME6401	Renewable Energy System	OEC	3	0	0	3	3
7	22ME6402	Additive Manufacturing systems	OEC	3	0	0	3	3
8	22EI6401	Introduction to Industrial Instrumentation and Control	OEC	3	0	0	3	3
9	22EI6402	Graphical Programming using Virtual Instrumentation	OEC	3	0	0	3	3
10	22AU6401	Recent Trends in Automotive Technology	OEC	3	0	0	3	3
11	22AU6402	Automotive Vehicle Safety	OEC	3	0	0	3	3
12	22EE6401	Digital Marketing	OEC	3	0	0	3	3
13	22EE6402	Research Methodology	OEC	3	0	0	3	3
14	22FT6401	Traditional Foods	OEC	3	0	0	3	3
15	22AG6401	Urban Agriculture and Organic Farming	OEC	3	0	0	3	3
16	22CH6401	Biomass and Bio Refinery	OEC	3	0	0	3	3

Note: Non-Circuit Departments can add one Open Elective course in the above list to offer for the circuit branches

OPEN ELECTIVE III

Students shall choose any one of the open elective courses such that the course content or title not belong to their own programme.

S NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22EC7401	Mobile Devices -Tools and Technology	OEC	3	0	0	3	3

OPEN ELECTIVE IV

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22LS7401	General studies for competitive examinations	OEC	3	0	0	3	3
2	22LS7402	Human Rights, Women Rights and Gender equity	OEC	3	0	0	3	3
3	22LS7403	Indian ethos and Human values	OEC	3	0	0	3	3
4	22LS7404	Financial independence and management	OEC	3	0	0	3	3
5	22LS7405	Yoga for Human Excellence	OEC	3	0	0	3	3
6	22LS7406	Democracy and Good Governance	OEC	3	0	0	3	3
7	22LS7407	NCC Level - II	OEC	3	0	0	3	3

Enrollment for B.E. / B. TECH. (HONOURS) / Minor Degree (optional)

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E. / B. Tech. (Honours) or Minor Degree. For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only. For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes.

Clause 4.10 of Regulation 2022 is applicable for the Enrolment of B.E. / B. TECH. (HONOURS) / Minor Degree (Optional).

HONOUR DEGREE VERTICAL COURSES

S. No.	Vertical-I Sensor Technologies and IoT	Vertical II Advanced Communication Systems	Vertical III Semiconductor Chip Design and Testing
1	Realtime Embedded Systems	Cognitive Radio Networks	Wide Bandgap Devices
2	Sensor for IoT applications	Remote Sensing	Validation and Testing Technology
3	Advanced Processor Architectures	Rocketry and Space Mechanics	Low Power VLSI
4	IOT Processors	Underwater Navigation Systems	VLSI Testing and Design for Testability
5	Wearable Devices	Massive MIMO Networks	Mixed Signal IC Design Testing
6	Industrial IoT and Industry 4.0	Advanced Wireless Communication Techniques	Analog IC Design

Vertical-I
Sensor Technologies and IoT

S No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
1	22EC5305	Realtime Embedded Systems	HDC	3	0	0	3	40	60	100
2	22EC6305	Sensor for IoT applications	HDC	3	0	0	3	40	60	100
3	22EC6306	Advanced Processor Architectures	HDC	3	0	0	3	40	60	100
4	22EC7304	IOT Processors	HDC	3	0	0	3	40	60	100
5	22EC7305	Wearable Devices	HDC	3	0	0	3	40	60	100
6	22EC8301	Industrial IoT and Industry 4.0	HDC	3	0	0	3	40	60	100

Vertical-II
Advanced Communication Systems

S No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
1	22EC5306	Cognitive Radio Networks	HDC	3	0	0	3	40	60	100
2	22EC6307	Remote Sensing	HDC	3	0	0	3	40	60	100
3	22EC6308	Rocketry and Space Mechanics	HDC	3	0	0	3	40	60	100
4	22EC7306	Underwater Navigation Systems	HDC	3	0	0	3	40	60	100
5	22EC7307	Massive MIMO Networks	HDC	3	0	0	3	40	60	100
6	22EC8203	Advanced Wireless Communication Techniques	HDC	3	0	0	3	40	60	100

Vertical-III
Semiconductor Chip Design and Testing

S No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
1	22EC5307	Wide Bandgap Devices	HDC	3	0	0	3	40	60	100
2	22EC6309	Validation and Testing Technology	HDC	3	0	0	3	40	60	100
3	22EC6310	Low Power VLSI	HDC	3	0	0	3	40	60	100
4	22EC7308	VLSI Testing and Design for Testability	HDC	3	0	0	3	40	60	100
5	22EC7309	Mixed Signal IC Design Testing	HDC	3	0	0	3	40	60	100
6	22EC8202	Analog IC Design	HDC	3	0	0	3	40	60	100

MINOR DEGREE VERTICAL COURSES

Embedded and IoT

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22EC5601	Electronics for Embedded Systems	MDC	3	0	0	3	3
2	22EC6601	Microcontroller and its Applications	MDC	3	0	0	3	3
3	22EC6602	Sensor and Embedded Systems	MDC	3	0	0	3	3
4	22EC7601	Fundamentals of IoT	MDC	3	0	0	3	3
5	22EC7602	Industrial IoT and Industry 4.0	MDC	3	0	0	3	3
6	22EC8601	IoT for Smart Systems	MDC	3	0	0	3	3

Vertical II
Fintech and Block Chain

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	21CS5602	Financial Management	MDC	3	0	0	3	3
2	21MB6231	Fundamentals of Investment	MDC	3	0	0	3	3
3	21MB6232	Banking, Financial Services andInsurance	MDC	3	0	0	3	3
4	21MB7231	Introduction to Blockchain and its Applications	MDC	3	0	0	3	3
5	21MB7232	Fintech Personal Finance and Payments	MDC	3	0	0	3	3
6	21MB8231	Introduction to Fintech	MDC	3	0	0	3	3

Vertical III
Entrepreneurship

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	21BA5601	Foundation of Entrepreneurship	MDC	3	0	0	3	3
2	21BA6601	Introduction to Business Venture	MDC	3	0	0	3	3
3	21BA6602	Team Building & Leadership Management for Business	MDC	3	0	0	3	3
4	21BA7601	Creativity & Innovation in Entrepreneurship	MDC	3	0	0	3	3
5	21BA7602	Principles of Marketing Management for Business	MDC	3	0	0	3	3
6	21BA8601	Human Resource Management for Entrepreneurs	MDC	3	0	0	3	3
7	21BA8602	Financing New Business Ventures	MDC	3	0	0	3	3

Vertical IV
Environment and Sustainability

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	21CEXXXX	Sustainable Infrastructure Development	MDC	3	0	0	3	3
2	21AG6233	Sustainable Agriculture and Environmental Management	MDC	3	0	0	3	3
3	21BM6233	Sustainable Bio Materials	MDC	3	0	0	3	3

4	21ME7233	Materials for Energy Sustainability	MDC	3	0	0	3	3
5	21CE7233	Green Technology	MDC	3	0	0	3	3
6	21CE8232	Environmental Quality Monitoring and Analysis	MDC	3	0	0	3	3

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SYLLABUS

SYLLABUS SEMESTER I

Programme	Course Code	Name of the Course	L	T	P	C
B.E./ B.Tech	22MA1101	**MATRICES AND CALCULUS (Common to all Branches)**	3	1	0	4

Course Objective	**The learner should be able to** 1. Construct the characteristic polynomial of a matrix and use it to identify Eigen values and Eigenvectors 2. Impart the knowledge of single variate calculus. 3. Familiarize the student with functions of several variables. 4. Acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications. 5. Make a vector differential operator for vector function and theorems to solve engineering problems.

Unit	Description	Instructional Hours
I	**Matrices** Eigen values and Eigen vectors – Properties of Eigen values and Eigen vectors (without proof) - Cayley - Hamilton Theorem (excluding proof) - Reduction of a quadratic form to canonical form by orthogonal transformation.	12
II	**Single Variate Calculus** Rolle's Theorem – Lagrange's Mean Value Theorem - Maxima and Minima – Taylor's and Maclaurin's Series.	12
III	**Functions of Several Variables** Partial derivatives - Total derivative - Jacobians – Maxima and minima of functions of two variables and Lagrange's method of undetermined multipliers.	12
IV	**Integral Calculus** Double integrals in Cartesian coordinates – Area enclosed by plane curves (excluding surface area) – Triple integrals in Cartesian co-ordinates – Volume of solids (Sphere, Ellipsoid, Tetrahedron) using Cartesian co-ordinates.	12
V	**Vector Calculus** Gradient, divergence and curl vectors - Green's theorem - Stoke's and Gauss divergence theorem (statement only) for cubes only.	12
	Total Instructional Hours	**60**

Course Outcome	**At the end of the course, the learner will be able to** CO1: Compute Eigen values and Eigen vectors of the given matrix and transform given quadratic form into canonical form. CO2: Apply the concept of differentiation to identify the maximum and minimum values of curve. CO3: Able to use differential calculus ideas on several variable functions. CO4: Apply multiple integral ideas in solving areas, volumes and other practical problems. CO5: Apply the concept of vector calculus in two and three-dimensional spaces.

TEXT BOOKS:

T1 - Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 10th edition, 2019.

T2 - K. P. Uma and S. Padma, "Engineering Mathematics I (Matrices and Calculus) ", Pearson Ltd,2022.

REFERENCE BOOKS:

R1 - Jerrold E. Marsden, Anthony Tromba, "Vector Calculus", W.H.Freeman, 2003-Strauss M. J, G. L Bradley and K. J .Smith, "Multivariable calculus", 6th edition, Prentice Hall, 2011.

R2 - Veerarajan T, "Engineering Mathematics", 5th edition, Mc Graw Hill Education(India) Pvt Ltd, New Delhi, 2016.

R3 - G. B. Thomas and R. L. Finney, "Calculus and Analytical Geometry", 9th Edition, Addison Wesley Publishing Company, 2016.

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	2	2	-	-	1	2	2	3	2
CO2	3	3	3	3	2	2	2	-	-	1	2	2	2	2
CO3	3	3	3	3	2	2	2	-	-	1	2	2	2	2
CO4	3	3	3	3	2	2	2	-	-	1	2	2	2	2
CO5	3	3	3	3	2	2	2	-	-	1	2	2	3	3
AVG	3	3	3	3	2.2	2	2			1	2	2	2.4	2.2

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Programme/ Semester	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech/ I	22CY1153	CHEMISTRY FOR ELECTRICAL SCIENCES (EEE,ECE & E&I)	2	0	2	3

Course Objective	**The learner should be able to** 1. Acquire knowledge on the concepts of chemistry involved in display systems and conducting polymer materials. 2. Extend the knowledge on the concepts of purification of water. 3. Extend the knowledge on principles of electrochemistry and modern batteries 4. Enhance the fundamental knowledge on the mechanism of corrosion and its control. 5. Gain knowledge on the E-waste management methods.

Unit	Description	Instructional Hours
I	**Water Science** Impurities in Water, Hardness of Water and Boiler feed Water – Boiler troubles -Sludge and scale formation, Caustic embrittlement, priming and foaming, boiler corrosion- - Softening Method - Ion-Exchange Method, Desalination of Brackish Water - Reverse Osmosis. **Estimation of hardness of water by EDTA.** **Determination of Dissolved Oxygen in sewage water by Winkler's method.** **Estimation of alkalinity of water sample by indicator method.**	6+9
II	**Polymers in Electronics** Conducting polymers – Definition – Properties – Applications - Synthesis, Properties and applications of Polyacetylene, Polyaniline, Poly-p-phenylenesulphide, Polypyrrole, Polythiophene. Biodegradable polymer: Preparation, Properties and applications of Poly Lactic acid (PLA).	6
III	**Electrochemical Cell and Energy Storage** Electrochemical cells - Single and Standard Electrode Potential - Nernst equationfor single electrode potential. EMF series - Applications. Batteries - Components - Classification - Construction, workingand applicationsofelectric vehicle batteries - Lithium-ionbattery,Nickel-Metal Hydride Batteries and Solar Cells. **Estimation of Ferrous iron by Potentiometry.**	6+3
IV	**Corrosion Science** Introduction, Chemical corrosion – Pilling Bedworth rule – electrochemical corrosion – theory and types of electrochemical corrosion - Galvanic corrosion, Differential aeration corrosion. Corrosion control – Sacrificial anode and impressed cathodic current methods - factors influencing the rate of corrosion.	6
V	**Electronic Waste Management** E-waste - Introduction - Definition – Sources - Effects of E-waste on environment and human health - need for E-waste management - Extraction Gold and copper from printed circuit boards (PCBs) - Disposal treatment methods of E-waste - recycling of E-waste. **Estimation of copper by EDTA method.**	6+3
	Total Instructional Hours	45

Course Outcome	**At the end of the course, the learner will be able to** CO1: Utilize the electronic materials for various applications. CO2:Explain the basic properties of water and its usage in domestic and industrial purposes. CO3: Develop knowledge on the basic principles of electrochemistry and applications of energy conversion and storage devices. CO4: Develop knowledge and understand the causes of corrosion and methods for corrosion prevention and protection of materials. CO5: Utilize the knowledge to handle the E-waste and reduce its impacts on environment.

TEXT BOOKS:

T1 - P. C. Jain & Monica Jain, "Engineering Chemistry" Dhanpat Rai Pub, Co., New Delhi, 17th edition, (2022).

T2 -O. G. Palanna, "Engineering chemistry" McGraw Hill Education India (2017).

REFERENCE BOOKS:

R1 - Shikha Agarwal "Engineering Chemistry -Fundamentals and Applications, Cambridge University Press, Delhi, 2019

R2 - S. S. Dara "A Text book of Engineering Chemistry" S. Chand& Co. Ltd., New Delhi (2018).

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	1	1	1	1	-	1	-	1	2		
CO2	2	3	2	1	1	1	1	-	1	-	1	2		
CO3	2	2	2	2	1	1	1	-	1	-	1	2		
CO4	2	2	2	2	1	1	1	-	1	-	1	2		
CO5	2	3	2	-	-	-	3	-	-	-	-	-		
AVG	2	2.6	2.2	1.5	1	1	1.4	-	1	-	1	2		

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Programme	Course Code	Name of the Course	L	T	P	C
B.E/B.Tech	22HE1151	**ENGLISH FOR ENGINEERS (Common to all Branches)**	2	0	2	3

Course Objective	**The student should be able** 1. To improve the communicative proficiency of learners. 2. To help learners use language effectively in professional writing. 3. To advance the skills of maintaining the suitable one of communication. 4. To introduce the professional life skills. 5. To impart official communication etiquette.

Unit	Description	Instructional Hours
I	**Language Proficiency:** Types of Sentences, Functional Units, Framing question. **Writing:** process description, Writing Checklist. **Vocabulary** – words on environment. **Practical Component: Listening-** Watching short videos and answer the questions, **Speaking-** Self introduction, formal & semi-formal, **Reading-** Purpose of Reading - Churning & Assimilation, Interpreting Ideas - Interpreting Graphs in Technical Writing.	7+2
II	**Language Proficiency**: Tenses, Adjectives and adverbs. **Writing:** Formal letters (letters conveying positive and negative news), Formal and informal email writing (using emoticons, abbreviations& acronyms), reading comprehension. **Vocabulary**– words on entertainment. **Practical Component: Listening**-Comprehensions based on TED talks **Speaking-** Narrating a short story or an event happened in their life **Reading** - Skimming – Scanning – Reading: Scientific Texts – Literary Texts	7+2
III	**Language Proficiency:** Prepositions, phrasal verbs. **Writing:** Formal thanks giving, Congratulating, warning and apologizing letters, cloze test. **Vocabulary** – words on tools. **Practical Component: Listening**-Listen to songs and answer the questions **Speaking**-Just a minute **Reading**- Reading feature articles (from newspapers and magazines) -Reading to identify point of view and perspective (opinion pieces, editorials etc.)	5+4
IV	**Language Proficiency:** Subject verb concord, Prefixes & suffixes. **Writing:** Preparing agenda &minutes, writing an event report. **Vocabulary**– words on engineering process. **Practical Component: Listening-** Comprehensions based on Talk of orators or interview shows **Speaking**-Presentation on a general topic with ppt. **Reading-** Reading Comprehension - Techniques for Good Comprehension - - Sequencing of Sentences.	5+4
V	**Language Proficiency:** Modal Auxiliaries, Active & passive voice, **Writing:** Project report (proposal & progress) ,sequencing of sentences **Vocabulary** –words on engineering material **Practical Component: Listening-** Listening- Comprehensions based on Nat Geo/Discovery channel videos **Speaking-** Preparing posters and presenting as a team. **Reading-** Biographies, travelogues, technical blogs.	6+3
	Total Instructional Hours	**45**

Course Outcome	**After completion of the course the learner will be able** CO1: To communicate in a professional forum CO2: To speak or write a content in the proficient language CO3: To maintain and use appropriate one of the communication. CO4: To read , write and present in a professional way. CO5: To follow the etiquettes in formal communication.

TEXT BOOKS:

T1- Norman Whitby, "Business Benchmark-Pre-intermediate to Intermediate", Cambridge University Press,2016.T2-

T2- Raymond Murphy, "Essential English Grammar", Cambridge UniversityPress,2019.

REFERENCE BOOKS:

R1- Meenakshi Raman and Sangeetha Sharma. "Technical Communication- Principles and Practice", Oxford University Press, 2009.

R2-Raymond Murphy, "English GrammarinUse"-4theditionCambridgeUniversityPress,2004.

R3-Kamalesh Sadanan"A Foundation Course for the Speakers of Tamil-Part-I & II", Orient Blackswan,2010.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO1	PSO2
CO1	2					1	2	2	2	3	1	1	1	2	
CO2	2	1			1	1	1	2	2	3		2		2	2
CO3	2	1			1	1	2	3	3	3		1	1	2	1
CO4	2	1				1	2	2	2	3	1	1			2
CO5	2					1	1	2	3	3		1	1	2	2
AVG	2	1			1	1	1.6	2.2	2.4	3	1	1.2	1	2	1.75

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Programme	Course Code	Name of the Course	L	T	P	C
BE-ECE	22EC1152	Fundamentals of Electronics and Communication Engineering	2	0	2	3
Course Objective	The student should be able 1. Acquire elementary knowledge on Electron Devices and 2. Familiarize the Logic gates Operation and digital circuit designs 3. Explore the Operation and Characteristics of Linear Integrated Circuits. 4. Be exposed to the basic operation of various communication technologies. 5. To impart knowledge about the Sensor Applications					

Unit	Description	Instructional Hours
I	**ELECTRONICS FUNDAMENTALS** Ohm's law, Voltage, Current, Resistance, Power, Voltmeter, Ammeter, Multimeter, Resistors in Series and Parallel circuits, Diodes, Transistors, LED.	6
II	**DIGITAL FUNDAMENTALS** Number Systems: Binary – Octal – Hexadecimal, Logic gates - OR, AND, NOT, EX-OR, NOR, NAND, Realization of simple 2x2 Boolean equations using Logic Gates, Adder, Subtractor	6
III	**LINEAR INTEGRATED CIRCUITS** Op-Amp: Adder-Subtractor, IC555 Timer and its Applications: lamp flashers, pulse generation, logic clocks, tone generation, security alarms.	6
IV	**COMMUNICATION TECHNOLOGIES** AM & FM Radio, RF-ID, IR Communication, Bluetooth, Zigbee, Wi-Fi, Mobile Communication: 2G to 6G, GSM, GPS	6
V	**SENSORS AND ITS APPLICATIONS** Sensors: IR range sensor – IR proximity sensor- Ultrasonic range sensor- Touch Sensor, Miniprojects using Arduino.	6
	Theory Instructional Hours	30
	Practicals- List of Experiments: 1. Measurement of voltage, current using Ohms Law and testing of circuit continuity 2. Realization of Boolean equation using logic gates	15

3. Blinking LED using IC555 Timer 4. Study of GSM & GPS Technology 5. Mini Project: Design & Development of Overhead Tank Water Level Controller	
Total Instruction Hours	**45**

Course Outcome	**After completion of the course the learner will be able** CO1: Understand Fundamentals of Electronics CO2: Able to design digital circuits. CO3: Able to develop integrated circuits using op-amp IC and 555 Timer IC. CO4: Understand Fundamentals of Communication. CO5: Able to design application circuits using sensors

TEXT BOOKS:

T1- Robert Boylestad and Louis Nashelsky,"Electron Devices and Circuit Theory"Prentice Hall,10th edition,July2008

T2-Thomas L. Floyd, "Digital Fundamentals", 10th Edition, Pearson Education Inc, 2011.

T3- Dennis Roddy, John Coolen ," Electronic Communications", 4th edition, Pearson Education, 2009

T4- D.Roy Choudhry, Shail Jain, "Linear Integrated Circuits", Wiley Eastern, New Delhi, 2014.

REFERENCE BOOKS:

R1- Simon Haykin, "Communication Systems", 4th edition, Wiley Publication, New Delhi, 2011.

R2- Ramakant A. Gayakwad, "OP-AMP and Linear ICs", 4th Edition, Pearson Education, 2015

R3- Thomas L. Floyd, "Digital Fundamentals", 10th Edition, Pearson Education Inc, 2011.

R4 -

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	2	-	-	-	-	-	-	3	2
CO2	3	3	3	3	3	2	-	-	-	-	-	-	2	2
CO3	3	3	3	3	3	2	-	-	-	-	-	-	2	2
CO4	3	3	3	3	3	2	-	-	-	-	-	-	2	3
CO5	3	3	3	3	3	2	-	-	-	-	-	-	2	2
AVG	3	3	3	3	3	2	-	-	-	-	-	-	2	2

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Programme	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech	22IT1151R	PYTHON PROGRAMMING AND PRACTICES AGRI, CHEM,FT,AERO, AUTO, CIVIL,MECH, MECT,ECE,BME)	2	0	2	3
Course Objective	**The learner should be able** 1. To know the basics of algorithmic problem solving 2. To read and write simple Python programs 3. To develop Python programs with conditionals and loops and to define Python functions and call them 4. To use Python data structures — lists, tuples, dictionaries 5. To do input/output with files in Python					

Unit	Description	Instructional Hours

I	**ALGORITHMIC PROBLEM SOLVING** Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). **Illustrative problems: To find the Greatest Common Divisor (GCD)oftwo numbers, Fahrenheit to Celsius, Perform Matrix addition.**	5+4
II	**DATA, STATEMENTS,CONTROL FLOW** Data Types, Operators and precedence of operators, expressions, statements, comments; Conditionals: Boolean values and operators, conditional (if), alternative (if -else), chained conditional (if –elif-else); Iteration: state, while, for, break, continue, pass; **Simple algorithms and programs: Area of the circle, check the given year is Leap year or not, Factorial of a Number.**	5+4
III	**FUNCTIONS, STRINGS** Functions, parameters and arguments; Fruitful functions: return values, local and global scope, function composition, recursive functions. Strings: string slices, immutability, string functions and methods, string module. **Illustrative programs: Perform Linear Search, Selection sort, Sum of all elements in a List, Pattern Programs**	5+4
IV	**LISTS, TUPLES, DICTIONARIES** Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension. **Illustrative programs: List Manipulation, Finding Maximum in a List, String processing.**	5+4
V	**FILES, MODULES, PACKAGES** Files and exception: text files, reading and writing files, errors and exceptions, handling exceptions, modules, packages **Illustrative programs: Reading writing in a file, word count, Handling Exceptions**	9
	Total Instructional Hours	**45**

Course Outcome	**At the end of the course, the learner will be able to** CO1: Develop algorithmic solutions to simple computational problems CO2: Read, write, execute by hand simple Python programs CO3: Structure simple Python programs for solving problems and Decompose a Python program into functions CO4: Represent compound data using Python lists, tuples, dictionaries CO5: Read and write data from/to files in Python Programs.

TEXT BOOKS:

T1: Guido van Rossum and Fred L. Drake Jr, An Introduction to Python – Revised and updated for Python 3.6.2, Shroff Publishers, First edition (2017).

T2:S. Annadurai, S.Shankar, I.Jasmine, M.Revathi, Fundamentals of Python Programming, Mc-Graw Hill Education (India) Private Ltd, 2019.

REFERENCE BOOKS:

R1:CharlesDierbach, —Introduction to Computer Science using Python: A Computational Problem- Solving Focus, Wiley India Edition,2013.

R2:Timothy A. Budd, —Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd., 2015

R3:Robert Sedgewick, Kevin Wayne, Robert Dondero, —Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson
India Education Services Pvt. Ltd., 2016

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	3		2				-			2
CO2	2	3	3		2				2			2
CO3	2	3	3		2				3			2
CO4	2	3	3		2				2			2
CO5	2	3	3		2				3			2
AVG	2	3	3		2				2.4			2

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Programme	Course Code	Name of the Course	L	T	P	C
B.E./ B.Tech	22HE1095	UNIVERSAL HUMAN VALUES (COMMON TO ALL BRANCHES)	2	0	0	0
Course Objectives	The student should be made 1. To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings. 2. Tofacilitatethedevelopmentofa Holisticperspectiveamongstudentstowardslifeandprofession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way. 3.To high light plausible implications of such a Holistic understanding interms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.					

Unit	Description	Instructional Hours
I	**Introduction to Value Education** Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education)-Understanding Value Education - Self-exploration as the Process for Value Education - Continuous Happiness and Prosperity – the Basic Human Aspirations - Happiness and Prosperity – Current Scenario - Method to Fulfill the Basic Human Aspirations	6
II	**Harmony in the Human Being and Harmony in the Family** Understanding Human being as the Co-existence of the Self and the Body - Distinguishing between the Needs of the Self and the Body - The Body as an Instrument of the Self - Understanding Harmony in the Self- Harmony of the Self with the Body - Programme to ensure self-regulation and Health	6
III	**Harmony in the Family and Society** Harmony in the Family – the Basic Unit of Human Interaction. Values in Human to Human Relationship 'Trust' – the Foundational Value in Relationship Values in Human to Human Relationship 'Respect' – as the Right Evaluation Understanding Harmony in the Society	6
IV	**Harmony in the Nature / Existence** Understanding Harmony in the Nature.Inter connectedness, self-regulation and Mutual Fulfillment among the Four Orders of Nature- Understanding Existence as Co-existence of mutually interacting units in all pervasivespace Realizing Existence as Co-existence at All Levels The Holistic Perception of Harmony in Existence.	6

	Vision for the Universal Human Order	
V	**Implications of the Holistic Understanding – a Look at Professional Ethics** Natural Acceptance of Human Values Definitiveness of (Ethical) Human Conduct A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order-Competence in Professional Ethics Holistic Technologies, Production Systems and Management Models-Typical Case Studies Strategies for Transition towards Value-based Life and Profession	6
	Total Instructional Hours	**30**

Course Outcome	**At the end of the course, the learner will be able** CO1: To become more aware of holistic vision of life - themselves and their surroundings. CO2: To become more responsible in life, in the Society and in handling problems with sustainable Solutions. CO3: To sensitive towards their commitment towards what they understood towards environment and Socially responsible behavior. CO4: To able to apply what have learnt to their own self in different day-to-day settings in real life and In handling problems with sustainable solutions. CO5: To develop competence and capabilities for maintaining Health and Hygiene.

Reference Books:

R1.A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1

R2.Teachers'ManualforAFoundationCourseinHumanValuesandProfessionalEthics,RRGaur, R Asthana,G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93- 87034-53-2

R3.JeevanVidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak,1999.

R4.Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	3	-	2	-	-	-	2	-	-	2
CO2	2	3	3	-	2	-	-	-	2	-	-	2
CO3	2	3	3	-	2	-	-	-	2	-	-	2
CO4	2	3	3	-	2	-	-	-	2	-	-	2
CO5	2	3	3	-	2	-	-	-	2	-	-	2
AVG	2	3	3	-	2	-	-	-	2	-	-	2

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Programme	Course Code	Name of the Course	L	T	P	C
B.E./ B.Tech	22HE1072	**ENTREPRENEURESHIP AND INNOVATION (Common to all Branches)**	1	0	0	1

Course Objectives	**The student should be made** 1. To acquire the knowledge and skills needed to manage the development of innovation. 2. To recognize and evaluate potential opportunities to monetize these innovations. 3. To plan specific and detailed method to exploit these opportunities. 4. To acquire the resources necessary to implement these plans. 5. To make students understand organizational performance and its importance.

Module	Description
1	**Entrepreneurial Thinking**
2	**Innovation Management**
3	**Design Thinking**
4	**Opportunity Spotting / Opportunity Evaluation**
5	**Industry and Market Research**
6	**Innovation Strategy and Business Models**
7	**Financial Forecasting**
8	**Business Plans/ Business Model Canvas**
9	**Entrepreneurial Finance**
10	**Pitching to Resources Providers / Pitch Deck**
11	**Negotiating Deals**
12	**New Venture Creation**
13	**Lean Start-ups**
14	**Entrepreneurial Ecosystem**
15	**Velocity Venture**
	TOTAL INSTRUCTIONAL HOURS 15

Course Outcome	**At the end of the course, the learner will be able to** CO1: Understand the nature of business opportunities, resources, and industries in critical and creative aspects. CO2: Understand the processes by which innovation is fostered, managed, and commercialized. CO3: Remember effectively and efficiently the potential of new business opportunities. CO4: Assess the market potential for a new venture, including customer need, competitors, and industry attractiveness. CO5: Develop a business model for a new venture, including revenue. Margins, operations, working capital, and investment

TEXT BOOKS

T1:AryaKumar“Entrepreneurship–CreatingandleadinganEntrepreneurialOrganization”,Pearson,SecondEdition(2012).
T2:EmrahYayici“DesignThinkingMethodology”, Artbiztech, FirstEdition(2016).

REFERENCE BOOKS

R1: Christopher Golis “Enterprise & Venture Capital”, Allen &Unwin Publication, Fourth Edition (2007).
R2: ThomasLockWood&EdgerPapke“InnovationbyDesign”,CareerPress.com,SecondEdition(2017).
R3: Jonathan Wilson “Essentials of Business Research”, Sage Publication, First Edition(2010).

WEB RESOURCES

W1:https://blof.forgeforward.in/tagged/startup-lessons
W2:https://blof.forgeforward.in/tagged/entrepreurship
W3:https://blof.forgeforward.in/tagged/minimum-viable-product
W4:https://blof.forgeforward.in/tagged/minimum-viable-product
W5:https://blof.forgeforward.in/tagged/innovation

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	-	-	-	-	2	2	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2
CO3	3	3	3	2	3	-	-	-	-	2	2	2
CO4	3	3	3	2	3	-	-	-	-	2	2	2
CO5	3	3	3	3	3	-	-	-	-	2	1	2
AVG	3	3	3	2.6	2.8	-	-	-	-	2	1.8	2

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HiCET

Programme	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech	22MC1094	**HERITAGE OF TAMIL (Common to all Branches)**	2	0	0	1

Course Objective	**The learner should be able to** 1. Introduce students to the great History of Tamil literature. 2. Establish the heritage of various forms of Rock art and Sculpture art. 3. To study and understand the various folk and Martial arts of Tamil culture 4. Introduce students to Ancient Tamil concepts to understand the richness of Tamil literature. 5. To learn about the various influences or impacts of Tamil language in Indian culture.

Unit	Description	Instructional Hours
I	**Language and Literature** 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 impacts of Buddhism & Jainism in Tamil and Bakthi literature of Azhwars and Nayanmars – Forms of minor poetry _ Development of Modern literature in Tamil – Contribution of Bharathiyar and Bharathidasan.	6
II	**Heritage _ Rock Art Paintings to Modern Art – Sculpture** Hero Stone to Modern Sculpture – Bronze icons – Tribes and their handcrafts - Art of temple car making – Massive Terracotta sculptures, Village deities, Thiruvalluvar statue at Kanyakumari, Making of musical instruments – Mridangam, Parai, Yazh and Nadhaswaram - Role of Temples in social and economic life of Tamils.	6
III	**Folk and Martial Arts** Therukoothu, Karagattem, Villupattu, Kaniyankoothu, Oyilattam, Leather puppertry, Silambattam.,Valari Tiger dance – Sports and Games of Tamils.	6
IV	**Thinai Concept of Tamils** 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 – Exporot and Import during Sangam age – Overseas conquest of Cholas.	6
V	**Contribution of Tamils to Indian National Movement and Indian Culture** 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.	6
	Total Instructional Hours	**30**

Course Outcome	**At the end of the course, the learner will be able to** CO1: Learn about the works pertaining to Sangam age CO2: Aware of our Heritage in art from Stone sculpture to Modern Sculpture. CO3Appreciate the role of Folk arts in preserving, sustaining and evolution of Tamil culture. CO4: Appreciate the intricacies of Tamil literature that had existed in the past. CO5: Understand the contribution of Tamil Literature to Indian Culture

TEXT BOOKS:

T1: Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)

T2: Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by:International Institute of Tamil Studies.

T3: Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu)(Published by: International Institute of Tamil Studies).

REFERENCE BOOKS:

R1-The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies)

R2- Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu TextBookand Educational Services Corporation, Tamil Nadu)

R3-Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – ReferenceBook.

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	3	-	-	-	-	-	2			2
CO2	2	3	3	-	-	-	-	-	2			2
CO3	2	3	3	-	-	-	-	-	2			2
CO4	2	3	-	-	-	-	-	-	2			2
CO5	2	3	-	-	-	-	-	-	2			2
AVG	2	3	1.8	-	-	-	-	-	2			2

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Programme	Course Code	Course Title	L	T	P	C
B.E/B.TECH	22HE1073	INTRODUCTION TO SOFT SKILLS	2	0	0	0

Course Objectives:	1. To develop and nurture the soft skills of the students through instruction, knowledge acquisition, demonstration and practice. 2. To enhance the students ability to deal with numerical and quantitative skills. 3. To identify the core skills associated with critical thinking. 4. To develop and integrate the use of English language skills.

Unit	Description	Instructional Hours
I	**Lessons on excellence** Skill introspection, Skill acquisition, consistent practice	2
II	**Logical Reasoning** Problem Solving - Critical Thinking- Lateral Thinking - Coding and Decoding – Series – Analogy - Odd Man Out - Visual Reasoning - Sudoku puzzles - Attention to detail	11
III	**Quantitative Aptitude** Addition and Subtraction of bigger numbers - Square and square roots - Cubes and cube roots - Vedic maths techniques - Multiplication Shortcuts - Multiplication of 3 and higher digit numbers – Simplifications - Comparing fractions - Shortcuts to find HCF and LCM - Divisibility tests shortcuts -	11

	Algebra and functions	
IV	**Recruitment Essentials** Resume Building - Impression Management	2
V	**Verbal Ability** Nouns and Pronouns – Verbs - Subject-Verb Agreement - Pronoun-Antecedent – Agreement – Punctuations	4
	Total Instructional Hours	30

Course Outcome:	CO1:	Students will analyze interpersonal communication skills. public speaking skills.
	CO2:	Students will exemplify tautology, contradiction and contingency by logical thinking.
	CO3:	Students will be able to develop an appropriate integral form to solve all sorts of quantitative problems.
	CO4:	Students can produce a resume that describes their education, skills, experiences and measurable achievements with proper grammar, format and brevity.
	CO5:	Students will be developed to acquire the ability to use English language with an error while making optimum use of grammar.

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B.E/B.Tech	22MC1093	தமிழர்மரபு	2	0	0	1

Unit	Description	Instructional Hours
I	**அலகு I** <u>மொழி மற்றும் இலக்கியம்</u>: **3** இந்திய மொழிக் குடும்பங்கள் – 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.	3
II	**அலகு II** மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை: **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.	3
III	**அலகு III** <u>நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்</u>: **3** தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.	3
IV	**அலகு IV** <u>தமிழர்களின் திணைக் கோட்பாடுகள்</u>: **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.	3
V	**அலகு V** <u>இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு</u>: **3** இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.	3
	Total Instructional Hours	**15**

PO&PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	3	-	-	-	-	-	2	-	-	2
CO2	2	3	3	-	-	-	-	-	2	-	-	2
CO3	2	3	3	-	-	-	-	-	2	-	-	2
CO4	2	3	-	-	-	-	-	-	2	-	-	2
CO5	2	3	-	-	-	-	-	-	2	-	-	2
AVG	2	3	3	-	-	-	-	-	2	-	-	2

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Chairman

SYLLABUS REVISION AND NEW COURSE INTRODUCED DETAILS FOR THE REGULATION 2022 – ACADEMIC YEAR 2024-25 ODD SEMESTER

Course introduced

S. No	Year	Semester	Existing course (in academic Year 2023-24)	Introduced course (for 2024-25)	Percentage of Revision
1	I	I	22EC1151- ELECTRON DEVICES	22EC1152- FUNDAMENTALS OF ELECTRONICS AND COMMUNICATION ENGINEERING	100

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HINDUSTHAN COLLEGE OF ENGINEERING AND TECHNOLOGY
(An Autonomous Institution, Affiliated to Anna University, Chennai
Approved by AICTE, New Delhi& Accredited by NAAC with 'A ++' Grade)
Valley Campus, Pollachi Highway, Coimbatore, Tamil Nadu

HINDUSTHAN
EDUCATIONAL AND CHARITABLE TRUST

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

R-2022 Curriculum and Syllabus for ODD Semester

2023-2027 Batch

Academic year 2024-2025

Curriculum
R2022

Curriculum under R2022
(for the batch admitted during 2023 – 2024)

SEMESTER I											
S. NO	COURSE CODE	COURSE TITLE	COURSE CATEGORY	L	T	P	C	TCP	CIA	ESE	TOTAL
THEORY											
1	22MA1101	MATRICES AND CALCULUS	BSC	3	1	0	4	4	40	60	100
THEORY WITH LAB COMPONENT											
2	22CY1151	CHEMISTRY FOR CIRCUIT ENGINEERING	BSC	2	0	2	3	4	50	50	100
3	22HE1151	ENGLISH FOR ENGINEERS	HSC	2	0	2	3	4	50	50	100
4	22EC1151	ELECTRON DEVICES	ESC	2	0	2	3	4	50	50	100
5	22IT1151/ 22CS1152	PYTHON PROGRAMMING AND PRACTICES/ OBJECT ORIENTED PROGRAMMING USING PYTHON (IBM STUDENTS ONLY)	ESC/ICC	2	0	2	3	4	50	50	100
EEC COURSES (SE/AE)											
6	22HE1072	ENTREPRENEURSHIP & INNOVATION (Common to all branches)	AEC	1	0	0	1	1	100	0	100
7	22HE1073	INTRODUCTION TO SOFT SKILLS (Common to all branches)	SEC	2	0	0	0	1	100	0	100
MANDATORY COURSE											
8	22MC1093/ 22MC1094	தமிழர்மரபு /HERITAGE OF TAMIL	MC	2	0	0	1	2	100	0	100
9	22MC1095	UNIVERSAL HUMAN VALUES (Common to all branches)	AEC	2	0	0	0	2	40	60	100
			TOTAL	**18**	**1**	**8**	**18**	**26**	**580**	**320**	**900**

SEMESTER II											
S. NO	COURSE CODE	COURSE TITLE	COURSE CATEGORY	L	T	P	C	TCP	CIA	ESE	TOTAL
THEORY											
1	22MA2102	DIFFERENTIAL EQUATIONS AND LAPLACE TRANSFORM	BSC	3	1	0	4	4	40	60	100
2	22CY2101	ENVIRONMENTAL STUDIES	ESC	2	0	0	2	3	40	60	100
3	22PH2101	BASICS OF MATERIAL SCIENCE	BSC	2	0	0	2	3	40	60	100
THEORY WITH LAB COMPONENT											

4	22PH2151	PHYSICS FOR CIRCUIT ENGINEERING PROGRAMME	BSC	2	0	2	3	4	50	50	100
5	22HE2151	EFFECTIVE TECHNICAL COMMUNICATION	HSC	2	0	2	3	4	50	50	100
6	22CS2255 22CS2253	PROGRAMMING USING C JAVA FUNDAMENTALS (IBM STUDENTS ONLY)	PCC ICC	2	0	2	3	4	50	50	100
PRACTICAL											
7	22ME2001	ENGINEERING PRACTICES	ESC	0	0	4	2	2	60	40	100
EEC COURSES (SE/AE)											
8	22HE2071	DESIGN THINKING (Common to all branches)	AEC	2	0	0	2	2	100	0	100
9	22HE2073	SOFT SKILLS AND APTITUDE-I (Common to all branches)	SEC	1	0	0	1	1	100	0	100
MANDATORY COURSES											
10	22MC2094/ 22MC2095	□□□□□□□□ □□□□□□□□□□□□□□□□ / TAMILS AND TECHNOLOGY	MC	2	0	0	1	2	100	0	100
11	22MC2093	NCC */NSS / YRC / Sports / Clubs / Society Service - Enrollment (Common)	MC	All students shall enroll, on admission, in anyone of the personality and character development programmes and undergo training for about 80 hours							
			TOTAL	**18**	**1**	**10**	**23**	**29**	**630**	**370**	**1000**

SEMESTER III											
S.NO	**COURSECODE**	**COURSETITLE**	**COURSE CATEGORY**	**L**	**T**	**P**	**C**	**TCP**	**CIA**	**ESE**	**TOTAL**
THEORY											
1	22MA3102	COMPLEX ANALYSIS AND TRANSFORMS (common to ECE,EEE,EIE)	BSC	3	1	0	4	4	40	60	100
2	22EC3201	ELECTRONIC CIRCUITS	PCC	3	0	0	3	3	40	60	100
3	22EC3202	SIGNALS AND SYSTEMS	PCC	3	0	0	3	3	40	60	100
4	22EC3203	DIGITAL ELECTRONICS	PCC	3	0	0	3	3	40	60	100
5	22EC3204	CIRCUITS AND NETWORKS	ESC	2	0	0	2	3	100	-	100
THEORY WITH LAB COMPONENT											
6	22EC3251	OOPS USING JAVA	ESC/ICC	2	0	2	3	3	50	50	100
PRACTICAL											
7	22EC3001	ELECTRONIC CIRCUITS LABORATORY	PCC	0	0	3	1.5	3	60	40	100
8	22EC3002	DIGITAL ELECTRONICS LABORATORY	PCC	0	0	3	1.5	3	60	40	100
EEC COURSES (SE/AE)											
9	22HE3071	SOFT SKILLS -2	SEC	1	0	0	1	1	100	0	100
10	22EC3901	MINI PROJECT 1	AEC	0	0	0	2	1	100	0	100
11	22MC3191	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	MC	2	0	0	0	2	100	0	100
			TOTAL	**17**	**1**	**8**	**24**	**28**	**730**	**410**	**1100**

SEMESTER IV											
S.NO	COURSE CODE	COURSE TITLE	COURSE CATEGORY	L	T	P	C	TCP	CIA	ESE	TOTAL
THEORY											
1	22HE4101	IPR AND START-UPS	HSC	2	0	0	2	2	40	60	100
2	22EC4201	ELECTRO MAGNETIC FIELDS	PCC	3	0	0	3	3	40	60	100
3	22EC4202	ANALOG COMMUNICATION	PCC	3	0	0	3	3	40	60	100
4	22EC4203	LINEAR INTEGRATED CIRCUITS	PCC	3	0	0	3	3	40	60	100
5	22EC4304	TRANSMISSION LINES AND WAVEGUIDES	PCC	3	0	0	3	3	40	60	100
THEORY WITH LAB COMPONENT											
6	22EC4251/ 22EC4252	CONTROL SYSTEMS/DESIGN THINKING-AN INTRODUCTION (IBM STUDENTS ONLY)	PCC/ICC	2	0	2	3	3	50	50	100
7	22EC4253	DATA COMMUNICATION AND NETWORKS	PCC	2	0	2	3	3	50	50	100
PRACTICAL											
8	22EC4001	LINEAR INTEGRATED CIRCUITS LAB	PCC	0	0	3	1.5	3	60	40	100
9	22EC4002	ANALOG COMMUNICATION LAB	PCC	0	0	3	1.5	3	60	40	100
EEC COURSES (SE/AE)											
10	22HE4071	SOFT SKILLS -3	SEC	1	0	0	1	1	100	0	100
			TOTAL	19	3	10	24	27	400	500	900

SEMESTER V											
S.NO	COURSE CODE	COURSE TITLE	COURSE CATEGORY	L	T	P	C	TCP	CIA	ESE	TOTAL
THEORY											
1	22EC5201	DIGITAL COMMUNICATION	PCC	3	0	0	3	3	40	60	100
2	22EC5202	ANTENNA AND WAVE PROPAGATION	PCC	3	1	0	4	3	40	60	100
3	22EC5203	MICROPROCESSORS AND MICROCONTROLLERS	PCC	3	0	0	3	3	40	60	100
4	22EC53XX/ 22EC5251	PROFESSIONAL ELECTIVE-1/ ANGULAR JS(IBM STUDENTS ONLY)	PEC/ICC	3	0	0	3	3	40	60	100
5	22EC53XX	PROFESSIONAL ELECTIVE-2	PEC	3	0	0	3	3	40	60	100
6	22EC53XX	PROFESSIONAL ELECTIVE-3	PEC	3	0	0	3	3	40	60	100
PRACTICAL											
7	22EC5001	MICROPROCESSORS AND MICROCONTROLLERS LAB	PCC	0	0	3	1.5	3	60	40	100
8	22EC5002	DIGITAL COMMUNICATION LAB	PCC	0	0	3	1.5	3	60	40	100
EEC COURSES (SE/AE)											

9	22HE5071	SOFT SKILLS -4 / FOREIGN LANGUAGES	SEC	1	0	0	1	1	100	0	100
			TOTAL	**19**	**1**	**6**	**23**	**25**	**440**	**460**	**900**

SEMESTER VI											
S.NO	**COURSE CODE**	**COURSE TITLE**	**COURSE CATEGORY**	**L**	**T**	**P**	**C**	**TCP**	**CIA**	**ESE**	**TOTAL**
THEORY											
1	22HS6101	PROFESSIONAL ETHICS	HSC	3	0	0	3	3	40	60	100
2	22EC63XX/ 22EC6251	PROFESSIONAL ELECTIVE-4/ NODE JS AND MICRO SERVICES (IBM STUDENTS ONLY)	PEC/ICC	3	0	0	3	3	40	60	100
3	22EC63XX / 22EC6252	PROFESSIONAL ELECTIVE-5/ IOT AND SPRING FRAMEWORK (IBM STUDENTS ONLY)	PEC/ICC	3	0	0	3	3	40	60	100
4	22EC64XX	OPEN ELECTIVE – 1*	OEC	3	0	0	3	3	40	60	100
5	22EC64XX	OPEN ELECTIVE – 2*	OEC	3	0	0	3	3	40	60	100
THEORY WITH LAB COMPONENT											
6	22EC6253	DIGITAL SIGNAL PROCESSING	PCC	2	0	2	3	4	50	50	100
7	22EC6254	VLSI DESIGN	PCC	2	0	2	3	4	50	50	100
EEC COURSES (SE/AE)											
8	22EC6901	MINI PROJECT 2	AEC	0	0	0	2	1	100	0	100
			TOTAL	**19**	**1**	**6**	**23**	**26**	**400**	**400**	**800**

SEMESTER VII											
S.NO	**COURSE CODE**	**COURSE TITLE**	**COURSE CATEGORY**	**L**	**T**	**P**	**C**	**TCP**	**CIA**	**ESE**	**TOTAL**
THEORY											
1	22EC7201	WIRELESS COMMUNICATION NETWORKS	PCC	3	0	0	3	3	40	60	100
2	22EC73XX/ 22EC7251	PROFESSIONAL ELECTIVE-6/ BLOCKCHAIN(IBM STUDENTS ONLY)	PEC/ICC	3	0	0	3	3	40	60	100
3	22EC74XX	OPEN ELECTIVE – 3*	OEC	3	0	0	3	3	40	60	100
4	22EC74XX	OPEN ELECTIVE – 4*	OEC	3	0	0	3	3	40	60	100
THEORY WITH LAB COMPONENT											
5	22EC7001	EMBEDDED SYSTEMS AND IOT	PCC	2	0	2	3	4	50	50	100
6	22EC7001	OPTICAL COMMUNICATION AND MICROWAVE ENGINEERING	PCC	2	0	2	3	4	50	50	100
EEC COURSES (SE/AE)											
7	22EC7901	INTERNSHIP	AEC	-	-	-	2	1	100	0	100
			TOTAL	**19**	**0**	**4**	**20**	**23**	**360**	**340**	**700**

students' who have opted NCC subjects in Semester I, II, III & IV are eligible to undergo NCC Open Elective Subjects.

3. The above-mentioned NCC Courses will be offered to the students who are going to be admitted in the Academic Year 2021 – 22 onwards.

SEMESTER WISE CREDIT DISTRIBUTION

B.E. / B.TECH. PROGRAMMES										
S.No.	Course Area	Credits per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	HSC	3	3	-	2	-	3	-	-	**11**
2	BSC	7	9	4	-	-	-	-	-	**20**
3	ESC	6	4	5	-	-	-	-	-	**15**
4	PCC	-	3	12	21	13	6	9	-	**64**
5	PEC	-	-	-	-	9	6	3	-	**18**
6	OEC	-	-	-	-	-	6	6	-	**12**
7	EEC	1	3	3	1	1	2	2	10	**23**
8	MC	1	1							**2**
Total		**18**	**23**	**24**	**24**	**23**	**23**	**20**	**10**	**165**

Credit Distribution R2022

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	18	23	24	24	23	23	20	10	**165**

LIST OF INDUSTRIAL CORE COURSES

S. No.	CODE	Courses	CAT	L	T	P	C	CIA	ESE	TOTAL
1	22CS1152	Object Oriented Programming using Python	ICC	2	0	2	3	50	50	100
2	22CS2153	Java Fundamentals	ICC	2	0	2	3	50	50	100
3	22EC3252	Relational Database Management System	ICC	2	0	2	3	50	50	100
4	22EC4252	Design Thinking-An Introduction	ICC	2	0	2	3	50	50	100
5	22EC5251	Angular JS	ICC	2	0	2	3	50	50	100
6	22EC6251	Node JS and Micro services	ICC	2	0	2	3	50	50	100
7	22EC6252	IoT and Spring Framework	ICC	2	0	2	3	50	50	100
8	22EC7251	Blockchain	ICC	2	0	2	3	50	50	100

PROFESSIONAL ELECTIVES

Vertical 1 Electronic System Design	Vertical 2 Communication Systems	Vertical 3 Wireless Networks	Vertical 4 Signal and Image Processing	Vertical 5 Biomedical Technologies	Vertical 6 Diversified Courses
Foundation Skills in Integrated Product Development	Satellite Communication	Network Security	Digital Image Processing	Medical Electronics	App Development
Measurements and Instrumentation	Global Positioning Systems	Wireless Sensors and Networks	Audio Signal Processing	Medical Informatics	Web Technologies
IoT Based System Design	Under Water Communication	High Speed Networks	Machine Vision	Medical Image Processing	Ethical Hacking
PCB Design	RF System Design	Cloud Computing	Artificial Intelligence and Machine Learning	Biometric Systems	Cryptocurrency and Blockchain Technologies
ASIC Design	Software Defined Radio	Wireless Broad Band Networks	Neural Networks and Deep Learning	Medical Robotics	3D Printing and Design
Introduction to PLC Programming	Radar Technologies	Cyber Forensics	Virtual Reality and Augmented Reality	Human Computer Interface	4G/5G Communication Networks

PROFESSIONAL ELECTIVE COURSES: VERTICALS

Vertical 1
Electronic System Design

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1.	22EC5301	Foundation Skills in Integrated Product Development	PEC1	3	0	0	3	3
2.	22EC5302	Measurements and Instrumentation	PEC2	3	0	0	3	3
3.	22EC5303	IoT Based System Design	PEC3	3	0	0	3	3
4.	22EC6301	PCB Design	PEC4	3	0	0	3	3
5.	22EC6302	ASIC Design	PEC5	3	0	0	3	3
6.	22EC7301	Introduction to PLC Programming	PEC6	3	0	0	3	3

Vertical 2
Communication Systems

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1.	22EC5304	Satellite Communication	PEC1	3	0	0	3	3
2.	22EC5305	Global Positioning Systems	PEC2	3	0	0	3	3
3.	22EC5306	Under Water Communication	PEC3	3	0	0	3	3
4.	22EC6303	RF System Design	PEC4	3	0	0	3	3
5.	22EC6304	Software Defined Radio	PEC5	3	0	0	3	3
6.	22EC7302	Radar Technologies	PEC6	3	0	0	3	3

Vertical 3
Wireless Networks

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1.	22EC5307	Network Security	PEC1	3	0	0	3	3
2.	22EC5308	Wireless Sensors and Networks	PEC2	3	0	0	3	3
3.	22EC5309	High Speed Networks	PEC3	3	0	0	3	3
4.	22EC6305	Cloud Computing	PEC4	3	0	0	3	3
5.	22EC6306	Wireless Broad Band Networks	PEC5	3	0	0	3	3
6.	22EC7303	Cyber Forensics	PEC6	3	0	0	3	3

Vertical 4
Signal and Image Processing

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1.	22EC5310	Digital Image Processing	PEC1	3	0	0	3	3
2.	22EC5311	Audio Signal Processing	PEC2	3	0	0	3	3
3.	22EC5312	Machine Vision	PEC3	3	0	0	3	3
4.	22EC6307	Artificial Intelligence and Machine Learning	PEC4	3	0	0	3	3
5.	22EC6308	Neural Networks and Deep Learning	PEC5	3	0	0	3	3
6.	22EC7304	Virtual Reality and Augmented Reality	PEC6	3	0	0	3	3

Vertical 5
Biomedical Technologies

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1.	22EC5311	Medical Electronics	PEC1	3	0	0	3	3
2.	22EC5312	Medical Informatics	PEC2	3	0	0	3	3
3.	22EC5313	Medical Image Processing	PEC3	3	0	0	3	3
4.	22EC6309	Biometric Systems	PEC4	3	0	0	3	3
5.	22EC6310	Medical robotics	PEC5	3	0	0	3	3
6.	22EC7305	Human Computer Interface	PEC6	3	0	0	3	3

Vertical 6
Diversified courses

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1.	22EC5314	App Development	PEC1	3	0	0	3	3
2.	22EC5315	Web Technologies	PEC2	3	0	0	3	3
3.	22EC5316	Ethical Hacking	PEC3	3	0	0	3	3
4.	22EC6311	Cryptocurrency and Blockchain Technologies	PEC4	3	0	0	3	3
5.	22EC6312	3D Printing and Design	PEC5	3	0	0	3	3
6.	22EC7306	4G/5G Communication Networks	PEC6	3	0	0	3	3

OPENELECTIVE I AND II (EMERGINGTECHNOLOGIES)

To be offered for the students other than CSE, IT, AI&ML, ECE & BIOMEDICAL

S NO.	COURSE CODE	COURSETITLE	CATEGORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AI6401	Artificial intelligence and Machine Learning Fundamentals	OEC	2	0	2	4	3
2	22CS6401	Blockchain Technology	OEC	2	0	2	4	3
3	22EC6401	Cyber Security	OEC	2	0	2	4	3
4	22EC6402	IoT Concepts and Applications	OEC	2	0	2	4	3
5	22IT6401	Data Science and Analytics	OEC	2	0	2	4	3
6	22BM6401	Augmented and Virtual Reality	OEC	2	0	2	4	3

OPEN ELECTIVE I AND II

To be offered for the students other than AUTO, AERO, AGRI, MECH, MCTS, CIVIL, EEE, CHEMICAL, FOOD TECH, E&I

S NO.	COURSE CODE	COURSETITLE	CATEGORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AE6401	Space Science	OEC	3	0	0	3	3
2	22MT6401	Introduction to Industrial Engineering	OEC	3	0	0	3	3
3	22MT6402	Industrial Safety and Environment	OEC	3	0	0	3	3
4	22CE6401	Climate Change and its Impact	OEC	3	0	0	3	3
5	22CE6402	Environment and Social Impact Assessment	OEC	3	0	0	3	3
6	22ME6401	Renewable Energy System	OEC	3	0	0	3	3
7	22ME6402	Additive Manufacturing systems	OEC	3	0	0	3	3
8	22EI6401	Introduction to Industrial Instrumentation and Control	OEC	3	0	0	3	3
9	22EI6402	Graphical Programming using Virtual Instrumentation	OEC	3	0	0	3	3
10	22AU6401	Recent Trends in Automotive Technology	OEC	3	0	0	3	3
11	22AU6402	Automotive Vehicle Safety	OEC	3	0	0	3	3
12	22EE6401	Digital Marketing	OEC	3	0	0	3	3
13	22EE6402	Research Methodology	OEC	3	0	0	3	3
14	22FT6401	Traditional Foods	OEC	3	0	0	3	3
15	22AG6401	Urban Agriculture and Organic Farming	OEC	3	0	0	3	3
16	22CH6401	Biomass and Bio Refinery	OEC	3	0	0	3	3

Note: Non-Circuit Departments can add one Open Elective course in the above list to offer for the circuit branches

OPEN ELECTIVE III

Students shall choose any one of the open elective courses such that the course content or title not belong to their own programme.

S NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22EC7401	Mobile Devices -Tools and Technology	OEC	3	0	0	3	3

OPEN ELECTIVE IV

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22LS7401	General studies for competitive	OEC	3	0	0	3	3

		examinations						
2	22LS7402	Human Rights, Women Rights and Gender equity	OEC	3	0	0	3	3
3	22LS7403	Indian ethos and Human values	OEC	3	0	0	3	3
4	22LS7404	Financial independence and management	OEC	3	0	0	3	3
5	22LS7405	Yoga for Human Excellence	OEC	3	0	0	3	3
6	22LS7406	Democracy and Good Governance	OEC	3	0	0	3	3
7	22LS7407	NCC Level - II	OEC	3	0	0	3	3

Enrollment for B.E. / B. TECH. (HONOURS) / Minor Degree (optional)

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E. / B. Tech. (Honours) or Minor Degree. For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only. For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes.

Clause 4.10 of Regulation 2022 is applicable for the Enrolment of B.E. / B. TECH. (HONOURS) / Minor Degree (Optional).

HONOUR DEGREE VERTICAL COURSES

S. No.	Vertical-I Sensor Technologies and IoT	Vertical II Advanced Communication Systems	Vertical III Semiconductor Chip Design and Testing
1	Realtime Embedded Systems	Cognitive Radio Networks	Wide Bandgap Devices
2	Sensor for IoT applications	Remote Sensing	Validation and Testing Technology
3	Advanced Processor Architectures	Rocketry and Space Mechanics	Low Power VLSI
4	IOT Processors	Underwater Navigation Systems	VLSI Testing and Design for Testability
5	Wearable Devices	Massive MIMO Networks	Mixed Signal IC Design Testing
6	Industrial IoT and Industry 4.0	Advanced Wireless Communication Techniques	Analog IC Design

Vertical-I
Sensor Technologies and IoT

S No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
1	22EC5305	Realtime Embedded Systems	HDC	3	0	0	3	40	60	100

2	22EC6305	Sensor for IoT applications	HDC	3	0	0	3	40	60	100
3	22EC6306	Advanced Processor Architectures	HDC	3	0	0	3	40	60	100
4	22EC7304	IOT Processors	HDC	3	0	0	3	40	60	100
5	22EC7305	Wearable Devices	HDC	3	0	0	3	40	60	100
6	22EC8301	Industrial IoT and Industry 4.0	HDC	3	0	0	3	40	60	100

Vertical-II
Advanced Communication Systems

S No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
1	22EC5306	Cognitive Radio Networks	HDC	3	0	0	3	40	60	100
2	22EC6307	Remote Sensing	HDC	3	0	0	3	40	60	100
3	22EC6308	Rocketry and Space Mechanics	HDC	3	0	0	3	40	60	100
4	22EC7306	Underwater Navigation Systems	HDC	3	0	0	3	40	60	100
5	22EC7307	Massive MIMO Networks	HDC	3	0	0	3	40	60	100
6	22EC8203	Advanced Wireless Communication Techniques	HDC	3	0	0	3	40	60	100

Vertical-III
Semiconductor Chip Design and Testing

S No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
1	22EC5307	Wide Bandgap Devices	HDC	3	0	0	3	40	60	100
2	22EC6309	Validation and Testing Technology	HDC	3	0	0	3	40	60	100
3	22EC6310	Low Power VLSI	HDC	3	0	0	3	40	60	100
4	22EC7308	VLSI Testing and Design for Testability	HDC	3	0	0	3	40	60	100
5	22EC7309	Mixed Signal IC Design Testing	HDC	3	0	0	3	40	60	100
6	22EC8202	Analog IC Design	HDC	3	0	0	3	40	60	100

MINOR DEGREE VERTICAL COURSES
Embedded and IoT

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22EC5601	Electronics for Embedded Systems	MDC	3	0	0	3	3

2	22EC6601	Microcontroller and its Applications	MDC	3	0	0	3	3
3	22EC6602	Sensor and Embedded Systems	MDC	3	0	0	3	3
4	22EC7601	Fundamentals of IoT	MDC	3	0	0	3	3
5	22EC7602	Industrial IoT and Industry 4.0	MDC	3	0	0	3	3
6	22EC8601	IoT for Smart Systems	MDC	3	0	0	3	3

Vertical II
Fintech and Block Chain

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	21CS5602	Financial Management	MDC	3	0	0	3	3
2	21MB6231	Fundamentals of Investment	MDC	3	0	0	3	3
3	21MB6232	Banking, Financial Services andInsurance	MDC	3	0	0	3	3
4	21MB7231	Introduction to Blockchain and its Applications	MDC	3	0	0	3	3
5	21MB7232	Fintech Personal Finance and Payments	MDC	3	0	0	3	3
6	21MB8231	Introduction to Fintech	MDC	3	0	0	3	3

Vertical III
Entrepreneurship

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	21BA5601	Foundation of Entrepreneurship	MDC	3	0	0	3	3
2	21BA6601	Introduction to Business Venture	MDC	3	0	0	3	3
3	21BA6602	Team Building & Leadership Management for Business	MDC	3	0	0	3	3
4	21BA7601	Creativity & Innovation in Entrepreneurship	MDC	3	0	0	3	3
5	21BA7602	Principles of Marketing Management for Business	MDC	3	0	0	3	3
6	21BA8601	Human Resource Management for Entrepreneurs	MDC	3	0	0	3	3
7	21BA8602	Financing New Business Ventures	MDC	3	0	0	3	3

Vertical IV
Environment and Sustainability

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	21CEXXXX	Sustainable Infrastructure Development	MDC	3	0	0	3	3

2	21AG6233	Sustainable Agriculture and Environmental Management	MDC	3	0	0	3	3
3	21BM6233	Sustainable Bio Materials	MDC	3	0	0	3	3
4	21ME7233	Materials for Energy Sustainability	MDC	3	0	0	3	3
5	21CE7233	Green Technology	MDC	3	0	0	3	3
6	21CE8232	Environmental Quality Monitoring and Analysis	MDC	3	0	0	3	3

P. Hayk

Chairman Bos

Chairman - Bos
ECE - HiCET

Dean-Academics

Dean (Academics)
HiCET

Principal

HINDUSTHAN ★ ACADEMIC COUNCIL ★ HINDUSTHAN COLLEGE OF ENGG & TECH
Chairman

SYLLABUS

Third Semester Syllabus
(for the batch admitted during 2023 – 2024)

Programme	Course Code	Name of the Course	L	T	P	C
B.E	22MA3102	COMPLEX ANALYSIS AND TRANSFORMS (EEE, EIE, ECE)	3	1	0	4
Course Objective	**The learner should be able to** 1. To understand the analytic functions and its properties. 2. To review Cauchy's theorem and its applications in evaluation of integral. 3. To examine Fourier series which is central to many applications in engineering 4. To gain knowledge in Fourier transform techniques in various situations. 5. To upskill the concept in Z transform techniques for discrete time systems					

Unit	Description	Instructional Hours
I	**COMPLEX DIFFERENTIATION** Functions of complex variables – Analytic functions – Cauchy's – Riemann equations and sufficient conditions (excluding proof) – Construction of analytic functions – Milne –Thomson's method – Conformal mapping $w = A+z$, Az, $1/z$ and bilinear transformations.	12
II	**COMPLEX INTEGRATION** Cauchy's integral theorem – Cauchy's integral formula –Taylor's and Laurent's series (statement only) –Residues - Cauchy's Residue theorem - Contour Integration with unit circle only.	12
III	**FOURIER SERIES** Dirichlet's conditions- General Fourier Series – Odd and Even Functions – Change of Interval - Parseval's Identity - Half Range Sine and Cosine Series.-Harmonic analysis	12
IV	**FOURIER TRANSFORMS** Fourier Transform Pairs - Fourier Sine and Cosine transforms – Properties - Transforms of Simple functions – Convolution Theorem (Statement only) – Parseval's identity (Statement only).	12
V	**Z - TRANSFORMS AND DIFFERENCE EQUATIONS** Z- Transforms - Elementary properties – Inverse Z - transform (using partial fraction and residues) – Convolution theorem(excluding proof)– Solution of difference equations using Z – transform	12
	Total Instructional Hours	**60**
Course Outcome	**At the end of the course, the learner will be able to** CO1: Understand the concept of analytic functions and discuss its properties. CO2: Evaluate various integrals by using Cauchy's residue theorem and classify singularities and derive Laurent series expansion CO3: Understand the principles of Fourier series which helps them to solve physical problems of Engineering CO4: Apply Fourier transform techniques which extend its applications. CO5: Illustrate the Z- transforms for analyzing discrete-time signals and systems	

TEXT BOOKS:

T1 – Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 2019.

T2 - Veerarajan T, "Engineering Mathematics", McGraw Hill Education (India) Pvt Ltd, New Delhi, 2016.

REFERENCE BOOKS:

R1 - James Ward Brown, Ruel Vance Churchill, Complex Variables and Applications, McGraw-Hill Higher Education, 2004

R2 - Dennis Zill, Warren S. Wright, Michael R. Cullen, Advanced Engineering Mathematics, Jones & Bartlett Learning, 2011

R3 - Ian N. Sneddon, Elements of Partial Differential Equations, Courier Corporation, 2013

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	1	1	-	-	1	-	2	2	2
CO2	3	3	3	2	2	1	1	-	-	1	-	2	2	2
CO3	3	3	3	3	3	1	-	-	-	1	-	2	2	2
CO4	3	3	3	2	2	1	-	-	-	1	-	2	2	2
CO5	3	3	3	3	3	1	-	-	-	1	-	2	2	2
AVG	3	3	3	2.4	2.4	1	1			1		2	2	2

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Programme	Course Code	Name of the Course	L	T	P	C
B.E	22EC3201	Electronic Circuits	3	0	0	3

Course Objective	**The learner should be able to** 1. To discover about biasing of BJT and JFET circuits. 2. To observe the behavior of small signal amplifiers using BJT. 3. To provide an insight on the large signal amplifiers and linear wave shaping circuits. 4. To impart knowledge on feedback amplifiers. 5. To discuss the operating principles of oscillators and multivibrators.

Unit	Description	Instructional Hours
I	**BIASING OF BJT AND FET** BJT– Need for biasing, DC Load Line and Bias Point – Various biasing methods of BJT – Thermal stability – Stability factors – Bias compensation techniques using Diode, thermistor and sensistor – Biasing BJT Switching Circuits- JFET – DC Load Line and Bias Point – Various biasing methods of JFET – MOSFET Biasing – Biasing FET Switching Circuit.	9

II	**SMALL SIGNAL AMPLIFIERS** h-parameter small-signal equivalent circuit –Midband analysis of single stage, CE amplifiers - Low frequency response of CE amplifiers - High frequency π model -High frequency response of CE amplifiers, Multistage amplifiers -Darlington Amplifier.	9
III	**LARGE SIGNAL AMPLIFIERS AND LINEAR WAVE SHAPING CIRCUITS** Classification of large signal amplifiers –Class A , Class B amplifier – Cross over Distortion -Push-Pull amplifier – complementary symmetry push-pull amplifier, Tuned amplifiers -Class C tuned amplifier - Integrator- Differentiator- Clippers- Clampers- Diode comparator .	9
IV	**FEEDBACK AMPLIFIERS** Block diagram, Loop gain, Gain with feedback, Effects of negative feedback. Sensitivity and desensitivity of gain, Cut-off frequencies, distortion, noise, input impedance and output impedance with feedback. Four types of negative feedback connections - voltage series feedback, voltage shunt feedback, current series feedback and current shunt feedback.	9
V	**OSCILLATORS AND MULTIVIBRATORS** Classification of oscillator, Barkhausen Criterion - Mechanism for start of oscillation and stabilization of amplitude. General form of an Oscillator, Analysis of Hartley, Colpitt's, RC phase shift and Wien bridge Oscillator- Astablemultivibrator–Monostablemultivibrator and Bistablemultivibrator.	9
	Total Instructional Hours	**45**
Course Outcome	**At the end of the course, the learner will be able to** CO1: Understand the need, methods, and thermal stability of biasing BJT and FET, including biasing for switching circuits. CO2: Analyze small signal amplifiers using h-parameters and understand their frequency responses and configurations, including CE and multistage amplifiers. CO3: Classify and analyze large signal amplifiers and wave shaping circuits like integrators, differentiators, clippers, clampers, and diode comparators. CO4: Comprehend the effects of negative feedback on gain, frequency response, distortion, noise, and impedance in various feedback configurations. CO5: Analyze the principles, design, and operation of various oscillators and multivibrators, including Hartley, Colpitt's, RC phase shift.	

TEXT BOOKS:

T1- S.Salivahanan, N.Suresh Kumar and A.Vallavaraj, "Electronic Devices and Circuits", 3rd Edition,2012, McGraw Hill.(All units)

T2- Donald .A. Neamen, "Electronic Circuit Analysis and Design" ,3 rd edition, Tata McGraw Hill, 2010(Unit IV)

REFERENCE BOOKS:

R1-Robert L.Boylestad, Louis Nasheisky, "Electronic Devices and Circuit Theory", 9th Edition, 2007.

R2- Jacob Millman,Christos C.Halkias,"Electronic Devices and Circuits" McGraw Hill , Edition 1991.

R3- D.Schilling and C.Belove, "Electronic Circuits", 3rd Edition, McGraw Hill, 1989.

R4- David A. Bell, "Electronic Devices and Circuits", fifth edition, Oxford Higher education

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	-		-	-	-	-	-	3	3	2
CO2	3	3	3	2	-		-	-	-	-	-	3	3	2
CO3	3	2	3	2	-		-	-	-	-	-	3	3	2
CO4	3	2	3	2	-		-	-	-	-	-	3	3	2
CO5	3	2	3	2	-		-	-	-	-	-	3	3	2
AVG	3	2.4	3	2								3	3	2

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Programme	Course Code	Name of the Course	L	T	P	C
B.E	22EC3202	Signals and Systems	3	0	0	3

Course Objective	The learner should be able to 1. To understand the basic signals and their properties. 2. To observe the mathematical tool of Fourier series and transforms. 3. To analyses the concept of system analysis using Laplace transforms. 4. To upskill the knowledge in discrete signal analysis using transforms.

Unit	Description	Instructional Hours
I	**SIGNALS AND SYSTEM REPRESENTATION & CLASSIFICATION** Standard signal representation –continuous and discrete domain. Sampling: Nyquist theorem, Representation of CT signals by samples, Reconstruction of CT signal from samples Mathematical operation on signals, classification of signals and system -analog and discrete.	9
II	**CONTINUOUS TIME (CT) SIGNALS** Fourier series analysis-Trigonometric form, spectrum of continuous time (CT) signals- Fourier and Laplace transform of standard signals-Region of Convergence (ROC).Inverse Fourier and Laplace transform–partial fraction method, Properties.	9
III	**LINEAR TIME INVARIANT- CONTINUOUS TIME (CT) SYSTEMS** Block diagram representation of system- Direct form I & II. Applying Fourier and Laplace transform : Transfer function ,impulse response and Frequency response of CT system , Convolution integrals-Integral & Graphical method.	9
IV	**DISCRETE TIME SIGNALS** DTFT and Inverse DTFT – properties of DTFT - z transform and Inverse z-transform – Region of Convergence, properties of z transform. Convolution sum-Graphical and Matrix method.	9
V	**LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS** Block diagram representation of system- Direct form I & II structure.DTFT and Z transform analysis of systems: Transfer function, impulse response, system response and Frequency response, Convolution and de-convolution	9
	Total Instructional Hours	**45**

Course Outcome	**At the end of the course, the learner will be able to** CO1: Understand and apply signal representation, Nyquist theorem, and signal reconstruction. CO2: Analyze CT signals using Fourier and Laplace transforms, including ROC and properties. CO3: Examine CT systems using Fourier and Laplace transforms to derive transfer functions and appraise impulse responses. CO4: Utilize DTFT and z-transform for signal analysis, including convolution operations. CO5: Represent and evaluate DT systems by applying DTFT and z-transform to determine transfer functions and system responses.

TEXT BOOKS:

T1 - AllanV.Oppenheim, S.Wilsky and S.H.Nawab, "Signals and Systems", Pearson, 2007.

T2 - P Ramakrishna Rao, "Signals and System", Tata McGraw-Hill Education,2010.

REFERENCE BOOKS:

R1 - M.J.Roberts, "Signals & Systems Analysis using Transform Methods & MATLAB", McGraw Hill, 2017.

R2 - B. P. Lathi, "Principles of Linear Systems and Signals", Second Edition, Oxford, 2009.

R3 - RameshBabu.P and Anandanatarajan, "Signals and Systems",Fifthedition,Scitech publications,2017.

R4 - NagoorKani, "Signals and Systems,Simplified", McGrawHill Publication, 2018.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	-		-	-	-	-	-	3	3	2
CO2	3	3	3	3	-		-	-	-	-	-	3	3	2
CO3	3	3	3	3	-		-	-	-	-	-	3	3	2
CO4	3	3	3	3	-		-	-	-	-	-	3	3	2
CO5	3	3	3	3	-		-	-	-	-	-	3	3	2
AVG	3	3	3	3	-		-	-	-	-	-	3	3	2

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Programme	Course Code	Name of the Course	L	T	P	C
B.E	22EC3203	Digital Electronics	3	0	0	3

Course Objective	**The learner should be able to** 1. To impart knowledge on different methods used for the simplification of Boolean functions 2. To explain the working of various combinational circuits 3. To convey the knowledge about synchronous sequential circuits. 4. To gain knowledge about asynchronous sequential circuits. 5. To disseminate knowledge on different types of memories.

Unit	Description	Instructional Hours

I	**DIGITAL FUNDAMENTALS** Boolean operation and expressions- Laws and rules of Boolean algebra - Simplification using Boolean algebra - Sum of Products (SOP) - Product of Sums (POS)- Karnaugh map Minimization- Quine - McCluskey method of minimization- Logic Gates- NAND–NOR implementations.	9
II	**COMBINATIONAL CIRCUIT DESIGN** Analysis and design of combinational circuits - Circuits for arithmetic operations: adder, subtractor, Carry look ahead adder-BCD adder-Magnitude Comparator-Encoders and Decoders-Multiplexers and Demultiplexers, Parity checker and generators.	9
III	**SYNCHRONOUS SEQUENTIAL CIRCUITS** Latches- Flip-flops- SR, JK, D, T, and Master-Slave - Edge triggering - Level Triggering-Analysis and design of synchronous sequential circuits: State diagram - State table – State minimization - State assignment, Synchronous Up/Down counters, mod n counters, Shift registers, Universal shift registers.	9
IV	**ASYNCHRONOUS SEQUENTIAL CIRCUITS** Analysis and design of asynchronous sequential circuits - Reduction of state and flow tables – Race-free state assignment – Hazards.	9
V	**MEMORY DEVICES AND DIGITAL INTEGRATED CIRCUITS** Classification of memories, Read/write operations- Memory decoding and expansion, Static and Dynamic RAM- PLDs- Architecture and implementation - Digital logic families -Characteristics - TTL, ECL and CMOS logic.	9
	Total Instructional Hours	45
Course Outcome	**At the end of the course, the learner will be able to** CO1: Understand Boolean operations, algebra simplification methods, and implement logic gates using NAND and NOR. CO2: Structuring and design combinational circuits for arithmetic operations and components including parity checkers. CO3: Analyze and design synchronous sequential circuits, including flip-flops, counters, and shift registers, using state diagrams and tables. CO4: Integrating and design asynchronous sequential circuits with state and flow table reduction, race-free state assignment, and hazard elimination. CO5: Construct memory classification, operations, decoding, PLDs, and the characteristics of various digital logic families like TTL, ECL, and CMOS.	

TEXT BOOKS:

T1- M. Morris Mano and Michael D. Ciletti, "Digital Design", 5th Edition, Pearson, 2013.

T2-Thomas L. Floyd, "Digital Fundamentals", 10th Edition, Pearson Education Inc, 2011.

REFERENCE BOOKS:

R1- A.Anandkumar, "Fundamentals of Digital Electronics", fourth edition ,PHI Learning Pvt. Ltd,2016.

R2- S.Salivahanan and S.Arivazhagan, "Digital Circuits and Design" ,Vikas publishing House Pvt. Ltd, 2013

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	-	-	-	-	-	1	1	3	2
CO2	3	3	2	2	2	-	-	-	-	-	1	1	3	2
CO3	3	2	3	2	2	-	-	-	-	-	1	1	3	3
CO4	3	3	3	2	2	-	-	-	-	-	1	1	3	3
CO5	3	3	3	2	2	-	-	-	-	-	1	1	3	3
AVG	3	2.8	2.8	2	2						1	1	3	2.6

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Programme	Course Code	Name of the Course	L	T	P	C
B.E	22EC3204	Circuits and Networks	2	0	0	2

Course Objective	**The learner should be able to** CO1:To upskill the fundamental concepts and introduce mesh and nodal analysis techniques for DC and AC Circuits CO2:To introduce various network reduction techniques and different network Theorems used for circuit analysis CO3:To introduce the phenomenon of resonance in coupled circuits CO4:To impart knowledge on transient response of the electric circuits CO5:To review two port networks and their characterization	
Unit	**Description**	**Instructional Hours**
I	**BASIC CONCEPTS OF DC AND AC CIRCUITS** Introduction to Basic Circuit Elements, Ohm's Law – Kirchhoff's Voltage law –Kirchhoff's Current law–Resistors in series and parallel Combinations, A.C Circuits –Complex Impedance, Mesh and Nodal analysis for D.C and A.C. circuits	9
II	**NETWORK REDUCTION AND THEOREMS** Network Reduction: Voltage and Current Division, Source Transformation, T & π Networks- Star-Delta conversion. Network theorems: Superposition theorem, Thevenin's theorem, Norton's theorem, Reciprocity theorem, Millman's theorem, and Maximum power transfer theorem, Application of Network theorems to DC and AC Circuits.	9
III	**RESONANCE AND COUPLED CIRCUITS** Resonance – Series and Parallel resonance – Variation of impedance with frequency -Variation in current through and voltage across L and C with frequency – Bandwidth – Q factor -Selectivity. Self-inductance – Mutual inductance – Dot rule – Coefficient of coupling –Series, Parallel connection of coupled inductors – Single tuned and double tuned coupled circuits	9
IV	**TRANSIENT ANALYSIS** Natural response-Forced response – Transient response of RC, RL and RLC circuits to excitation by Step Signal, Impulse Signal and exponential sources – Complete response of RC, RL and RLC Circuits to sinusoidal excitation.	9

V	**TWO PORT NETWORKS** Two port networks, Z parameters, Y parameters, Transmission (ABCD) parameters, Hybrid(H) Parameters, Interconnection of Two Port Networks (Series, Parallel and Cascade)	9
	Total Instructional Hours	45
Course Outcome	**At the end of the course, the learner will be able to** CO1: Understand circuit elements, laws (Ohm's, Kirchhoff's), and analyze circuits using mesh and nodal methods for both DC and AC scenarios. CO2: Apply network reduction techniques/network theorems and determine behaviour of the given DC and AC circuit CO3: Analyze series and parallel resonance, impedance variation with frequency, Q factor, and coupled circuits. CO4: Evaluate natural, forced, and transient responses of RC, RL, and RLC circuits to various excitation signals. CO5: Comprehend and assess two port networks utilizing Z, Y, ABCD, and H parameters, and their interrelationships (series, parallel, cascade).	

TEXT BOOKS:

T1- William H. Hayt, Jr. Jack E. Kemmerly and Steven M. Durbin, —Engineering Circuit Analysis‖, McGraw Hill Science Engineering, Eighth Edition, 11th Reprint 2016.
T2- Joseph Edminister and Mahmood Nahvi, —Electric Circuits‖, Schaum's Outline Series, Tata McGraw Hill Publishing Company, New Delhi, Fifth Edition Reprint 2016.

REFERENCE BOOKS:

R1-Hayt and Kemmerly, "Engineering Circuit Analysis", McGraw Hill Education, New Delhi, 8th Ed, 2013.
R2-Van Valkenberg, "Network Analysis", Prentice Hall India Learning Pvt. Ltd., 3rd Edition, 1980.
R3-K. S. Suresh Kumar, "Electric Circuit Analysis", Pearson Publications, 2013.
R4-Chakrabarti, "Circuit Theory Analysis and Synthesis", DhanpatRai& Co., Seventh - Revised edition, 2018
R5-R. Gupta, "Network Analysis and Synthesis", S. Chand & Company Ltd, 2010.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	-		-	-	-	-	-	3	3	2
CO2	3	3	3	2	-		-	-	-	-	-	3	3	2
CO3	3	2	3	2	-		-	-	-	-	-	3	3	2
CO4	3	2	3	2	-		-	-	-	-	-	3	3	2
CO5	3	2	3	2	-		-	-	-	-	-	3	3	2
AVG	3	2.4	3	2								3	3	2

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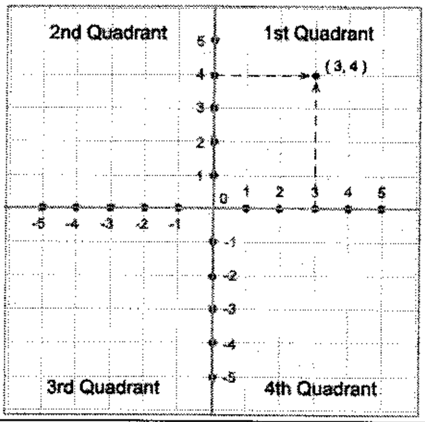
Programme	Course Code	Name of the Course	L	T	P	C
B.E	22EC3251	**Object Oriented Programming using Java**	2	0	2	3

Course Objective	**The learner should be able to** 1. To understand the concepts of Object Oriented Programming. 2. To impart the fundamental concepts of core JAVA. 3. To enable the students to gain programming skills in JAVA. 4. To know how to handle exceptions. 5. To develop multithread programming logic	
Unit	**Description**	**Instructional Hours**
I	**INTRODUCTIONTOOBJECTORIENTEDPROGRAMMING** Object oriented programming concepts – objects-classes- methods and messages-abstraction and encapsulation-inheritance- abstract classes-polymorphism-Benefits of OOP, Application of OOP-Java Evolution-Features of Java-Difference of Java from C and C++.	9
II	**OVERVIEW OF JAVA LANGUAGE** Basics of Java programming, Data types, constants -Variables and Arrays, Operators and expressions , Decision making and branching – looping –Classes, Objects and Methods- access specifiers – static members –Constructors-this keyword-finalize method	9
III	**PACKAGES AND INTERFACES** Java API Packages –Naming conventions-creating, accessing, using Packages- Inheritance– Method Overriding- Abstract class Interfaces: Multiple inheritance-defining, extending, implementing interfaces- -final keyword	9
IV	**EXCEPTION HANDLING** Fundamentals-Exception types –Uncaught exceptions-Using try and catch-Multiple Catch-Nested try-Throws-Finally-Built in Exceptions-Throwing own exceptions	9
V	**MULTITHREAD PROGRAMMING** Creating Threads- Extending thread class-Stopping and Blocking Thread-Life cycle –Using Thread-Thread Exceptions-Thread priority-Synchronization-Runnable Interface-Inter thread communication	9
	Total Instructional Hours	45

S.No	List of Experiments
1	Ramu went to a restaurant to had his meals. He is charged with Rs. 70.50. The tax should be8% of the meal cost. The tip should be 10% of the total after adding the tax. Write a java program to display the mealcost,taxamount, tip amount, andtotalbillon the screen.
2	Rhea Pandey's teacher has asked her to prepare well for the lesson on seasons. When her teacher tells a month, she needs to say the season corresponding to that month. Write a java program to solve the above task. Spring – March to May, Summer – June to August, Autumn – September to November and, Winter – December to February. Month should be in the range 1 to 12. If not the output should be "Invalid month"
3	Write a Java program to find the eligibility of admission for a professional course based on the following criteria: Eligibility Criteria: Marks in Maths>=65 and Marks in Phy>=55 and Marks in Chem>=50 and Total in all three subject >=190 or Total in Maths and Physics >=140 Input the marks obtained in Physics :65 Input the marks obtained in Chemistry :51 Input the marks obtained in Mathematics :72 Total marks of Maths, Physics and Chemistry: 188 Total marks of Maths and Physics: 137 The candidate is not eligible.

4	Write a Java program to accept a coordinate point in a XY coordinate system and determine in which quadrant the coordinate pointlies. 
5	XYZ Technologies is in the process of increment the salary of the employees. This increment is done based on their salary and their performance appraisal rating. If the appraisal rating is between 1 and 3, the increment is 10% of the salary. If the appraisal rating is between 3.1 and 4, the increment is 25% of the salary. If the appraisal rating is between 4.1 and 5, the increment is 30% of the salary. Help them to do this, by writing a Java program that displays the incremented salary. Note: If either the salary is 0 or negative (or) if the appraisal rating is not in the range 1 to 5 (inclusive), then the output should be "Invalid Input". XYZ TECHNOLOGIES
6	DraftajavaProgramtoCalculateAverageof'n'NumbersUsingArrays
7	Suppose you have a Piggie Bank with an initial amount of $50 and you have to add some more amount to it. Create a class 'AddAmount' with a data member named 'amount' with an initial value of $50. Now make two constructors of this class as follows: 1 - without any parameter - no amount will be added to the PiggieBank 2 - having a parameter which is the amount that will be added to the PiggieBank Create an object of the 'AddAmount' class and display the final amount in the Piggie Bank.
8	Write a java program for multilevel inheritance
9	Write a java program to create an abstract class named Shape that contains an empty method named number Of Sides( ).Provide three classes named Trapezoid, Triangle and Hexagon such that each one of the classes extends the class Shape. Each one of the classes contains only the method number Of Sides( ) that shows the number of sides in the given geometrical figures
10	Write a java program in which you will declare two interface sum and sub inherits these interfaces through class A1 and display their content.
11	Write a java program for multiple exception handling.
12	Write a java program to implement multithreading
Course Outcome	**At the end of the course, the learner will be able to** CO1: Understand the concepts of OOPs. CO2: Simulate the syntax, semantics and classes in Java language. CO3: Design program using User Defined packages and interfaces. CO4: Develop applications using Exception handling in java CO5: Implement the use of multithread programming.

TEXT BOOKS:

T1 – Herbert Schild, "Java The Complete Reference", Eighth Edition, McGraw Hill, 201

T2 - E Balagurusamy, "Programming with JAVA", Fifth Edition, McGraw Hill, 2015.

REFERENCE BOOKS:

R1 - .Balagurusamy, "Programming with java A Primer", fifth edition, McGraw – Hill 2014

R2 - H.M.Deitel, P.J.Deitel, "Java : how to program", Fifth edition, Prentice Hall of India private limited,2003.

R3 - Cay S. Horstmann, "Core Java Fundamentals", Volume 1, 11 th Edition, Prentice Hall, 2018

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	3		-	-	3	-	-	2	3	1
CO2	3	2	3	3	3		-	-		-	-	3	3	3
CO3	3	3	3	3	2		-	-	3	2	-	2	3	3
CO4	3	2	2	3	3		-	-			-	3	3	2
CO5	3	3	3	3	2		-	-	3	2	-	2	3	2
AVG	3	3	3	3	3				3	2		2	3	2

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Programme	Course Code	Name of the Course	L	P	T	C
BE	22EC3001	Electronic Circuits Lab	0	0	3	1.5

Course Objective	To introduce various methods of biasing transistors for designing amplifiers. To design and analysis transistor as amplifiers. To analyze and design wave shaping circuits and signal generator. To design and analysis multivibrators. To simulate various electronic circuits using multisim.
Exp.No.	**Description of the Experiments**
1	Design, construct and test the following biasing circuits and find the transient analysis and frequency response of Single BJT and FET. a) Fixed bias b) Self bias
2	Current series Feedback Amplifiers
3	RC Phase shift oscillator
4	Hartley Oscillator
5	Class C tuned Amplifier
6	Class B and
7	Class AB Amplifiers
8	Common Collector Amplifier
9	Astablemultivibrator
	Simulation Experiments
10	Darlington Amplifier
11	Colpitt's Oscillator
12	Integrator, Differentiator, Clipper and Clamper circuits.

13	Monostable multivibrator
Total Practical Hours	**45**
Course Outcome	CO1: Design and analyze the biasing circuits CO2: Construct and analyze various amplifier configurations CO3: Construct and analyze the performance of signal generators for a specified frequency CO4: Design and analyze the multivibrator circuits CO5: Analyze the performance of electronic circuits using PSPICE.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	3	3		-	-	2	2	-	3	3	3
CO2	3	2	3	3	3		-	-	2	2	-	3	3	3
CO3	3	2	3	3	3		-	-	2	2	-	3	3	3
CO4	3	2	3	3	3		-	-	2	2	-	3	3	3
C05	3	2	3	3	3		-	-	2	2	-	3	3	3
AVG	3	2	3	3	3				2	2		3	3	3

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Programme	**Course Code**	**Name of the Course**	**L**	**P**	**T**	**C**
BE	**22EC3002**	**Digital Electronics Lab**	**0**	**0**	**3**	**1.5**

Course Objective	To design and analysis different adder circuits. To Demonstrate the formal procedures for the analysis and design of combinational circuits To Use appropriate design technique to design the different sequential circuits. To Apply the concepts of Hardware Description Language for designing combinational circuits To Apply the concepts of Hardware Description Language for designing sequential circuits
Exp.No.	**Description of the Experiments**
	Design, implement and test the following digital circuits,
1	4-bit binary Adder / Subtractor using IC 7483.
2	BCD adder using IC 7483.
3	Multiplexer and De-multiplexer using logic gates.
4	Encoder and Decoder using logic gates.

5	Parity checker and generator.
6	4 – bit binary ripple counter.
7	3-bit synchronous up / down counter.
8	4 – bit shift register using Flip – flops.
	Software Experiments
1	Adder / Subtractor Circuits and BCD adder using Verilog code
2	Magnitude Comparator and ALU using Verilog code
3	Synchronous Counters using Verilog code
4	Asynchronous counters using Verilog code
5	Sequence Detector using Verilog code for digital lab
Total Practical Hours	45
Course Outcome	CO1: Construct the performance of various combinational circuits. CO2: Implement and develop various synchronous logic circuits. CO3: Analyze the performance of various combinational circuits. CO4: Design and develop various synchronous logic circuits. CO5: Formulate the design procedure of combinational and sequential digital circuits using Hardware Description Language

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	3	3		-	-	2	2	-	3	3	3
CO2	3	2	3	3	3		-	-	2	2	-	3	3	3
CO3	3	2	3	3	3		-	-	2	2	-	3	3	3
CO4	3	2	3	3	3		-	-	2	2	-	3	3	3
CO5	3	2	3	3	3		-	-	2	2	-	3	3	3
AVG	3	2	3	3	3				2	2		3	3	3

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Programme	Course Code	Course Title	L	T	P	C
BE/BTECH	22HE3071	Soft Skill-II	1	0	0	1

Course Objectives:	1. To make the students aware of the importance, the role and the content of soft skills through Instruction, knowledge acquisition, demonstration and practice. 2. To learn everything from equations to probability with a completely different approach. 3.To make the students learn on an increased ability to explain the problem comprehensively.

Unit	Description	Instructional Hours
I	**Group Discussion & Presentation Skills:** GD skills – Understanding the objective and skills tested in a GD – General types of GDs – Roles in a GD – Do's & Don'ts – Mock GD & Feedback. - Presentation Skills – Stages involved in an effective presentation – selection of topic, content, aids – Engaging the audience – Time management – Mock Presentations & Feedback	4
II	**Interview Skills and Personality Skills:** Interview handling Skills – Self preparation checklist – Grooming tips: do's & don'ts – mock interview & feedback - Interpersonal skills-creative thinking-problem solving-analytical skills	3
III	**Business Etiquette & Ethics:** Etiquette – Telephone & E-mail etiquette – Dining etiquette – do's & Don'ts in a formal setting – how to impress. Ethics – Importance of Ethics and Values – Choices and Dilemmas faced – Discussions from news headlines.	3
IV	**Quantitative Aptitude:** Permutation, Combination - Probability - Logarithm - Quadratic Equations - Algebra - Progression - Geometry - Mensuration.	3
V	**Logical Reasoning:** Logical Connectives - Syllogisms - Venn Diagrams – Cubes - Coded inequalities - Conditions and Grouping	2

Course Outcome:	CO1:	Develop skills for effective participation in group discussions and delivering impactful presentations, with mock sessions for practical feedback.
	CO2:	Enhancing interview skills with preparation, grooming tips, and practice sessions, cultivating interpersonal, creative, problem-solving, and analytical abilities.
	CO3:	Apply proper etiquette in communication and formal settings, alongside discussions on ethics, values, and real-world dilemmas.
	CO4:	Master mathematical concepts including permutation, combination, probability, logarithm, quadratic equations, algebra, progression, geometry, and mensuration.
	CO5:	Develop proficiency in logical connectives, syllogisms, Venn diagrams, cubes, coded inequalities, conditions, and grouping for logical reasoning challenges.

REFERENCE BOOKS

R1:	Bridging the Soft Skills Gap: How to Teach the Missing Basics to Todays Young Talent- Bruce Tulgan
R2:	Quantitative Aptitude for Competitive Examinations (5th Edition) - Abhjit Guha
R3:	How to crack test of Reasoning - Jaikishan and Premkishan
R4:	The hand on guide to Analytical Reasoning and Logical Reasoning - Peeyush Bhardwaj

Chairman Bos

Chairman - Bos
ECE - HiCET

ACADEMIC COUNCIL HINDUSTHAN COLLEGE OF ENGG & TECH Chairman

Dean-Academics

Dean (Academics)
HiCET

Programme	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech	22MC3191	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	2	0	0	0

Course Objective	**The student should be able** 1.To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system. 2.To make the students understand the traditional knowledge and analyze it and apply it to their day to day life. 3.To impart basic principles of thought process, Itihas and Dharma Shastra and connecting society and nature. 4. To understand the concept of Intellectual and intellectual property rights with special Reference. 5. The course focuses on introduction to Indian Knowledge System, Indian perspective of modern scientific world-view and basic principles of Yoga and Indian philosophy

Unit	Description	Instructional Hours
I	**Introduction to traditional knowledge:** Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, Indigenous Knowledge (IK), characteristics, traditional knowledge vs indigenous knowledge, traditional knowledge vs western knowledge	6
II	**Protection of traditional knowledge:** The need for protecting traditional knowledge, Significance of TK Protection, value of TK in global economy, Role of Government to harness TK	6
III	**Itihas and Dharma-Shastra** **Itihas:** The Mahabharata - The Puranas - The Ramayana **Dharma-Shastra:** Manu Needhi - The Tirukkural– ThiruArutpa	6
IV	**Traditional knowledge and intellectual property:** Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge	6
V	**Indian philosophy** Jain – Buddhist – Charvaka – Samkhya - Yoga - Nyaya - Vaisheshika-SaivaSiddhanta	6
	Total Instructional Hours	**30**

Course Outcome	**After completion of the course the learner will be able** 1. Identify the concept of Traditional knowledge and its importance. 2. Explain the need and importance of protecting traditional knowledge. 3. Explain the need and importance of Itihas and Dharma Shastra. 4. Interpret the concepts of Intellectual property to protect the traditional knowledge. 5. Interpret the concepts of indian philosophy to protect the traditional knowledge.

REFERENCE BOOKS:

Traditional Knowledge System in India, by Amit Jha, 2009.
2. Traditional Knowledge System in India by Amit Jha Atlantic publishers, 2002.
3. "Knowledge Traditions and Practices of India" Kapil Kapoor1, Michel Danino2.
4. V. Sivaramakrishna (Ed.), Cultural Heritage of India-Course Material, BharatiyaVidya Bhavan, Mumbai, 5th Edition, 2014.
5. V N Jha (Eng. Trans,), Tarkasangraha of Annam Bhatta, InernationalChinmay Foundation, Velliarnad, Amaku,am.

Chairman Bos

Chairman - BoS
ECE - HiCET

ACADEMIC COUNCIL
Chairman
HINDUSTHAN COLLEGE OF ENGG & TECH

Dean-Academics

Dean (Academics)
HICET

HINDUSTHAN COLLEGE OF ENGINEERING AND TECHNOLOGY
(An Autonomous Institution, Affiliated to Anna University, Chennai
Approved by AICTE, New Delhi& Accredited by NAAC with 'A ++' Grade)
Valley Campus, Pollachi Highway, Coimbatore, Tamil Nadu

HINDUSTHAN
EDUCATIONAL AND CHARITABLE TRUST

HICET

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

R-2022 Curriculum and Syllabus for ODD Semester

2022-2026 Batch

Academic Year: 2024-2025

Curriculum
R2022

Curriculum under R2022
(for the batch admitted during 2022 – 2023)

SEMESTER I

S. NO	COURSE CODE	COURSE TITLE	COURSE CATEGORY	L	T	P	C	TCP	CIA	ESE	TOTAL
		THEORY									
1	22MA1101	MATRICES AND CALCULUS	BSC	3	1	0	4	4	40	60	100
		THEORY WITH LAB COMPONENT									
2	22CY1151	CHEMISTRY FOR CIRCUIT ENGINEERING	BSC	2	0	2	3	4	50	50	100
3	22HE1151	ENGLISH FOR ENGINEERS	HSC	2	0	2	3	4	50	50	100
4	22EC1151	ELECTRON DEVICES	ESC	2	0	2	3	4	50	50	100
5	22IT1151/ 22CS1152	PYTHON PROGRAMMING AND PRACTICES/ OBJECT ORIENTED PROGRAMMING USING PYTHON (IBM STUDENTS ONLY)	ESC/ICC	2	0	2	3	4	50	50	100
		EEC COURSES (SE/AE)									
6	22HE1071	UHV	AEC	2	0	0	2	3	40	60	100
7	22HE1072	ENTREPRENEURSHIP & INNOVATION	AEC	1	0	0	1	1	100	0	100
		MANDATORY COURSE									
8	22MC1091/ 22MC1092	தமிழரும்தொழில்நுட்பமும்/Indian Constitution	MC	2	0	0	0	2	100	0	100
			TOTAL	**16**	**1**	**8**	**19**	**26**	**480**	**320**	**800**

SEMESTER II

S. NO	COURSE CODE	COURSE TITLE	COURSE CATEGORY	L	T	P	C	TCP	CIA	ESE	TOTAL
		THEORY									
1	22MA2102	DIFFERENTIAL EQUATIONS AND LAPLACE TRANSFORM	BSC	3	1	0	4	4	40	60	100
2	22CY2101	ENVIRONMENTAL STUDIES	ESC	2	0	0	2	3	40	60	100
3	22PH2101	BASICS OF MATERIAL SCIENCE	BSC	2	0	0	2	3	40	60	100
		THEORY WITH LAB COMPONENT									
4	22PH2151	PHYSICS FOR CIRCUIT ENGINEERING PROGRAMME	BSC	2	0	2	3	4	50	50	100
5	22HE2151	EFFECTIVE TECHNICAL COMMUNICATION	HSC	2	0	2	3	4	50	50	100
6	22CS2255	PROGRAMMING USING C	PCC	2	0	2	3	4	50	50	100
	22CS2253	JAVA FUNDAMENTALS (IBM STUDENTS ONLY)	ICC								
		PRACTICAL									
7	22ME2001	ENGINEERING PRACTICES	ESC	0	0	4	2	2	60	40	100

EEC COURSES (SE/AE)												
8	22HE2071	DESIGN THINKING	AEC	1	0	2	2	2	100	0	100
9	22HE2072	SOFT SKILLSAND APTITUDE -1	SEC	1	0	0	1	1	100	0	100
MANDATORY COURSES												
10	22MC2091 22MC2092	தமிழர்மரபு/ **Heritage of Tamils**	MC	2	0	0	0	2	100	0	100
11	22MC2093	NCC */NSS / YRC / SPORTS / CLUBS / SOCIETY SERVICE - ENROLLMENT (COMMON)	MC	All students shall enroll, on admission, in anyone of the personality and character development programmes and undergo training for about 80 hours							
			TOTAL	**17**	**1**	**12**	**22**	**29**	**630**	**370**	**1000**

SEMESTER III												
S.NO	**COURSECODE**	**COURSETITLE**	**COURSE CATEGORY**	**L**	**T**	**P**	**C**	**TCP**	**CIA**	**ESE**	**TOTAL**
THEORY											
1	22MA3102	COMPLEX ANALYSIS AND TRANSFORMS (common to ECE, EEE,EIE)	BSC	3	1	0	4	4	40	60	100
2	22EC3201	ELECTRONIC CIRCUITS	PCC	3	0	0	3	3	40	60	100
3	22EC3202	SIGNALS AND SYSTEMS	PCC	3	0	0	3	3	40	60	100
4	22EC3203	DIGITAL ELECTRONICS	PCC	3	0	0	3	3	40	60	100
5	22EC3204	CIRCUITS AND NETWORKS	ESC	2	0	0	2	3	100	-	100
THEORY WITH LAB COMPONENT											
6	22EC3251/ 22IT3252	OOPS USING JAVA/RELATIONAL DATABASE MANAGEMENT SYSTEM (IBM STUDENTS ONLY)	ESC/ICC	2	0	2	3	3	50	50	100
PRACTICAL											
7	22EC3001	ELECTRONIC CIRCUITS LABORATORY	PCC	0	0	3	1.5	3	60	40	100
8	22EC3002	DIGITAL ELECTRONICS LABORATORY	PCC	0	0	3	1.5	3	60	40	100
EEC COURSES (SE/AE)											
9	22HE3071	SOFT SKILLS -2	SEC	1	0	0	1	1	100	0	100
10	22EC3901	MINI PROJECT 1	AEC	0	0	0	2	1	100	0	100
MANDATORY COURSES											
11	22MC3191	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	MC	2	0	0	0	2	100	0	100
		TOTAL		**17**	**1**	**8**	**24**	**28**	**730**	**410**	**1100**

SEMESTER IV											
S.NO	**COURSE CODE**	**COURSE TITLE**	**COURSE CATEGORY**	**L**	**T**	**P**	**C**	**TCP**	**CIA**	**ESE**	**TOTAL**
THEORY											
1	22HE4101	IPR AND START-UPS	HSC	2	0	0	2	2	40	60	100
2	22EC4201	ELECTRO MAGNETIC FIELDS	PCC	3	0	0	3	3	40	60	100

3	22EC4202	ANALOG COMMUNICATION	PCC	3	0	0	3	3	40	60	100
4	22EC4203	LINEAR INTEGRATED CIRCUITS	PCC	3	0	0	3	3	40	60	100
5	22EC4304	TRANSMISSION LINES AND WAVEGUIDES	PCC	3	0	0	3	3	40	60	100
THEORY WITH LAB COMPONENT											
6	22EC4251/ 22EC4252	CONTROL SYSTEMS/DESIGN THINKING-AN INTRODUCTION (IBM STUDENTS ONLY)	PCC/ICC	2	0	2	3	3	50	50	100
7	22EC4253	DATA COMMUNICATION AND NETWORKS	PCC	2	0	2	3	3	50	50	100
PRACTICAL											
8	22EC4001	LINEAR INTEGRATED CIRCUITS LAB	PCC	0	0	3	1.5	3	60	40	100
9	22EC4002	ANALOG COMMUNICATION LAB	PCC	0	0	3	1.5	3	60	40	100
EEC COURSES (SE/AE)											
10	22HE4071	SOFT SKILLS -3	SEC	1	0	0	1	1	100	0	100
			TOTAL	**19**	**3**	**10**	**24**	**27**	**400**	**500**	**900**

SEMESTER V											
S.NO	**COURSE CODE**	**COURSE TITLE**	**COURSE CATEGORY**	**L**	**T**	**P**	**C**	**TCP**	**CIA**	**ESE**	**TOTAL**
THEORY											
1	22EC5201	DIGITAL COMMUNICATION	PCC	3	0	0	3	3	40	60	100
2	22EC5202	ANTENNA AND WAVE PROPAGATION	PCC	3	1	0	4	3	40	60	100
3	22EC5203	MICROPROCESSORS AND MICROCONTROLLERS	PCC	3	0	0	3	3	40	60	100
4	22EC53XX/ 22EC5251	PROFESSIONAL ELECTIVE-1/ ANGULAR JS (IBM STUDENTS ONLY)	PEC/ICC	3	0	0	3	3	40	60	100
5	22EC53XX	PROFESSIONAL ELECTIVE-2	PEC	3	0	0	3	3	40	60	100
6	22EC53XX	PROFESSIONAL ELECTIVE-3	PEC	3	0	0	3	3	40	60	100
PRACTICAL											
7	22EC5001	MICROPROCESSORS AND MICROCONTROLLERS LAB	PCC	0	0	3	1.5	3	60	40	100
8	22EC5002	DIGITAL COMMUNICATION LAB	PCC	0	0	3	1.5	3	60	40	100
EEC COURSES (SE/AE)											
9	22HE5071	SOFT SKILLS -4 / FOREIGN LANGUAGES	SEC	1	0	0	1	1	100	0	100
			TOTAL	**19**	**1**	**6**	**23**	**25**	**440**	**460**	**900**

SEMESTER VI											
S.NO	**COURSE CODE**	**COURSE TITLE**	**COURSE CATEGORY**	**L**	**T**	**P**	**C**	**TCP**	**CIA**	**ESE**	**TOTAL**
THEORY											
1	22HS6101	PROFESSIONAL ETHICS	HSC	3	0	0	3	3	40	60	100

2	22EC63XX/ 22EC6251	PROFESSIONAL ELECTIVE-4/ NODE JS AND MICRO SERVICES (IBM STUDENTS ONLY)	PEC/ICC	3	0	0	3	3	40	60	100
3	22EC63XX / 22EC6252	PROFESSIONAL ELECTIVE-5/ IOT AND SPRING FRAMEWORK (IBM STUDENTS ONLY)	PEC/ICC	3	0	0	3	3	40	60	100
4	22EC64XX	OPEN ELECTIVE – 1*	OEC	3	0	0	3	3	40	60	100
5	22EC64XX	OPEN ELECTIVE – 2*	OEC	3	0	0	3	3	40	60	100
THEORY WITH LAB COMPONENT											
6	22EC6253	DIGITAL SIGNAL PROCESSING	PCC	2	0	2	3	4	50	50	100
7	22EC6254	VLSI DESIGN	PCC	2	0	2	3	4	50	50	100
EEC COURSES (SE/AE)											
8	22EC6901	MINI PROJECT 2	AEC	0	0	0	2	1	100	0	100
			TOTAL	**19**	**1**	**6**	**23**	**26**	**400**	**400**	**800**

SEMESTER VII											
S.NO	**COURSE CODE**	**COURSE TITLE**	**COURSE CATEGORY**	**L**	**T**	**P**	**C**	**TCP**	**CIA**	**ESE**	**TOTAL**
THEORY											
1	22EC7201	WIRELESS COMMUNICATION NETWORKS	PCC	3	0	0	3	3	40	60	100
2	22EC73XX/ 22EC7251	PROFESSIONAL ELECTIVE-6/ BLOCKCHAIN (IBM STUDENTS ONLY)	PEC/ICC	3	0	0	3	3	40	60	100
3	22EC74XX	OPEN ELECTIVE – 3*	OEC	3	0	0	3	3	40	60	100
4	22EC74XX	OPEN ELECTIVE – 4*	OEC	3	0	0	3	3	40	60	100
THEORY WITH LAB COMPONENT											
5	22EC7001	EMBEDDED SYSTEMS AND IOT	PCC	2	0	2	3	4	50	50	100
6	22EC7001	OPTICAL COMMUNICATION AND MICROWAVE ENGINEERING	PCC	2	0	2	3	4	50	50	100
EEC COURSES (SE/AE)											
7	22EC7901	INTERNSHIP	AEC	-	-	-	2	1	100	0	100
			TOTAL	**19**	**0**	**4**	**20**	**23**	**360**	**340**	**700**

SEMESTER VIII											
S.NO	**COURSE CODE**	**COURSE TITLE**	**COURSE CATEGORY**	**L**	**T**	**P**	**C**	**TCP**	**CIA**	**ESE**	**TOTAL**
EEC COURSES (SE/AE)											
1	22EC8901	PROJECT WORK/GRANTED PRODUCT PATENT	AEC	0	0	20	10	20	100	100	200
			TOTAL	**0**	**0**	**20**	**10**	**20**	**100**	**100**	**200**

Note:

1. *As per the AICTE guideline, in Semesters I, II, III & IV NCC one credit subject is added as Value Added Course with Extra Credit. Further, the students who enrolled his/her name in HICET NCC and Air Wing are eligible to undergo this subject. The earned extra credits printed in the Consolidated Mark sheet as per the regulation.

students' who have opted NCC subjects in Semester I, II, III & IV are eligible to undergo NCC Open Elective Subjects.

3. The above-mentioned NCC Courses will be offered to the students who are going to be admitted in the Academic Year 2021 – 22 onwards.

Chairman Bos | Dean-Academics | Principal

SEMESTER WISE CREDIT DISTRIBUTION

B.E. / B.TECH. PROGRAMMES										
S.No.	Course Area	Credits per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	HSC	3	3	-	2	-	3	-	-	**11**
2	BSC	7	9	4	-	-	-	-	-	**20**
3	ESC	6	4	5	-	-	-	-	-	**15**
4	PCC	-	3	12	21	13	6	9	-	**64**
5	PEC	-	-	-	-	9	6	3	-	**18**
6	OEC	-	-	-	-	-	6	6	-	**12**
7	EEC	3	3	3	1	1	2	2	10	**25**
8	MC	□	□							
Total		**19**	**22**	**24**	**24**	**23**	**23**	**20**	**10**	**165**

Credit Distribution R2022

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	19	22	24	24	23	23	20	10	165

LIST OF INDUSTRIAL CORE COURSES

S. No.	CODE	Courses	CAT	L	T	P	C	CIA	ESE	TOTAL
1	22CS1152	Object Oriented Programming using Python	ICC	2	0	2	3	50	50	100
2	22CS2153	Java Fundamentals	ICC	2	0	2	3	50	50	100
3	22EC3252	Relational Database Management System	ICC	2	0	2	3	50	50	100
4	22EC4252	Design Thinking-An Introduction	ICC	2	0	2	3	50	50	100
5	22EC5251	Angular JS	ICC	2	0	2	3	50	50	100

6	22EC6251	Node JS and Micro services	ICC	2	0	2	3	50	50	100
7	22EC6252	IoT and Spring Framework	ICC	2	0	2	3	50	50	100
8	22EC7251	Blockchain	ICC	2	0	2	3	50	50	100

PROFESSIONAL ELECTIVE COURSES: VERTICALS

Vertical 1 Electronic System Design	**Vertical 2 Communication Systems**	**Vertical 3 Wireless Networks**	**Vertical 4 Signal and Image Processing**	**Vertical 5 Biomedical Technologies**	**Vertical 6 Diversified Courses**
Foundation Skills in Integrated Product Development	Satellite Communication	Network Security	Digital Image Processing	Medical Electronics	App Development
Measurements and Instrumentation	Global Positioning Systems	Wireless Sensors and Networks	Audio Signal Processing	Medieal Informatics	Web Technologies
IoT Based System Design	Under Water Communication	High Speed Networks	Machine Vision	Medical Image Processing	Ethical Hacking
PCB Design	RF System Design	Cloud Computing	Artificial Intelligence and Machine Learning	Biometric Systems	Cryptocurrency and Blockchain Technologies
ASIC Design	Software Defined Radio	Wireless Broad Band Networks	Neural Networks and Deep Learning	Medical Robotics	3D Printing and Design
Introduction to PLC Programming	Radar Technologies	Cyber Forensics	Virtual Reality and Augmented Reality	Human Computer Interface	4G/5G Communication Networks

Vertical 1
Electronic System Design

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1.	22EC5301	Foundation Skills in Integrated Product Development	PEC1	3	0	0	3	3
2.	22EC5302	Measurements and Instrumentation	PEC2	3	0	0	3	3
3.	22EC5303	IoT Based System Design	PEC3	3	0	0	3	3
4.	22EC6301	PCB Design	PEC4	3	0	0	3	3
5.	22EC6302	ASIC Design	PEC5	3	0	0	3	3
6.	22EC7301	Introduction to PLC Programming	PEC6	3	0	0	3	3

Vertical 2

Communication Systems

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1.	22EC5304	Satellite Communication	PEC1	3	0	0	3	3
2.	22EC5305	Global Positioning Systems	PEC2	3	0	0	3	3
3.	22EC5306	Under Water Communication	PEC3	3	0	0	3	3
4.	22EC6303	RF System Design	PEC4	3	0	0	3	3
5.	22EC6304	Software Defined Radio	PEC5	3	0	0	3	3
6.	22EC7302	Radar Technologies	PEC6	3	0	0	3	3

Vertical 3

Wireless Networks

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1.	22EC5307	Network Security	PEC1	3	0	0	3	3
2.	22EC5308	Wireless Sensors and Networks	PEC2	3	0	0	3	3
3.	22EC5309	High Speed Networks	PEC3	3	0	0	3	3
4.	22EC6305	Cloud Computing	PEC4	3	0	0	3	3
5.	22EC6306	Wireless Broad Band Networks	PEC5	3	0	0	3	3
6.	22EC7303	Cyber Forensics	PEC6	3	0	0	3	3

Vertical 4

Signal and Image Processing

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1.	22EC5310	Digital Image Processing	PEC1	3	0	0	3	3
2.	22EC5311	Audio Signal Processing	PEC2	3	0	0	3	3
3.	22EC5312	Machine Vision	PEC3	3	0	0	3	3
4.	22EC6307	Artificial Intelligence and Machine Learning	PEC4	3	0	0	3	3
5.	22EC6308	Neural Networks and Deep Learning	PEC5	3	0	0	3	3
6.	22EC7304	Virtual Reality and Augmented Reality	PEC6	3	0	0	3	3

Vertical 5

Biomedical Technologies

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1.	22EC5311	Medical Electronics	PEC1	3	0	0	3	3
2.	22EC5312	Medical Informatics	PEC2	3	0	0	3	3
3.	22EC5313	Medical Image Processing	PEC3	3	0	0	3	3
4.	22EC6309	Biometric Systems	PEC4	3	0	0	3	3
5.	22EC6310	Medical robotics	PEC5	3	0	0	3	3
6.	22EC7305	Human Computer Interface	PEC6	3	0	0	3	3

Vertical 6

Diversified courses

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1.	22EC5314	App Development	PEC1	3	0	0	3	3
2.	22EC5315	Web Technologies	PEC2	3	0	0	3	3
3.	22EC5316	Ethical Hacking	PEC3	3	0	0	3	3
4.	22EC6311	Cryptocurrency and Blockchain Technologies	PEC4	3	0	0	3	3
5.	22EC6312	3D Printing and Design	PEC5	3	0	0	3	3
6.	22EC7306	4G/5G Communication Networks	PEC6	3	0	0	3	3

OPENELECTIVE I AND II (EMERGINGTECHNOLOGIES)

To be offered for the students other than CSE, IT, AI&ML, ECE & BIOMEDICAL

S NO.	COURSE CODE	COURSETITLE	CATEGORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AI6401	Artificial intelligence and Machine Learning Fundamentals	OEC	2	0	2	4	3
2	22CS6401	Blockchain Technology	OEC	2	0	2	4	3
3	22EC6401	Cyber Security	OEC	2	0	2	4	3
4	22EC6402	IoT Concepts and Applications	OEC	2	0	2	4	3
5	22IT6401	Data Science and Analytics	OEC	2	0	2	4	3
6	22BM6401	Augmented and Virtual Reality	OEC	2	0	2	4	3

OPEN ELECTIVE I AND II

To be offered for the students other than AUTO, AERO, AGRI, MECH, MCTS, CIVIL, EEE, CHEMICAL, FOOD TECH, E&I

S NO.	COURSE CODE	COURSETITLE	CATEGORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AE6401	Space Science	OEC	3	0	0	3	3
2	22MT6401	Introduction to Industrial Engineering	OEC	3	0	0	3	3
3	22MT6402	Industrial Safety and Environment	OEC	3	0	0	3	3
4	22CE6401	Climate Change and its Impact	OEC	3	0	0	3	3
5	22CE6402	Environment and Social Impact Assessment	OEC	3	0	0	3	3
6	22ME6401	Renewable Energy System	OEC	3	0	0	3	3
7	22ME6402	Additive Manufacturing systems	OEC	3	0	0	3	3
8	22EI6401	Introduction to Industrial Instrumentation and Control	OEC	3	0	0	3	3
9	22EI6402	Graphical Programming using Virtual Instrumentation	OEC	3	0	0	3	3
10	22AU6401	Recent Trends in Automotive Technology	OEC	3	0	0	3	3
11	22AU6402	Automotive Vehicle Safety	OEC	3	0	0	3	3
12	22EE6401	Digital Marketing	OEC	3	0	0	3	3
13	22EE6402	Research Methodology	OEC	3	0	0	3	3
14	22FT6401	Traditional Foods	OEC	3	0	0	3	3
15	22AG6401	Urban Agriculture and Organic Farming	OEC	3	0	0	3	3
16	22CH6401	Biomass and Bio Refinery	OEC	3	0	0	3	3

Note: Non-Circuit Departments can add one Open Elective course in the above list to offer for the circuit branches

OPEN ELECTIVE III

Students shall choose any one of the open elective courses such that the course content or title not belong to their own programme.

S NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PERWEEK			TOTAL CONTAC T PERIODS	CREDITS
				L	T	P		
1	22EC7401	Mobile Devices -Tools and Technology	OEC	3	0	0	3	3

OPEN ELECTIVE IV

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PERWEEK			TOTAL CONTAC T PERIODS	CREDITS
				L	T	P		
1	22LS7401	General studies for competitive examinations	OEC	3	0	0	3	3
2	22LS7402	Human Rights, Women Rights and Gender equity	OEC	3	0	0	3	3

3	22LS7403	Indian ethos and Human values	OEC	3	0	0	3	3
4	22LS7404	Financial independence and management	OEC	3	0	0	3	3
5	22LS7405	Yoga for Human Excellence	OEC	3	0	0	3	3
6	22LS7406	Democracy and Good Governance	OEC	3	0	0	3	3
7	22LS7407	NCC Level - II	OEC	3	0	0	3	3

Enrollment for B.E. / B. TECH. (HONOURS) / Minor Degree (optional)

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E. / B. Tech. (Honours) or Minor Degree. For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only. For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes.

Clause 4.10 of Regulation 2022 is applicable for the Enrolment of B.E. / B. TECH. (HONOURS) / Minor Degree (Optional).

HONOUR DEGREE VERTICAL COURSES

S. No.	Vertical-I Sensor Technologies and IoT	Vertical II Advanced Communication Systems	Vertical III Semiconductor Chip Design and Testing
1	Realtime Embedded Systems	Cognitive Radio Networks	Wide Bandgap Devices
2	Sensor for IoT applications	Remote Sensing	Validation and Testing Technology
3	Advanced Processor Architectures	Rocketry and Space Mechanics	Low Power VLSI
4	IOT Processors	Underwater Navigation Systems	VLSI Testing and Design for Testability
5	Wearable Devices	Massive MIMO Networks	Mixed Signal IC Design Testing
6	Industrial IoT and Industry 4.0	Advanced Wireless Communication Techniques	Analog IC Design

Vertical-I
Sensor Technologies and IoT

S No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
1	22EC5305	Realtime Embedded Systems	HDC	3	0	0	3	40	60	100

2	22EC6305	Sensor for IoT applications	HDC	3	0	0	3	40	60	100
3	22EC6306	Advanced Processor Architectures	HDC	3	0	0	3	40	60	100
4	22EC7304	IOT Processors	HDC	3	0	0	3	40	60	100
5	22EC7305	Wearable Devices	HDC	3	0	0	3	40	60	100
6	22EC8301	Industrial IoT and Industry 4.0	HDC	3	0	0	3	40	60	100

Vertical-II
Advanced Communication Systems

S No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
1	22EC5306	Cognitive Radio Networks	HDC	3	0	0	3	40	60	100
2	22EC6307	Remote Sensing	HDC	3	0	0	3	40	60	100
3	22EC6308	Rocketry and Space Mechanics	HDC	3	0	0	3	40	60	100
4	22EC7306	Underwater Navigation Systems	HDC	3	0	0	3	40	60	100
5	22EC7307	Massive MIMO Networks	HDC	3	0	0	3	40	60	100
6	22EC8203	Advanced Wireless Communication Techniques	HDC	3	0	0	3	40	60	100

Vertical-III
Semiconductor Chip Design and Testing

S No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
1	22EC5307	Wide Bandgap Devices	HDC	3	0	0	3	40	60	100
2	22EC6309	Validation and Testing Technology	HDC	3	0	0	3	40	60	100
3	22EC6310	Low Power VLSI	HDC	3	0	0	3	40	60	100
4	22EC7308	VLSI Testing and Design for Testability	HDC	3	0	0	3	40	60	100
5	22EC7309	Mixed Signal IC Design Testing	HDC	3	0	0	3	40	60	100
6	22EC8202	Analog IC Design	HDC	3	0	0	3	40	60	100

MINOR DEGREE VERTICAL COURSES
Embedded and IoT

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22EC5601	Electronics for Embedded Systems	MDC	3	0	0	3	3
2	22EC6601	Microcontroller and its Applications	MDC	3	0	0	3	3
3	22EC6602	Sensor and Embedded Systems	MDC	3	0	0	3	3
4	22EC7601	Fundamentals of IoT	MDC	3	0	0	3	3

5	22EC7602	Industrial IoT and Industry 4.0	MDC	3	0	0	3	3
6	22EC8601	IoT for Smart Systems	MDC	3	0	0	3	3

Vertical II
Fintech and Block Chain

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	21CS5602	Financial Management	MDC	3	0	0	3	3
2	21MB6231	Fundamentals of Investment	MDC	3	0	0	3	3
3	21MB6232	Banking, Financial Services andInsurance	MDC	3	0	0	3	3
4	21MB7231	Introduction to Blockchain and its Applications	MDC	3	0	0	3	3
5	21MB7232	Fintech Personal Finance and Payments	MDC	3	0	0	3	3
6	21MB8231	Introduction to Fintech	MDC	3	0	0	3	3

Vertical III
Entrepreneurship

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	21BA5601	Foundation of Entrepreneurship	MDC	3	0	0	3	3
2	21BA6601	Introduction to Business Venture	MDC	3	0	0	3	3
3	21BA6602	Team Building & Leadership Management for Business	MDC	3	0	0	3	3
4	21BA7601	Creativity & Innovation in Entrepreneurship	MDC	3	0	0	3	3
5	21BA7602	Principles of Marketing Management for Business	MDC	3	0	0	3	3
6	21BA8601	Human Resource Management for Entrepreneurs	MDC	3	0	0	3	3
7	21BA8602	Financing New Business Ventures	MDC	3	0	0	3	3

Vertical IV
Environment and Sustainability

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	21CEXXXX	Sustainable Infrastructure Development	MDC	3	0	0	3	3
2	21AG6233	Sustainable Agriculture and Environmental Management	MDC	3	0	0	3	3
3	21BM6233	Sustainable Bio Materials	MDC	3	0	0	3	3

4	21ME7233	Materials for Energy Sustainability	MDC	3	0	0	3	3
5	21CE7233	Green Technology	MDC	3	0	0	3	3
6	21CE8232	Environmental Quality Monitoring and Analysis	MDC	3	0	0	3	3

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SYLLABUS

Fifth Semester Syllabus
(for the batch admitted during 2022 – 2023)

Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC5201	Digital Communication	3	0	0	3

Course Objective	The student should be able to. 1. To Understand waveform coding and representation techniques. 2. To Analyze baseband transmission and pulse shaping methods. 3. To Evaluate passband transmission models and modulation schemes. 4. To Apply error control coding techniques and algorithms. 5. To Implement spread-spectrum systems and applications.	
Course Prerequisite	Linear Algebra Analog Communication	
Unit	**Description**	**Instructional Hours**
I	**WAVEFORM CODING & REPRESENTATION** Low pass sampling- Aliasing- Quantization-Uniform & non- uniform quantization- quantization noise-SNR calculation -Companding - PCM-DPCM-DM-ADM-Line codes	9
II	**BASEBAND TRANSMISSION** ISI- Eye pattern -Nyquist criterion for distortion less transmission- Pulse Shaping- Correlative coding - Receiving filters- Matched filters, Correlation receiver Adaptive Equalization	9
III	**PASSBAND TRANSMISSION** Passband Transmission model -Geometric Representation of signals - Generation, detection, PSD& BER of Coherent BPSK, BFSK & QPSK – QAM – Carrier Synchronization – Structure of Non-coherent Receivers – Principle of DPSK.	9
IV	**ERROR CONTROL CODING** Channel coding theorems -Linear Block codes - Hamming codes–cyclic codes Convolutional Codes -Code Tree, Trellis, and State diagram - Viterbi Algorithm.	9
V	**SPREAD-SPECTRUM SYSTEMS** PN Sequences - Direct-Sequence Spread-Spectrum System-Frequency Hopping Systems– Synchronization- Processing gain and jamming - Applications: CDMA –Multipath Suppression	9
	Total Instructional Hours	45
Course Outcome	**After completion of the course the learner will be able to** CO1: Understand working of waveform coding techniques and analyze their performance CO2: Design systems to mitigate intersymbol interference (ISI) and optimize baseband transmission. CO3: Analyze the error performance of Digital Modulation Techniques. CO4: Compare different error detecting and error correction codes CO5: Apply PN sequences and spread-spectrum techniques for CDMA and multipath suppression.	

TEXT BOOKS

T1 - Simon Haykin , "Digital Communications", John Wiley & Sons, Inc, Singapore, 2011
T2 - Lathi B P , "Modern Digital and Analog communication Systems", Oxford University Press, 2010

REFERENCE BOOKS:

1. Proakis J G, Salehi M , "Digital Communications", Tata McGraw Hill, New Delhi, 2018.
2. Bernard Sklar , "Digital Communications- Fundamentals and applications", Pearson Education, New Delhi, 2009.
3. Sam Shanmugam K , "Digital and Analog communication systems", John Wiley Inc, Singapore, 2008.
4. H P Hsu, Schaum Outline Series - "Analog and Digital Communications" TMH 2006

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	-	3						3	3	3
CO2	3	3	2	3	-	3						3	3	2
CO3	3	3	2	2	2	3						3	3	3
CO4	3	3	3	3	2	3						3	3	3
CO5	3	3	2	2	-	3						3	3	3
AVG	3	2.8	2.2	2.4	2	3						3	3	2.8

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC5202	**Antenna and Wave Propagation**	3	1	0	4

Course Objective	1.. To understand the concept of radiation phenomena and the antenna parameters 2. To identify the radiation mechanism of array antennas 3. To analyze the radiation characteristics of aperture and slot antennas 4. To impart knowledge on Frequency Independent Antennas and measurements 5. To analyze the propagation of radio waves and various types of wave propagation
Course pre-requisites:	1. 21EC4201- Electromagnetic Fields 2. 21EC5202-Transmission Lines and Wave Guides

Unit	Description	Instructional Hours
I	**FUNDAMENTALS OF RADIATION:** Definition of antenna parameters – Gain, Directivity, Effective aperture, Radiation Resistance, Band width, Beam width, Input Impedance. Antenna noise temperature, Radiation from Oscillating dipole, Half-wave dipole, Folded dipole, Yagi array	12
II	**APERTURE AND SLOT ANTENNAS:** Radiation from rectangular apertures, Uniform and Tapered aperture, Horn antenna, Reflector antenna, Aperture blockage, Feeding structures, Slot antennas, Microstrip antennas – Radiation mechanism – Applications	12
III	**ANTENNA ARRAYS:** Point Source, Array of Two-point sources, N -Element Uniform Linear Array, Broad-Side array, End-Fire Array, Pattern multiplication, Concept of Phased arrays, Adaptive array, Antenna Synthesis-Binomial array.	12
IV	**SPECIAL ANTENNAS:** Frequency independent antennas –Spiral antenna, Helical antenna, Log periodic Antenna. Electronic band gap structure and applications, Antenna Measurements-Test Ranges, Measurement of Gain, Radiation pattern, Polarization, VSWR	12

V	**PROPAGATION OF RADIO WAVES:** Modes of propagation, Structure of atmosphere, Ground wave propagation, Tropospheric propagation, Duct propagation, Troposcatter propagation , Flat earth and Curved earth concept, Sky wave propagation – Virtual height, critical frequency, Maximum usable frequency – Skip distance, Fading , Multi hop propagation	12
	Total Instructional Hours	**60**
Course Outcome	**After completion of the course the learner will be able to** CO1: Explain the radiation phenomena and the antenna parameters CO2: Understand the radiation mechanism of various types of array antennas. CO3: Categorize the radiation pattern of aperture and slot antennas CO4: Assess the purpose on Frequency Independent Antennas and measurements CO5: Analyze the characteristics of different types of radio wave propagation at different frequencies	

TEXT BOOKS:

T1- John D Kraus, Ronald J Marhefka, Ahmad S Khan "Antennas and Wave Propagation", Fifth Edition, Mc Graw Hill Education (India) Private Limited, Special Edition 2012.

T2 - K.D.Prasad, "Antenna and Wave propagation", Satya Prakashan Publishers, Third Reprint Edition, 2016

REFERENCE BOOKS:

R1- Constantine.A.Balanis "Antenna Theory Analysis and Design", Third Edition, Wiley India Pvt.Ltd., Reprint 2016-

R2 - Edward.C.Jordan and Keith G.Balmain, "Electromagnetic Waves and Radiating Systems", Second Edition, PHI Learning Private Limited, 2011.

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	-	-	-	-	-	-	2	3	3
CO2	3	3	3	3	-	-	-	-	3	-	-	2	3	3
CO3	3	2	2	2	-	-	-	-	2	-	-	3	3	3
CO4	3	3	3	2	-	-	-	-	3	-	-	3	3	3
CO5	3	3	2	3	-	-	-	-	3	-	-	3	3	3
AVG	3	2.8	2.4	2.4	-	-	-	-	2.75	-	-	2.6	3	3

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC5203	MICROPROCESSOR AND MICRO CONTROLLER	3	0	0	3
Course Objective	1. Study the Architecture of 8085 and 8086 microprocessor. 2. Learn the design aspects of I/O and Memory Interfacing circuits. 3. Study about communication and bus interfacing. 4. Study the Architecture of 8051 microcontroller 5. Study the concepts of microcontroller interfacing					

Unit	Description	Instructional Hours
I	**THE 8085 AND 8086 MICROPROCESSORS** Overview of 8-bit microprocessor - Introduction to 8086 – Microprocessor architecture – Addressing modes – Instruction set- Assembly language programming – Modular Programming – Interrupts and interrupt service routines.	9
II	**8086 SYSTEM BUS STRUCTURE** 8086 signals – Basic configurations – System bus timing –System design using 8086 – Introduction to Multiprogramming – Multiprocessor configurations – Coprocessor, closely coupled and loosely Coupled configurations – Introduction to advanced processors	9
III	**I/O INTERFACING** Parallel communication interface – Serial communication interface – D/A and A/D Interface – Timer Interface – Keyboard /display controller – Interrupt controller – DMA controller – Programming and applications Case studies: Traffic Light control, LED display, LCD display.	9
IV	**MICROCONTROLLER &INTERFACING** Architecture of 8051 – Special Function Registers (SFRs) – I/O Pins Ports and Circuits – Instruction set – Addressing modes – Assembly language programming. Programming 8051 Timers – Serial Port Programming – Interrupts Programming – LCD & Keyboard Interfacing – ADC, DAC & Sensor Interfacing – Stepper Motor	9
V	**ARM PROCESSOR** Arcon RISC Machine – Architectural Inheritance – Core & Architectures – Registers – Pipeline – Interrupts – ARM organization – ARM processor family – ARM instruction set- Thumb Instruction set – Instruction cycle timings – The ARM Programmer's model- ARM Assembly Language Programming	9
	Total Instructional Hours	45
Course Outcome	**After completion of the course the learner will be able to** CO1: Write programs on 8086 microprocessors. CO2: Design I/O circuits. CO3: Design Memory Interfacing circuits. CO4: Design and implement 8051 microcontroller-based systems. CO5: Write programs on ARM processors.	

TEXT BOOKS:

T1-Ramesh S. Goankar, "Microprocessor Architecture, Programming and Applications with 8085", 5th Edition, Prentice Hall (Unit 1)

T2- Yu-Cheng Liu, Glenn A.Gibson, "Microcomputer Systems: The 8086 / 8088 Family – Architecture, Programming and Design", Prentice Hall of India, 2011. (Unit 1, 2, 3)

T3- Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", Second Edition, Pearson education, 2011 (Unit 4, 5)

REFERENCE BOOKS:

R1 – Doughlas V.Hall, "Microprocessors and Interfacing, Programming and Hardware", TMH,2012

R2- Krishna Kant, "Microprocessors and microcontrollers architecture programming and system design 8085 8086 8051 8096 PHI Learning Private Limited", 2014

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	2	2	-	-	-	-	-	2	3	2
CO2	3	3	3	2	2	1	-	-	-	-	-	1	3	2
CO3	3	3	3	2	2	1	-	-	-	-	-	1	2	2
CO4	3	3	3	3	3	2	-	-	-	-	2	2	2	3
CO5	2	1	2	1	3	-	2	-	1	-	-	2	2	2
AVG	2.8	2.4	2.6	2	2.4	1.5	0.4	-	0.2	0	0.4	1.6	2.4	2.2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC5251	Angular JS	3	0	0	3

Course Objective	
	1.Learn the core concepts of Angular including components. 2.Learn and Apply directives, Services & dependency injection, pipes, views, forms and tables, Animation, Angular with SQL 3.Explored the essential Angular features and have gained the skills you need to build robust single-page applications. 4.Learn various testing tools. 5.Demonstrate Material design for Mobile

Unit	Description	Instructional Hours
I	**INTRODUCTION TO JAVASCRIPT** JavaScript-SinglePageApp-MVC-Controller-Template-Expression-Modules-Filter-Difference between Angular and React.	9
II	**ANGULAR 7** Node Js-NPM-Angular CLI-IDE-Angular Architecture-Life cycle core feature-Angular 7 with Bootstrap.	7
III	**ANGULAR 7 CORE COMPONENTS** Modules-Services-Pipes-CustomPipes-Events-Forms-Tables-DOM-Directives-Views-Routing-Animation-Angular with SQL-Angular with Server-Material Design for Mobile.	5
IV	**TESTING APPS** Introduction of Karma and Jasmine -Setup and tear down-Test Class-Angular Testbed(ATB)-ATB features.	3

V	**BOILERPLATE** Introduction to Boilerplate-Boilerplate code-Boilerplate component-initialize boilerplate	5
	Description of the Experiments 1. Analyze DOM HTML and Java script Functions. 2. Create a Single page Application. 3. Setup Angular Environment and Complete the sample Hello World Application. 4. Implement Angular 7 modules. 5. Setup backend service using Express framework of NodeJS . 6. Setup Mongodb and use backend service to perform CRUD Operations. 7. Build an Inventory Management Application. 8. Build Mobile App using Angular Material Design Component. 9. Karma and Jasmine to perform end to end automated testing 10. Initialize Boilerplate to kickstart a project.	16
	Total Instructional Hours	45
Course Outcome	CO1:Demonstrate Angular concepts including components, Modules & Directive. CO2:Demonstrate Services, Animation, forms & tables, Events . CO3:Demonstrate Angular using SQL CO4:Understand how to use Karma and Jasmine for E2E testing	

TEXT BOOKS:

T1 :IBM CE-AngularJS

REFERENCE BOOKS:

R1: Angular: Up and Running: Learning Angular, Step by Step by Shyam Seshadri.
R2: Angular : From Theory to Practice by Asim Hussain
R3: Getting MEAN with Mongo, Express, Angular, and Node by Simon Holmes

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Programme	Course code	Name of the course	L	T	P	C
BE	22EC5001	**Microprocessor and Micro Controller Lab**	0	0	3	1.5

Course Objective	1.Introduce ALP concepts and features 2. Write ALP for arithmetic and logical operations in 8086 and 8051 3. Differentiate Serial and Parallel Interface 4. Interface different I/Os with Microprocessors 5. Be familiar with MASM
Expt.No.	**Description of the Experiments**
Using 8086 Microprocessor and MASM software	

1.	Basic Arithmetic and Logical operations.
2.	Code conversion and Decimal arithmetic
3.	Matrix operations
4.	Searching
5.	Sorting
Using 8086 Microprocessor and Interfacing	
6.	Parallel interface
7.	Serial interface
8.	Key board and Display interface
9.	A/D and D/A interface
Using 8051 Micro controller	
10.	Basic arithmetic and Logical operations
11.	Square and 2's complement of a number
12.	Stepper motor control interface
Total Instructional Hours	45
Course Outcome	**After completion of the course the learner will be able to** CO1: Write ALP Programmes for fixed and Floating Point and Arithmetic CO2: Interface different I/Os with processor CO3: Generate waveforms using Microprocessors CO4: Execute Programs in 8051 CO5: Explain the difference between simulator and Emulator

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	3		-		-	-	-	2	3	3
CO2	3	3	3	3	3		-		3	-	-	2	2	3
CO3	3	2	2	2	3		-		2	-	-	-	3	3
CO4	3	3	3	2	3		-		3	-	-	3	2	3
CO5	3	3	2	3	3		-		3	-	-	3	3	3
AVG	3	3	2	2	3				3			3	2.6	3

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Programme	Course code	Name of the course	L	T	P	C
BE	22EC5002	**Digital Communication Lab**	0	0	3	1.5
Course Objective	1. To Apply Pulse Code Modulation (PCM) and Differential Pulse Code Modulation (DPCM). 2. To Analyze Line Coding Schemes for digital transmission. 3. To Design ASK modulator and demodulator circuits. 4. To Evaluate PSK and FSK digital modulation techniques. 5. To Perform MATLAB simulations for modulation schemes.					
Expt.No.	**Description of the Experiments**					
	Hardware Experiments					
1	Pulse Code Modulation and Demodulation					
2	Line Coding Schemes					

3	Differential pulse code modulation
4	ASK modulator and Demodulator
5	Digital Modulation –PSK, FSK
	Simulation Experiments using MATLAB
6	Simulation of ASK, FSK, and BPSK Generation and Detection Schemes
7	Simulation of QPSK Generation and Detection Schemes.
8	Simulation of QAM Generation and Detection Schemes.
9	Simulation of Linear Block and Cyclic Error Control coding Schemes.
10	Viterbi decoder for decoding Convolutional codes
	Total Instructional Hours 45
Course Outcome	After completion of the course the learner will be able to CO1: Evaluate the performance of PCM, DPCM and Delta modulation schemes. CO2: **Illustrate** the principles and applications of different Line Coding Schemes in digital communication. Co3: Implement different digital modulation schemes like ASK, FSK and PSK CO4: Simulate digital communication techniques like ASK, FSK & PSK using MATLAB CO5: Analyze source/channel encoding & decoding methods.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	3	-	3	3	3	-	3	3	3
CO2	3	3	3	3	3	3	-	3	3	3	-	3	3	3
CO3	3	3	3	3	3	3	-	3	3	3	-	3	3	3
CO4	3	3	3	3	3	3	-	3	3	3	-	3	3	3
CO5	3	3	3	3	3	3	-	3	3	3	-	3	3	3
AVG	3	3	3	3	3	3	-	3	3	3	-	3	3	3

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PROFESSIONAL ELECTIVES

PROFESSIONAL ELECTIVE COURSES

Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC5301	**Foundation Skills in Integrated Product Development**	3	0	0	3
Course Objective	1. To understand the global trends and development methodologies of various types of product sandservices 2.To conceptualize, prototype and develop product management plan for a new product based on the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems. 3. To familiarize with conceptualization, design techniques, and testing strategies. 4. To grasp the concept of system modeling for systems, sub-systems, and their interfaces, and come to a solution for the ideal system specification and characteristics. 5.To Explore industry dynamics and IPD essentials activities for engineering customer					

Unit	Description	Instructional Hours
I	**BASICS OF PRODUCTDEVELOPMENT** Global Trends Analysis and Product decision - Social Trends - Technical Trends-EconomicTrends - Environmental Trends - Political/Policy Trends - Introduction to Product DevelopmentMethodologiesandManagement-OverviewofProductsandServices-TypesofProductDevelopment - Overview of Product Development methodologies - Product Life Cycle – Product Development Planning and Management.	9
II	**REQUIREMENTSAND SYSTEM DESIGN** Requirement Engineering - Types of Requirements - Requirement Engineering - traceability Matrix and Analysis - Requirement Management - System Design & Modeling - Introduction to System Modeling-System Optimization- System Specification-Sub-System Design-Interface Design.	9
III	**DESIGNAND TESTING** Conceptualization-IndustrialDesignandUserInterfaceDesign-IntroductiontoConceptgeneration Techniques – Challenges in Integration of Engineering Disciplines - Concept Screening& Evaluation - Detailed Design - Component Design and Verification – Mechanical, Electronics andSoftwareSubsystems-HighLevelDesign/LowLevelDesignofS/WProgram-TypesofPrototypes,S/WTesting-HardwareSchematic,Componentdesign,LayoutandHardwareTesting Prototyping - Introduction to Rapid Prototyping and Rapid Manufacturing - System Integration, Testing, Certification and Documentation	9
IV	**SUSTENANCEENGINEERINGANDEND-OF-LIFE(EOL)SUPPORT** IntroductiontoProductverificationprocessesandstages-IntroductiontoProductValidationprocesses and stages - Product Testing Standards and Certification - Product Documentation -Sustenance-MaintenanceandRepair–Enhancements-ProductEoL-ObsolescenceManagement–Configuration Management-EoL Disposal	9

V	**BUSINESSDYNAMICS–ENGINEERINGSERVICESINDUSTRY** The Industry- Engineering Services Industry- Product Development in Industry versus Academia –The IPD Essentials-Introduction to Vertical Specific Product Development processes-Manufacturing / Purchase and Assembly of Systems - Integration of Mechanical, Embedded and Software Systems–Product Development Trade-offs-Intellectual Property Rights and Confidentiality– Security and Configuration Management.	9
	Total Instructional Hours	**45**
Course Outcome	**After Completion of the course, the students will have the ability to:** **CO1:**Understand global trends (social, technical, economic, environmental, political/policy), product development methodologies, and product life cycle stages. **CO2:**Solvespecificproblemsindependentlyoraspart of ateam **CO3:**Be skilled in industrial and user interface design, concept generation, detailed component design, and prototyping techniques. **CO4:**Gain proficiency in verification/validation stages, testing standards, EOL management, and configuration control. **CO5:**Comprehend vertical-specific product development, integration of mechanical, embedded, and	

TEXT BOOKS:

T1. Book specially prepared byNASSCOMaspertheMoU.
T2:KarlTUlrichandStephenDEppinger,"ProductDesignandDevelopment",TataMcGrawHill,FifthEdition,2011.
T3:JohnWNewstormandKeithDavis,"OrganizationalBehavior",TataMcGrawHill,EleventhEdition,2005

REFERENCE BOOKS:

R1. HiriyappaB,"CorporateStrategy–ManagingtheBusiness",AuthorHouse,2013.
R2:PeterFDrucker,"PeopleandPerformance",Butterworth–Heinemann[Elsevier],Oxford,2004.
R3:VinodKumarGargandVenkitaKrishnanNK,"EnterpriseResourcePlanning–Concepts",SecondEdition,PrenticeHall,2003.
R4:MarkSSandersandErnestJMcCormick,"HumanFactorsinEngineeringandDesign",McGrawHill Education,Seventh Edition,2013

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	3	3	2	2	-	-	-	2	2	2	2	2
2	3	3	3	3	2	2	-	-	-	2	2	2	2	2
3	3	3	3	3	2	1	-	-	-	2	2	2	2	2
4	3	2	2	4	2	2	-	-	-	2	0	2	2	1
5	3	2	2	3	2	1	-	-	-	2	2	2	2	1
CO	3	2.6	2.6	3.2	2	1.6	-	-	-	2	1.6	2	2	1.6

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC5302	**Measurements and Instrumentation**	3	0	0	3

Course Objective	1. To introduce basic instruments, error analysis, and bridge measurements. 2. Tounderstand the working principle of electronic instruments. 3. Tolearn the use of different types of signal generators and analysers 4. Toexplore types and applications of transducers in measurement systems. 5. Tointroduce digital data acquisition and fiber optic measurement principles.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO MEASUREMENT SYSTEMS & INDICATING EQUIPMENTS** Introduction to Instruments & their Representation, Static & Dynamic characteristics of Instruments, Types Of Errors-Error Analysis. PMMC, DC Ammeters & Voltmeters, Multimeter or VOM, Calibration of DC Instruments Bridge Measurements: Wheatstone, Kelvin, Maxwell, Schering and Wien Bridge.	9
II	**ELECTRONIC INSTRUMENTS FOR MEASURING & RECORDING** AC Voltmeter using Rectifier, True RMS-Responding voltmeters, Electronic Multimeter Digital Voltmeter, Q meter, Cathode Ray Oscilloscope (CRO), Recorders: Galvanometric, Servo type Potentiometric, Magnetic type & Digital Recorder.	9
III	**SIGNAL GENERATION & SIGNAL ANALYSIS** Sine wave generator, Frequency synthesized signal generator, Sweep frequency generators Function generators-Audio frequency signal generation. Wave analyzers -Harmonic distortion analyzer -spectrum analysis.	9
IV	**TRANSDUCERS** Classification of Transducers-Selecting a Transducer -Strain Gages-Displacement Transducers- Pressure Measurements, Temperature Measurements- Non-Electrical, Electrical & radiation methods. Flow Measurements.	9
V	**DATA ACQUISITION SYSTEMS AND FIBER OPTIC MEASUREMENTS** Elements of a Digital Data Acquisition System - Interfacing Transducers to Electronic Control & Measuring Systems - Multiplexing - Computer Controlled Test Systems: Testing of Audio Amplifier & Radio Receiver, - IEEE 488 Bus & Electrical interface - Fiber Optic Measurements: Power Measurement and System Loss - Optical Time Domains Reflectometer.	9
	Total Instructional Hours	**45**

Course Outcome	**After completion of the course the learner will be able to** CO1: Acknowledge instrument characteristics, types of errors, and calibration techniques. CO2: Explore knowledge on Electronic Instruments. CO3: Explain the different types of Signal generators, CRO and wave analysers. CO4: Identify various types of transducers and their working. CO5: Acquire knowledge on the various processes of instrumentation that is controlled by computers.

TEXT BOOKS:

T1- Albert D.Helfrick and William D.Cooper, Modern Electronic Instrumentation and Measurement Techniques, PHI, 2003.
T2- Ernest O.Doebelin, Measurements System-Application & Design, McGraw-Hill,1990,Fourth Edition.

REFERENCE BOOKS:

R1 - B.C.Nakara, K.K.Chaudhry, Instrumentation Measurement and Analysis , McGraw - Hill , 2004. .

R2 - J.B.Gupta, "A Course In Electronics And Electrical Measurements And Instrumentation", S.K.Kataria and sons,2013

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	3	2	-		-	-	-	-	-	3	3	2
2	3	3	3	2	-		-	-	-	-	-	3	3	2
3	3	2	3	2	-		-	-	-	-	-	3	3	2
4	3	2	3	2	-		-	-	-	-	-	3	3	2
5	3	2	3	2	-		-	-	-	-	-	3	3	2
CO	3	2.4	3	2								3	3	2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC5303	**IoT based System Design**	3	0	0	3

Course Objective	1. To Introduce the evolution and characteristics of IoT. 2. To Explain IoT enabling technologies and architecture. 3. To Explore IoT middleware and interoperability challenges. 4. To Cover IoT communication technologies and network layers. 5. To Provide insights into IoT implementation tools and applications	
Unit	**Description**	**Instructional Hours**
I	**INTRODUCTION TO INTERNET OF THINGS** Rise of the machines – Evolution of IoT – Web 3.0 view of IoT – Definition and characteristics of IoT – IoT Enabling Technologies – IoT Architecture — Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects - IoT levels and deployment templates – A panaromic view of IoT applications	9
II	**MIDDLEWARE AND PROTOCOLS OF IOT** Middleware technologies for IoT system (IoT Ecosystem Overview – Horizontal Architecture Approach for IoT Systems – SOA based IoT Middleware) Middleware architecture of RFID,WSN,SCADA,M2M –Interoperability challenges of IoT-Protocols for RFID,WSN,SCADA,M2M- Zigbee, KNX,BACNet,MODBUS - Challenges Introduced by 5G in IoT Middleware(Technological Requirements of 5G Systems - Perspectives and a Middleware Approach Toward 5G (COMPaaS Middleware) – Resource management in IoT.	9
III	**COMMUNICATION AND NETWORKING** IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks – Application Transport Methods: Supervisory Control and Data Acquisition –Application Layer Protocols: CoAP and MQTT- Data aggregation & dissemination.	9
IV	**IOT IMPLEMENTATION TOOLS** Introduction to Python, Introduction to different IoTtools, Developing applications through IoT tools, Developing sensor based application through embedded system platform, Implementing IoT concepts with python, Implementation of IoT with Raspberry Pi	9
V	**APPLICATIONS AND CASE STUDIES** Home automations - Smart cities – Environment – Energy – Retail – Logistics – Agriculture – Industry - Health and life style – Case study.	9

	Total Instructional Hours	**45**

Course Outcome	Upon Completion of the course, the students will have the ability to: CO1: Understand the evolution and defining characteristics of IoT, including its enabling technologies and architectural components. CO2: Identify the architecture, infrastructure models of IoT. CO3: Acquire knowledge of IoT communication technologies, network layers, and application layer protocols essential for IoT deployment. CO4: Analyze and design different models for IoT implementation. CO5: Identify and design the new models for market strategic interaction through case studies and practical examples.

TEXT BOOKS:

T1. Honbo Zhou, "Internet of Things in the cloud:A middleware perspective", CRC press, 2012.
T2. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-onApproach)", VPT, 1st Edition, 2014.

REFERENCE BOOKS:

R1-Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press, 2017.

R2- 2. Constandinos X. Mavromoustakis, George Mastorakis, Jordi MongayBatalla, "Internet of Things (IoT) in 5G Mobile Technologies" Springer International Publishing Switzerland 2016.

R3-. Dieter Uckelmann, Mark Harrison, Florian Michahelles, "Architecting the Internet of Things" Springer-Verlag Berlin Heidelberg, 2011..

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	3	3	3		-	-	2	2	-	3	3	3
2	3	2	3	3	3		-	-	2	2	-	3	3	3
3	3	2	3	3	3		-	-	2	2	-	3	3	3
4	3	2	3	3	3		-	-	2	2	-	3	3	3
5	3	2	3	3	3		-	-	2	2	-	3	3	3
CO	3	2	3	3	3				2	2		3	3	3

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Programme	Course Code	Name of the Course	L	T	P	C
BE/B.Tech	22EC5304	**Satellite Communication**	3	0	0	3

Course Objective	To understand the historical development and basic principles of satellite communications. To compare different network transmission technologies used in satellite communication systems. To describe orbital mechanics and spacecraft challenges affecting satellite operations. To explain radio wave propagation characteristics and polarization effects in satellite communications. To analyze the components and functions of the space segment and earth segment in satellite systems.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO SATELLITE COMMUNICATION** Historical background, Basic concepts of Satellite Communications, Communication Networks and Services, Comparison of Network Transmission technologies, Orbital and Spacecraft problems, Growth of Satellite communications. **Orbits and Launching Methods:** Introduction, Kepler's First Law, Kepler's Second Law, Kepler's Third Law, Definitions of Terms for Earth-Orbiting Satellites, Orbital Elements, Apogee and Perigee Heights, Orbit Perturbations, Effects of a non spherical earth, Atmospheric drag.	9
II	**RADIO WAVE PROPAGATION AND POLARIZATON** **Radio wave Propagation:** Introduction, Atmospheric Losses, Ionospheric Effects, Rain Attenuation, Other Propagation Impairments. **Polarization:** Introduction, Antenna Polarization, Polarization of Satellite Signals, Cross Polarization, Discrimination, Ionospheric Depolarization, Rain Depolarization, Ice Depolarization.	9
III	**THE SPACE SEGMENT AND THE EARTH SEGMENT** **The space segment:**Introduction, The Power Supply, Attitude Control, Spinning satellite stabilization, Momentum wheel stabilization, Station Keeping, Thermal Control, TT&C Subsystem, Transponders, The wideband receiver, The input demultiplexer, The power amplifier, The Antenna Subsystem **The Earth Segment:** Introduction, Receive-Only Home TV Systems, The outdoor unit, The indoor unit for analog (FM) TV, Master Antenna TV System, Community Antenna TV System, Transmit-Receive Earth Stations.	9
IV	**THE SPACE LINK** Introduction, Equivalent Isotropic Radiated Power, Transmission Losses, Free-space transmission, Feeder losses, Antenna misalignment losses, Fixed atmospheric and ionospheric losses, The Link-Power Budget Equation, System Noise, Carrier-to-Noise Ratio, The Uplink, Saturation flux density, Input backoff, Downlink, Output back-off, Combined Uplink and Downlink C/N Ratio	9
V	**SATELLITE ACCESS AND SPECIALIZED SERVICES** Introduction, Single Access, Preassigned FDMA, Demand-Assigned FDMA, Spade System, TDMA, Preassigned TDMA, Demand-assigned TDMA, Satellite-Switched TDMA, Code-Division Multiple Access **Satellite Mobile and Specialized Services:** Introduction, Satellite Mobile Services, VSATs, Radarsat, Global Positioning Satellite System (GPS), Orbcomm, Iridium.	9
	Total Instructional Hours	**45**

Course Outcome	**After the completion of the course, the learner will be able to** CO1: Understand principle, working and operation of various sub systems of satellite as well as the earth station. CO2: Analyze the effects of radio wave propagation and polarization on satellite communications CO3: Encompassing the design, components, operations, and functions of spacecraft subsystems and earth-based equipment CO4: Analyze and optimize uplink and downlink parameters in satellite communication systems to maximize efficiency CO5: Learn advanced techniques and regulatory aspects of satellite communication and Understand role of satellite in various applications

TEXT BOOKS:

T1- Satellite Communications, by Dennis Roddy(Fourth edition),McGraw Hill

T2 – Satellite Communication Systems Engineering, by Wilbur L. Pritchard, Henri G. Suyderhoud, Robert A. Nelson (Second Edition), Pearson

REFERENCE BOOKS:

R1 – Satellite Communication, by Timothy Pratt, Charles Bostian, Jeremy Allnutt(Second Edition), John Wiley & Sons.

R2-Satellite Technology, Principles and Applications, by Anil K. Maini, VarshaAgarwal(Second Edition), Wiley.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2							2	2	3	2
CO2	3	3	2	2							2	2	3	2
CO3	3	3	2	2							3	2	2	3
CO4	3	2	2	2							2	2	2	3
CO5	3	3	3	3							2	2	3	3
AVG	3	2.6	2.2	2.2							2.2	2	2.6	2.6

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Programme	**Course Code**	**Name of the Course**	**L**	**T**	**P**	**C**
BE	22EC5305	**Global Positioning System**	3	0	0	3
Course Objective	1. To understand the fundamental principles and architecture of GPS and GLONASS satellite systems. 2. To analyze GPS signal characteristics, including acquisition, tracking, and error sources. 3. To evaluate GPS receiver design options, antenna considerations, and methods for error mitigation. 4. To explore Differential GPS (DGPS) concepts, including LADGPS and WADGPS, and their applications. 5. To apply GPS technology in various applications such as surveying, navigation systems, and military operations.					

Unit	Description	Instructional Hours
I	**Introduction:** Basic concept, system architecture, GPS and GLONASS Overview, Satellite Navigation, Time and GPS, User position and velocity calculations, GPS, Satellite Constellation, Operation Segment, User receiving Equipment, Space Segment Phased development, GPS aided Geoaugmented navigation (GAGAN) architecture.	9
II	**Signal Characteristics:** GPS signal components, purpose, properties and power level, signal acquisition and tracking, Navigation information extraction, pseudorange estimation, frequency estimation, GPS satellite position calculation, Signal structure, anti-spoofing (AS), selective availability, Difference between GPS and GALILEO satellite construction.	9
III	**GPS Receivers & Data Errors:** Receiver Architecture, receiver design options, Antenna design, GPS error sources, SA errors, propagation errors, ionospheric error, tropospheric error, multipath, ionospheric error, estimation using dual frequency GPS receiver, Methods of multipath mitigation, Ephemeris data errors, clock errors.	9
IV	**Differential GPS:** Introduction, LADGPS, WADGPS, Wide Area Augmentation systems, GEO Uplink subsystem, GEO downlink systems, Geo Orbit determination, Geometric analysis, covariance analysis, GPS /INS Integration Architectures	9
V	**GPS Applications:** GPS in surveying, Mapping and Geographical Information System, Precision approach Aircraft landing system, Military and Space application, intelligent transportation system. GPS orbital parameters, description of receiver independent exchange format (RINEX), Observation data and navigation message data parameters, GPS position determination, least squares method	9
	Total Instructional Hours	**45**

Course Outcome	**After completion of the course the learner will be able to** CO1: Evaluate the architecture, operation, and advanced features of satellite navigation systems CO2: Facilitating a deep understanding and application of satellite navigation principles in practical scenarios CO3: Implement advanced techniques for error mitigation, including dual-frequency GPS receivers for ionospheric error estimation CO4: Integrate differential GPS concepts and implementations into a cohesive understanding CO5: Apply GPS across diverse applications

TEXT BOOKS:

T1-Mohinder S.Grewal, Lawrence R.Weill, Angus P.Andrews, "Global positioning systems, Inertial Navigation and Integration", Wiley 2007.

T2-B.Parkinson, J.Spilker, Jr.(Eds), "GPS: Theory and Applications", Vol.I&Vol.II, AIAA, 370 L'Enfant Promenade SW, Washington, DC 20024, 1996.

REFERENCE BOOKS:

R1 E.D.Kaplan, Christopher J. Hegarty, "Understanding GPS Principles and Applications", Artech House Boston 2005.

R2 - Ahmed El-Rabbany" Introduction to GPS:The Global Positioning System" Artech House BOSTON., 2002

R3 - A.Leick, "GPS Satellites Surveying", 2nd edition, John Wiley& Sons,NewYork,1995

R4 -B.Hoffman - Wellenhof, H.Lichtenegger and J.Collins, "GPS: Theory and Practice", 4th revised edition, Springer, Wein, New york, 1997.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	-		-	-	-	1	-	3	3	2
CO2	3	3	3	2	-		-	-	-	1	-	3	3	2
CO3	3	3	3	2	-		-	-	-	-	-	3	3	2
CO4	3	2	3	2	-		-	-	-	1	-	3	3	2
CO5	3	2	3	2	-		-	-	-	-	-	3	3	2
AVG	3	2.6	3	2						1		3	3	2

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Programme	Course code	Name of the Course	L	T	P	C
BE	22EC5306	Underwater Communication	3	0	0	3

Course Objective	1. To learn about fiber optic communication for underwater application 2. To acquire underwater MI communication and sensor networking 3. To analyze and apply principles of underwater acoustic communication 4. To understand the challenges in underwater communication 5. To synthesize advanced techniques in underwater cable design and handling systems across diverse applications.

Unit	Description	Instructional Hours
I	**UNDERWATER FIBREOPTICS COMMUNICATION** Basics of Fibre Optics communication: Working Principle, Single Mode, Multi-Mode, Effect on Fibrebending,StandardFOConnectors,CableRequirementforUnderwaterApplication,CableCharacteristics, Basic design for Electro-Optical(E-O) Underwater Cable, Handling system for E-Ocables, Optical slip ring and its application, An insight into Fibre Optic Telemetry.	9
II	**UNDERWATER OPTICALCOMMUNICATION** Introduction, Classification of Underwater Wireless Optical Communication Links, Underwater Optical Communication (UWOC) System: Modulation, Coding, Light Source Technology, Common Lasers in UWOC, Signal Detectors and its merits and demerits, Alignment and Compensation, UWCNetwork,AbsorptionandScatteringLosses,UWOCChannelModeling, UWOCLinkTurbulence,Noisein the UWOC Channel. UWOC Networks.	9
III	**UNDER WATER MI COMMUNICATION & SENSOR NETWORKS** Fundamental Principles of Magnetic Induction, Basic Element of Magnetism, Magnetic Induction, Lenz's Law, Mutual and Self Induction, Inductive and Capacitive Reactance of the coil, MI Communication System: MI Coil, Matching Network, Communication Block: MI Wireless Sensor Networks: UW sensor network Application and Its Architecture, Localization, Medium Access protocols, Routing Protocols, Cross-layer Protocols, Recent trend on MI communication.	9
IV	**BASIC PRINCIPLES OF UNDERWATER ACOUSTIC COMMUNICATION** Ocean Acoustic environment; Measuring sound levels and relevant units; Sound propagation in the ocean – sound velocity profiles in the deep water and shallow water Speed of underwater sound, Underwater Sound Transmission Loss, Acoustic Field Model: Ray Theory Model, Structure and Performance of UWAC System: Basic Structure of UWAC System, Performance Indicators of UWAC System, Characteristics of the UWA Channel.	9
V	**UNDERWATER ACOUSTIC NETWORK TECHNOLOGY** Basics on Underwater Acoustic Modem and its construction, Bandwidth and its limitations, Characteristics of UWA Network, Topology of UWA Network, Network Protocol Architecture of UWA Network, UWAC Challenges and Research Trends, Comparison study on RF, Optical and Acoustic Communication in Underwater. Underwater telephone, Acoustic Positioning System, Underwater beacon.	9
Total Instructional Hours		**45**

Course Outcome	**After completion of the course the learner will be able to** CO1: Understand the working principles of fiber optics and differentiate between single-mode and multi-mode fibers. CO2: Evaluate modulation, coding, and light source technologies in UWOC. CO3: Design and optimize MI communication systems and UW sensor networks CO4: Assess the structure, performance indicators, and characteristics of underwater acoustic communication systems CO5:Design and optimize underwater acoustic network topologies and protocols.

TEXT BOOKS:

T1. YiLou,NiaxAhmed,Underwater CommunicationsandNetworks, FirstEdition,Springer,2021

REFERENCE BOOKS :

R1: FerialEl-Hawary,TheOceanEngineeringHandbook,FirstEdition, CRCPress,2001

R2:L.M.Brekhovskikh and Yu. P. Lysanov, Fundamentals of ocean acoustics, Third Edition,Springer,2003

R3:RobertJUrick,Principlesof underwatersound,ThirdEdition, PeninsulaPublishing,2013

R4:RahulSharma, DeepSeaMiningHandbook,FirstEdition,Springer,2017

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	-		-	-	-	2	-	3	3	2
CO2	3	3	3	2	-		-	-	-	1	-	3	3	2
CO3	3	3	3	2	-		-	-	-	1	-	3	3	2
CO4	3	3	3	2	-		-	-	-	1	-	3	3	2
CO5	3	3	3	2	-		-	-	-	2	-	3	3	2
AVG	3	3	3	2						1.4		3	3	2

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Programme	Course code	Name of the Course	L	T	P	C
BE	22EC5307	Network Security	3	0	0	3

Course Objective	1.To impart knowledge on the Network security services, attacks and mechanisms. 2.To familiarize the principles of block ciphers and stream ciphers 3.To explore the concepts of public key cryptography and the authentication techniques. 4.To gain knowledge on various Data Integrity algorithms and the methods used for key distribution 5.To understand the security services provided to internet.

Unit	Description	Instructional Hours
I	**INTRODUCTION** OSI security architecture –Security Services, Mechanisms and attacks-Network security model-Symmetric cipher model- substitution techniques, transposition techniques, steganography.	9
II	**SYMMETRIC CIPHERS** Block cipher principles- Data Encryption Standard(DES)-Advanced Encryption Standard (AES)-Multiple Encryption-Triple DES- modes of block cipher-stream ciphers-RC5 algorithm.	9
III	**ASYMMETRIC CIPHERS** Principles of public key cryptosystems-RSA algorithm-Key management – Diffie Hellman Key exchange- EI Gamal cryptography-Elliptic curve arithmetic-Elliptic curve cryptography.	9
IV	**MUTUAL TRUST , AUTHENTICATION AND DATA INTEGRITY** Mutual trust, Symmetric key distribution using symmetric encryption-symmetric key distribution using asymmetric encryption-distribution of public keys-X.509 Authentication services-Remote user- Authentication principles-Kerberos, Data integrity : Security of hash function and MAC –SHA - HMAC –DSS .	9
V	**INTERNET SECURITY:** Security Services for E-mail-Pretty Good Privacy-S/MIME. Overview of IP Security – IP security policy-Encapsulation Security Payload (ESP)-SSL/TLS Basic Protocol-combining security associations-Internet key exchange.	9
	Total Instructional Hours	**45**

Course Outcome	**After completion of the course the learner will be able to** CO1: Illustrate the appropriate Cryptographic technique to overcome the security attacks. CO2: Outline the characteristics of various Symmetric Ciphers. CO3: Demonstrate the principles Asymmetric ciphers. CO4:Develop a secured system with authentication and integrity services. CO5:Apply the necessary internet security algorithm for various applications.

TEXT BOOKS:

T1- William Stallings, Cryptography and Network Security, 6th Edition, Pearson Education, March 2013.

T2- Behrouz A. Ferouzan, "Cryptography & Network Security", 3rd Edition, Tata Mc Graw Hill, 2007.

REFERENCE **BOOKS :**

R1 - Charlie Kaufman, Radia Perlman and Mike Speciner, "Network Security", 2nd Edition, Prentice Hall of India, 2002.

R2 - Bruce Schneier and Neils Ferguson, "Practical Cryptography", First Edition, Wiley Dream tech India Pvt Ltd, 2003

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	-	-	-	-	3	-	-	2	3	3
CO2	3	3	3	3	-	-	-	-	3	-	-	2	3	3
CO3	3	3	2	3	-	-	-	-	3	-	-	2	3	3
CO4	3	3	3	3	-	-	-	-	3	-	-	3	3	3
CO5	3	3	2	3	-	-	-	-	3	-	-	3	3	3
AVG	3	3	2.4	3	-	-	-	-	3	-	-	2.6	3	3

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC5308	**Wireless Sensor and Networks**	3	0	0	3

Course Objective	1. To familiarize on characteristics and challenges of Wireless Sensor Networks 2. To understand the network architecture of Wireless Sensor Networks 3. To learn the various medium access control protocols for WSNs environment 4. To gain knowledge on time synchronization and topology control mechanisms for WSNs 5. To explore various routing protocols and discuss the applications of WSNs

Unit	Description	Instructional Hours
I	**OVERVIEW OF WIRELESS SENSOR NETWORKS** Challenges for Wireless Sensor Networks-Characteristic Requirements, Required Mechanisms-Difference between MANETs and WSNs- Applications of WSN.	9
II	**ARCHITECTURES** Single-Node Architecture - Hardware Components-Energy Consumption of Sensor Nodes - Operating Systems and Execution Environments-Example of sensor Nodes. Network Architecture -Sensor Network Scenarios- Optimization Goals and Figures of Merit, Gateway Concepts.	9
III	**MEDIUM ACCESS CONTROL PROTOCOLS** Fundamentals of MAC protocols - Low duty cycle protocols and wakeup concepts - Contention-based protocols - Schedule-based protocols - SMAC - Traffic-adaptive medium access protocol (TRAMA) - The IEEE 802.15.4 MAC protocol. Naming and addressing: Fundamentals-Address and Name Management, Assignment of MAC Addresses.	9

IV	**TIME SYNCHRONIZATION AND TOPOLOGY CONTROL** Introduction to time synchronization problem-Protocols based on sender/receiver synchronization-localization and positioning-possible approaches-single – hop localization positioning in multi-hop environments- Topology control-Motivation and basic ideas controlling topology in flat network-hierarchal networks by dominating sets-hierarchal networks by clustering-combining hierarchal topologies and power control.	9
V	**ROUTING PROTOCOLS AND APPLICATIONS** Gossiping and agent-based unicast forwarding-Energy-efficient unicast-Broadcast and Multicast-Geographic routing-Mobile nodes, Application-Target detection and tracking-edge detection-Field sampling	9
	Total Instructional Hours	**45**

Course Outcome	CO1: Outline the characteristics and challenges of Wireless Sensor Networks CO2: Explain the WSN network architecture and its operation CO3: Summarize various medium access protocols used for WSN. CO4: Categorize the various mechanism for time synchronization and topology control in WSN CO5: Compare and Contrast various routing techniques used in WSN

TEXT BOOKS:

T1-Holger Karl & Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley, 2005.

T2- Feng Zhao & Leonidas J. Guibas, "Wireless Sensor Networks- An Information Processing Approach", Morgan Khaufmann Publishers'

REFERENCE BOOKS:

R1- KazemSohraby, Daniel Minoli, &TaiebZnati, "Wireless Sensor Networks-Technology, Protocols, And Applications", John Wiley, 2007.

R2-Anna Hac, "Wireless Sensor Network Designs", John Wiley, 2003.

R3-Edgar H.Callaway,Jr. and Edgar H.Callaway, "Wireless Sensor Networks :Architectures and Protocols", CRC Press, August 2003.

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	-	-	-	-	2	-	-	2	3	3
CO2	3	3	3	3	-	-	-	-	3	-	-	2	3	3
CO3	3	2	2	3	-	-	-	-	2	-	-	3	3	3
CO4	3	3	3	3	-	-	-	-	3	-	-	3	3	3
CO5	3	3	2	3	-	-	-	-	3	-	-	3	3	3
AVG	3	2.8	2.4	3	-	-	-	-	2.6	-	-	2.6	3	3

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC5309	**High Speed Networks**	3	0	0	3

Course Objective	1. To impart the fundamental knowledge on Frame relay networks and ATM networks 2. To understand the concepts of congestion and traffic management 3. To explore and gain knowledge on Graph Theory and Internet Routing 4. To familiarize more about Quality of Service in IP Networks 5. To study the importance of Compression in High Speed Networks

Unit	Description	Instructional Hours
I	**HIGH SPEED NETWORKS** Protocols and TCP/IP Suite-TCP and IP-Frame Relay –Asynchronous Transfer Mode-High Speed LANs	9
II	**CONGESTION AND TRAFFIC MANAGEMENT** Congestion Control in Data Networks and Internets- Link-level Flow and Error Control-TCP Traffic Control-Traffic and Congestion Controls in ATM Networks	9
III	**INTERNET ROUTING** Overview of Graph Theory and Least-Cost Paths-Internet Routing Protocols-Exterior Routing Protocols and Multicast	9
IV	**QOS IN IP NETWORKS** Integrated and Differentiated Services-Protocols for QoS Support: Resource ReservationRSVP- Multiprotocol Label Switching - Real Time Transport Protocol	9
V	**COMPRESSION** Overview of Information Theory: Information and Entropy, Coding-Lossless Compression-Lossy Compression	9
	Total Instructional Hours	**45**

Course Outcome	CO1: Interpret ATM and Frame relay networks CO2: Describe the concepts of congestion and traffic management CO3: Analyze the Quality of service in various IP Networks. CO4: Examine the Principle of wireless network operation and compression CO5: Categorize the various compression technique in Network management.

TEXT BOOKS:

T1- William Stallings, "High-Speed Networks and Internets: Performance and Quality of Service", Pearson Education, Second Edition, 2002

T2- Jean WarlandandPravinVaraiya, "High Performance Communication Networksl", Jean Harcourt Asia Pvt. Ltd., Second Edition, 2001

REFERENCE BOOKS:

R1-Behrouz A. Forouzan, "Data Communication and Computer Networking", Fourth Edition,

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	2	2	-	-	2	-	-	2	3	3
CO2	3	3	3	2	2	1	-	-	3	-	-	2	3	3
CO3	3	3	3	2	2	1	-	-	2	-	-	3	3	3
CO4	3	3	3	3	3	2	-	-	3	-	-	3	3	3
CO5	2	1	2	1	3	-	-	-	3	-	-	3	3	3
AVG	2.8	2.4	2.6	2	2.4	1.5	-	-	2.8	-	-	2.6	3	3

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC5310	**Digital Image Processing**	3	0	0	3

Course Objective	1. To grasp essential steps, components, and visual perception elements in image processing. 2. To implement spatial and frequency domain filters for image enhancement and restoration. 3. To utilize restoration methods and segmentation techniques for feature extraction and pattern recognition. 4. To implement morphological operations and compression standards like JPEG and MPEG. 5. To apply supervised and unsupervised learning methods, including neural networks, in pattern recognition.

Unit	Description	Instructional Hours
I	**DIGITAL IMAGE FUNDAMENTALS** Introduction – Fundamental Steps in Digital Image Processing –Components of an Image Processing System, Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – RGB and HSI color models.	9
II	**IMAGE ENHANCEMENT** **Spatial Domain**: Gray level transformations – Histogram processing: Histogram equalization – Basics of Spatial Filtering –Smoothing and Sharpening Spatial Filtering -Homomorphic filtering, Color image enhancement **Frequency Domain**: Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters.	9
III	**IMAGE RESTORATION AND SEGMENTATION** **Restoration**: Image Restoration degradation model– Mean Filters – Inverse Filtering – Wiener filtering- Geometric transformations-spatial transformations. **Segmentation**: point, line, edge detection-Edge Linking via Hough transformation – Region based segmentation: Region Growing, Region splitting and merging - Practical applications –process an image using various segmentation techniques.	9
IV	**MORPHOLOGICAL PROCESSING AND IMAGE COMPRESSION** **Morphological processing**- Dilation and Erosion-Segmentation by morphological watersheds.**Compression**: Fundamentals – Error Free Compression – Variable Length Coding: Huffman coding, Arithmetic Coding – Compression Standards: JPEG and MPEG.	9

V	**PATTERN CLASSIFICATION** Feature extraction-Boundary representation – Chain Code, Signature, skeleton – boundary descriptor-shape number- Patterns classification methods- supervised and unsupervised neural networks in Pattern recognition.	9
	Total Instructional Hours	**45**
Course Outcome	**After completion of the course the learner will be able to** CO1: Apply fundamental concepts and techniques to process and enhance digital images effectively. CO2: Implement spatial and frequency domain filters to improve image clarity and quality. CO3: Utilize restoration techniques and segmentation methods to extract features and analyze images. CO4: Implement morphological operations and understand image compression techniques for efficient data storage. CO5: Apply feature extraction and classification methods, including neural networks, to recognize patterns in images.	

TEXT BOOKS:

T1- Rafael C Gonzalez, Richard E Woods, "Digital Image Processing", Pearson Education Inc, Fourth Edition, 2018. (Units I – V)

T2- Anil K- Jain, "Fundamentals of Digital Image Processing", Pearson/Prentice Hall of India,2002.

REFERENCE BOOKS:

R1- Annadurai and Shanmughalakshmi, "Fundamentals of Digital Image Processing',Pearson India,2006.

R2 - S.Jayaraman,S.Esakkirajan,T.Veerakumar, "Digital Image Processing", TMH New Delhi ,2009

R3 - Kenneth R. Castleman, "Digital Image Processing", Pearson, 2006

R4- Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, "Digital Image Processing using MATLAB ", Pearson Education, Inc., 2004.

R5- William K. Pratt, "Digital Image Processing", John Wiley, New York, 2002.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	3		-	-	3	-	-	2	3	1
CO2	3	2	3	3	3		-	-		-	-	3	3	3
CO3	3	3	3	3	2		-	-	3	2	-	2	3	3
CO4	3	2	2	3	3		-	-			-	3	3	2
CO5	3	3	3	3	2		-	-	3	2	-	2	3	2
AVG	3	3	3	3	3				3	2		2	3	2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC5311	**Audio Signal Processing**	3	0	0	3

Course Objective	1.To understand the mechanics of speech and audio processing, including speech production, auditory perception, and perceptual audio quality measures. 2.To learn time and frequency domain methods for extracting and analyzing speech signal parameters 3.To familiarize linear predictive analysis techniques for speech signal processing 4.To explore time-frequency analysis techniques for audio processing, focusing on filter banks and transforms. 5.To study and implement algorithms for speech and audio signal processing, including recognition, synthesis, and watermarking.

Unit	Description	Instructional Hours
I	**UNIT I MECHANICS OF SPEECH AND AUDIO** Speech production mechanism – Nature of Speech signal – Digital Model of speech signals - Classification of Speech sounds – Phones – Phonemes – Phonetic and Phonemic alphabets – Articulatory features-Anatomical pathways from the ear to perception of sound - The peripheral auditory system. Absolute Threshold of Hearing - Critical Bands- Simultaneous Masking, MaskingAsymmetry, Perceptual Entropy -Basic measuring philosophy - Subjective versus objective perceptual testing - The perceptual audio quality measure(PAQM).	9
II	**UNIT II TIME AND FREQUENCY DOMAIN METHODS FOR SPEECH PROCESSING** Time domain parameters of Speech signal – Methods for extracting the parameters: Energy, Average Magnitude –Zero Crossing Rate (ZCR)– Silence Discrimination using ZCR and energy - Short Time Fourier analysis – Formant extraction and Pitch Extraction	9
III	**UNIT III LINEAR PREDICTIVE ANALYSIS OF SPEECH** Formulation of Linear Prediction problem in Time Domain – Basic Principle – Auto correlation method – Covariance method – Solution of LPC equations – Cholesky method – Durbin's Recursive algorithm – lattice formation and solutions – Comparison of different methods – Application of LPC parameters – Pitch detection using LPC parameters – Formant analysis – VELP – CELP.	9
IV	**UNIT IV TIME-FREQUENCY ANALYSIS FOR AUDIO: FILTER BANKS AND TRANSFORMS** Analysis- Synthesis Framework for M-band Filter Banks- Filter Banks for Audio Coding: Design Considerations- Quadrature Mirror and Conjugate Quadrature Filters- Tree-Structured QMF- Cosine Modulated "Pseudo QMF" M-band Banks - Cosine Modulated Perfect Reconstruction (PR) M-band Banks and Modified Discrete Cosine Transform (MDCT).	9
V	**UNIT V SPEECH AND AUDIO SIGNAL PROCESSING ALGORITHMS** Algorithms: Dynamic Time Warping, Hidden Markov Model– Gaussian Mixture Model - Automatic 20 Speech Recognition – Feature Extraction for ASR - Speaker identification and verification – Voice response system – Speech Synthesis - Digital Audio Watermarking - Audio MPEG	9
	Total Instructional Hours	**45**

Course Outcome	**After completion of the course the learner will be able to** CO1: Understand speech signal mechanisms, classify speech sounds, and apply auditory perception principles in audio quality assessment. CO2: Analyze speech and audio signals in the time and frequency domains. CO3: Formulate and solve LPC problems, compare methods, and utilize LPC parameters for pitch detection and formant analysis. CO4: Design and implement M-band filter banks, QMF, and MDCT for audio coding and analysis applications. CO5: Develop and apply algorithms for ASR, speaker identification, speech synthesis, and digital audio watermarking.

TEXT BOOKS:

T1- . L.R.Rabiner and R.W.Schaffer, "Digital Processing of Speech signals", Pearson Education Singapore Pvt. Ltd, First Edition,2008.
T2:Ben Gold and Nelson Morgan, "Speech and Audio Signal Processing", John Wiley and Sons Inc., Singapore,Second Edition, 2011.
T3:Quatieri, "Discrete-time Speech Signal Processing", Pearsm Education, First Edition, 2002.
T4:UdoZölzer "A John, "Digital Audio Signal Processing", Wiley & sons Ltd Publications, Second Edition, 2008.

REFERENCE BOOKS:

R1- Mark Kahrs and Karlheinz Brandenburg, "Applications of Digital Signal Processing to Audio And Acoustics",Springer Publishing Company, Incorporated, 2013.
R2:Ken C. Pohlmann, "Principles of Digital Audio", McGraw Hill, New Delhi, Sixth Edition, 2010.
R3:John Watkinson, "An Introduction to Digital Audio", Focal Press, Second Edition, 2002.
R4:SpaniasAndress, Painter Ted @ AttiVentataraman, "Audio Signal Processing and Coding", John Wiley &Sons, New Delhi, 2013.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	-		-	-	-	-	-	3	3	2
CO2	3	3	3	2	-		-	-	-	-	-	3	3	2
CO3	3	2	3	2	-		-	-	-	-	-	3	3	2
CO4	3	2	3	2	-		-	-	-	-	-	3	3	2
CO5	3	2	3	2	-		-	-	-	-	-	3	3	2
AVG	3	2.4	3	2								3	3	2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC5312	**Machine Vision**	3	0	0	3

Course Objective	1.To introduce fundamental concepts and techniques in image formation and processing, including geometric and photometric principles, filtering, and transformations. 2.To learn techniques for feature detection, matching, and segmentation in digital images. 3.To understand and implement feature-based alignment and motion estimation techniques for 2D and 3D images and videos. 4.To explore methods and algorithms for 3D reconstruction from visual data, including shape recovery and surface representation techniques. 5.To study image-based rendering techniques and recognition algorithms for visual data analysis and understanding.

Unit	Description	Instructional Hours
I	**UNIT I INTRODUCTION TO IMAGE FORMATION AND PROCESSING** Computer Vision - Geometric primitives and transformations - Photometric image formation - The digital camera - Point operators - Linear filtering - More neighborhood operators - Fourier transforms - Pyramids and wavelets - Geometric transformations - Global optimization.	9
II	**UNIT II FEATURE DETECTION, MATCHING AND SEGMENTATION** Points and patches - Edges - Lines - Segmentation - Active contours - Split and merge - Mean shift and mode finding - Normalized cuts - Graph cuts and energy-based methods.	9
III	**UNIT III FEATURE-BASED ALIGNMENT & MOTION ESTIMATION** 2D and 3D feature-based alignment - Pose estimation - Geometric intrinsic calibration - Triangulation - Two-frame structure from motion - Factorization - Bundle adjustment - Constrained structure and motion - Translational alignment - Parametric motion - Spline-based motion - Optical flow - Layered motion.	9
IV	**UNIT IV 3D RECONSTRUCTION** Shape from X - Active rangefinding - Surface representations - Point-based representationsVolumetric representations - Model-based reconstruction - Recovering texture maps and albedosos.	9
V	**UNIT V IMAGE-BASED RENDERING AND RECOGNITION** View interpolation Layered depth images - Light fields and Lumigraphs - Environment mattes - Video-based rendering-Object detection - Face recognition - Instance recognition - Category recognition - Context and scene understanding-Recognition databases and test sets.	9
	Total Instructional Hours	**45**

Course Outcome	After completion of the course, the learner will be able to CO1: Apply basic image formation and processing techniques, including geometric transformations, filtering, and Fourier analysis. CO2: Proficient in detecting points, edges, lines, and performing segmentation using advanced methods like active contours and graph cuts. CO3: Acquire skills in pose estimation, triangulation, structure from motion, bundle adjustment, and optical flow for analyzing and aligning visual data. CO4: Apply various approaches such as shape from X, model-based reconstruction, and texture mapping for generating 3D models from images or range data. CO5: Apply image-based rendering techniques and recognition algorithms to tasks including view interpolation, object detection, and face and scene recognition.

TEXT BOOKS:

T1- . Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer- Texts in Computer Science, Second Edition, 2022.
T2:Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, Second Edition, 2015.

REFERENCE BOOKS:

R1- Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
R2: Christopher M. Bishop; Pattern Recognition and Machine Learning, Springer, 2006 3. E. R. Davies, Computer and Machine Vision, Fourth Edition, Academic Press, 2012.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	3	-	-	-	-	-	-	2	3	1
CO2	3	2	3	3	3	-	-	-	-	-	-	3	3	3
CO3	3	3	3	3	2	-	-	-	-	-	-	2	3	3
CO4	3	2	2	3	3	-	-	-	-	-	-	3	3	2
CO5	3	3	3	3	2	-	-	-	-	-	-	2	3	2
AVG	3	3	3	3	3	-	-	-	-	-	-	2	3	2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC5313	Medical Electronics	3	0	0	3

Course Objective	1.To understand the principles and techniques of bio-potential recording, including the use of electrodes, amplifiers, and various recording methods. 2.To learn about the measurement of biochemical and non-electrical parameters in the medical field, including pH, blood flow, cardiac output, and respiratory measurement. 3.To familiarize students with various assist devices used in medical instrumentation, such as pacemakers, defibrillators, and imaging systems. 4.To explore the applications of physical medicine and biotelemetry, including the use of diathermies and telemetry principles in medical practice. 5.To stay updated on recent trends in medical instrumentation, including the use of thermography, endoscopy, and telemedicine.

Unit	Description	Instructional Hours
I	**ELECTRO-PHYSIOLOGYAND BIO-POTENTIALRECORDING** The origin of Bio-potentials; biopotential electrodes, biological amplifiers, ECG, EEG, EMG, PCG, lead systems and recording methods, typical waveforms and signal characteristics.	9
II	**BIO-CHEMICALAND NON ELECTRICALPARAMETER MEASUREMENT** pH, PO_2, PCO_2, colorimeter, Auto analyzer, Blood flow meter, cardiac output, respiratory measurement, Blood pressure, temperature, pulse, Blood Cell Counters..	9
III	**ASSIST DEVICES** Cardiac pacemakers, DC Defibrillator, Dialyser, Ventilators, Magnetic Resonance Imaging Systems, Ultrasonic Imaging Systems, Heart lung machine.	9
IV	**PHYSICAL MEDICINEAND BIOTELEMETRY** Diathermies-Shortwave,ultrasonicandmicrowavetypeandtheirapplications,SurgicalDiathermy-Telemetryprinciples,biotelemetry	9
V	**RECENTTRENDS IN MEDICAL INSTRUMENTATION** Thermo graph, endoscopy unit, Laser in medicine, Introduction to telemedicine, Insulin Pumps, Radio pill, Brain machine interface, Lab on a chip.	9
	Total Instructional Hours	**45**

Course Outcome	**After completion of the course the Students will be able to** 1.Understand the principles and techniques involved in electro-physiology and bio-potential recording, including the use of bio-potential electrodes, biological amplifiers, and different types of recording methods. 2.Describe various bio-chemical and non-electrical parameter measurement techniques, such as pH, PO2, PCO2, and blood flow meter, and understand how these measurements are used in medical diagnosis and treatment. 3.Identify and explain the function of assist devices used in medical instrumentation, such as cardiac pacemakers, ventilators, and magnetic resonance imaging systems. 4.Demonstrate an understanding of physical medicine and biotelemetry, including the use of diathermies, telemetry principles, and biotelemetry techniques in medical monitoring and treatment. 5.Discuss recent trends in medical instrumentation, such as thermo graph, endoscopy unit, and lab on a chip technology, and understand their applications in healthcare.

TEXT BOOKS:

T1- LeslieCromwell,"BiomedicalInstrumentationandMeasurement",PrenticeHallofIndia,New Delhi,2007. (Unit I to V).

REFERENCE BOOKS:

R1 - JohnG.Webster,"MedicalInstrumentationApplicationandDesign",3rdEdition,WileyIndiaEdition,2007.
R2 - Khandpur,R.S.,"HandbookofBiomedicalInstrumentation",TATAMcGraw-Hill,NewDelhi,2003.
R3 - JosephJ.CarrandJohnM.Brown,"IntroductiontoBiomedicalEquipmentTechnology",JohnWileyand Sons, NewYork, 2004

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	2	2	-	-	1	2	2	3	2
CO2	3	3	3	3	2	2	2	-	-	1	2	2	2	2
CO3	3	3	3	3	2	2	2	-	-	1	2	2	2	2
CO4	3	3	3	3	2	2	2	-	-	1	2	2	2	2
CO5	3	3	3	3	2	2	2	-	-	1	2	2	3	3
AVG	3	3	3	3	2.2	2	2			1	2	2	2.4	2.2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC5314	Medical Informatics	3	0	0	3

Course Objective	1.To Understand the Fundamentals of Medical Informatics 2 To Explore Computer Applications in Medical Imaging and Laboratories 3.To Examine Computerized Patient Records 4.To Analyze Computer-Assisted Medical Decision-Making 5.To Discover Recent Trends in Medical Informatics	
Unit	**Description**	**Instructional Hours**
I	**INTRODUCTION TO MEDICAL INFORMATICS** Introduction-Structure of Medical Informatics–Internet and Medicine- Security issues, Computer based medical information retrieval, Hospital management and information system,	9
II	**COMPUTERS IN CLINICAL LABORATORY AND MEDICAL IMAGING** Automated clinical laboratories- Automated methods in hematology, cytology and histology, Intelligent Laboratory Information System-Computer assisted medical imaging-nuclear medicine, ultrasound imaging, computed X-ray tomography, Radiation therapy and planning, Nuclear Magnetic Resonance.	9
III	**COMPUTERISED PATIENT RECORD** Introduction -conventional patient record, Components and functionality of CPR, Development tools, Intranet, CPR in Radiology - Application server provider, Clinical information system, Computerized prescriptions for patients.	9
IV	**COMPUTER ASSISTED MEDICAL DECISION - MAKING** Neuro computers and Artificial Neural Networks application, Expert system-General model of CMD, Computer–assisted decision support system – production rule system cognitive model, semantic networks, decisions analysis in clinical medicine-computers in the care of critically ill patients, Computer aids for the handicapped.	9
V	**RECENTTRENDSIN MEDICAL INFORMATICS** Virtual reality applications in medicine, Virtual endoscopy, Computer assisted surgery, Surgical simulation, Telemedicine - Tele surgery, Computer assisted patient education and health- Medical education and healthcare information, computer assisted instruction in medicine.	9
	Total Instructional Hours	**45**
Course Outcome	**After completion of the course the student will be able to** CO1: Proficiency in Medical Informatics **CO2**: Application of Computer Technology in Medical Fields. **CO3**: Development and Management of Computerized Patient Records. **CO4**: Enhanced Decision-Making Skills. **CO5**: Awareness of Modern Medical Informatics Trends.	

TEXT BOOKS:

T1- Mohan Bansal,"Medicalinformatics",TataMcGrawHillPublishingLtd,2003.
T2:R.D.Lele,"Computersinmedicineprogressinmedicalinformatics",TataMcgrawHill,2005

REFERENCE BOOKS:

R1 - Kathryn J.Hannah,MarionJBall,"HealthInformatics",3rdEdition,Springer,2006.

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	2	-	-	-	-	-	-	3	2
CO2	3	3	3	3	3	2	-	-	-	-	-	-	2	2
CO3	3	3	3	3	3	2	-	-	-	-	-	-	2	2
CO4	3	3	3	3	3	2	-	-	-	-	-	-	2	3
CO5	3	3	3	3	3	2	-	-	-	-	-	-	2	2
AVG	3	3	3	3	3	2	-	-	-	-	-	-	2	2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC5315	Medical Image Processing	3	0	0	3
Course Objective	1.To Introduce spatial processing 2.To Explore frequency filtering 3.To Teach image restoration 4.To Discuss image compression. 5. To Study image recognition.					
Unit	Description					Instructional Hours
I	**SPATIAL DOMAINPROCESSING** Introduction,StepsinDigitalImageProcessing -Components –ElementsofVisualPerception - Image Sensing and Acquisition - Image Sampling and Quantization -Relationships betweenpixels - color models- DICOM, Various modalities of Medical Imaging-CT, MRI, PET,Thermo graphy,Angiography,CADSystem,Histogramprocessing–BasicsofSpatialFiltering–Smoothing and SharpeningSpatial Filtering.					9
II	**FREQUENCYDOMAIN PROCESSING** SmoothingandSharpeningfrequencydomainfilters–Ideal,ButterworthandGaussianfilters. Notch filter, Wavelets -Sub band coding-Multi resolution expansions Wavelets basedimageprocessing.					9
III	**MEDICAL IMAGERESTORATIONANDSEGMENTATION** Image Restoration - Inverse Filtering – Wiener filtering. Detection of Discontinuities–EdgeLinking and Boundary detection – Region based segmentation- Region Growing, RegionSplitting,Morphologicalprocessing-erosionanddilation, KMeansand FuzzyClustering.					9

IV	**MEDICAL IMAGE COMPRESSION** Image Compression models – Error Free Compression – Variable Length Coding – Bit-PlaneCoding – Lossless Predictive Coding – Lossy Compression – Lossy Predictive Coding – CompressionStandards -JPEG,JPEG2000.	9
V	**MEDICAL IMAGEREPRESENTATION AND RECOGNITION** Boundaryrepresentation-ChainCode-Polygonalapproximation,signature,boundarysegments - Boundary description–Shape number -Fourier Descriptor, moments- RegionalDescriptors – Topological feature, Texture - Patterns and Pattern classes - Recognition basedonmatching, ContentBasedImageRetrieval. Analysis of TissueStructure.	9
	Total Instructional Hours	**45**
Course Outcome	**After completion of the course the students will be able to** CO1: Understand spatial filtering. CO2: Apply frequency filters CO3: Perform image restoration. CO4: Implement compression techniques. CO5: Recognize image patterns.	

TEXT BOOKS:

T1:G.R. Sinha, Bhagwaticharanpatel, Medical Image Processing: Concepts andApplications,PHILearningprivatelimited.2014
T2: KayvanNajarianandRobertSplinter,"BiomedicalSignalandImageProcessing",SecondEdition,CRCPress, 2005.
T3: E.R.Davies,"Computer &MachineVision",FourthEdition,AcademicPress,2012.

REFERENCE BOOKS:

R1: RafaelC.Gonzalez,RichardE.Woods,StevenL.Eddins,"DigitalImageProcessingUsingMATLAB", Third Edition Tata McGrawHill Pvt.Ltd., 2011.
R2: AnilJainK."FundamentalsofDigital ImageProcessing",PHILearningPvt.Ltd.,2011.
R3: WilliamKPratt,"Digital ImageProcessing",JohnWilley,2002.
R4: MalayK.Pakhira,"DigitalImageProcessingandPatternRecognition",FirstEdition,PHILearningPvt.Ltd., 2011.
R5: Geoff Dougherty, Medical Image Processing: Techniques and Applications, SpringerScience &Business Media, 25-Jul-2011
R6:Isaac N. Bankman, Handbook of Medical Image Processing and Analysis, ScienceDirect,2ndEdition •2009

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	-	-	-	-	-	1	1	3	2
CO2	3	3	2	2	2	-	-	-	-	-	1	1	3	2
CO3	3	2	3	2	2	-	-	-	-	-	1	1	3	3
CO4	3	3	3	2	2	-	-	-	-	-	1	1	3	3
CO5	3	3	3	2	2	-	-	-	-	-	1	1	3	3
AVG	3	2.8	2.8	2	2						1	1	3	2.6

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC5316	**App Development**	3	0	0	3
Course Objective	To learn development of native applications with basic GUI Components To develop cross-platform applications with event handling To develop applications with location and data storage capabilities To develop web applications with database access					

Unit	Description	Instructional Hours
I	**FUNDAMENTALSOFMOBILE&WEBAPPLICATIONDEVELOPMENT** Basics of Web and Mobile application development, Native App, Hybrid App, Cross-platform App, Progressive Web App, Responsive Web design.	9
II	**NATIVEAPPDEVELOPMENTUSING JAVA** Native Web App, Benefits of Native App, Scenarios to create Native App, Tools for creating Native App, Cons of Native App, Popular Native App Development Frame works, Java & Kotlin for Android,Swift&Objective-CforiOS,BasicsofReactNative,NativeComponents,JSX,State,Props.	9
III	**HYBRIDAPPDEVELOPMENT** Hybrid Web App, Benefits of Hybrid App, Criteria for creating Native App, Tools for creating Hybrid App, Cons of Hybrid App, Popular Hybrid App Development Frameworks, Ionic, Apache Cordova	9
IV	**CROSS-PLATFORMAPPDEVELOPMENTUSINGREACT-NATIVE** What is Cross-platform App, Benefits of Cross-platform App, Criteria for creating Cross-platform App, Tools for creating Cross-platform App, Cons of Cross-platform App, Popular Cross- platform App Development Frameworks, Flutter, Xamarin, React-Native, Basics of React Native, Native Components, JSX, State, Props	9
V	**NON-FUNCTIONALCHARACTERISTICSOFAPPFRAMEWORKS** Comparison of different App frameworks, Build Performance, App Performance, Debugging capabilities, Time to Market, Maintainability, Ease of Development, UI/UX, Reusability	9
	Total Instructional Hours	**45**

Course Outcome	**After successful completion of the course the student will be able to** **CO1:**Develop Native applications with GUI Components. **CO2:**Develop hybrid applications with basic event handling. **CO3:**Implement cross-platform applications with location and data storage capabilities. **CO4:**Implement cross platform applications with basic GUI and event handling. **CO5:**Develop web applications with cloud database access.

TEXT BOOKS:

T1- HeadFirstAndroidDevelopment,DawnGriffiths,O'Reilly,1st edition
T2-ApacheCordovainAction,RaymondK.Camden,Manning.2015
T3-FullStackReactNative:CreatebeautifulmobileappswithJavaScriptandReactNative, Anthony Accomazzo, Houssein Djirdeh, Sophia Shoemaker, Devin Abbott, Full Stack publishing

REFERENCE BOOKS:

R1- AndroidProgrammingforBeginners,JohnHorton,PacktPublishing,2ndEdition
R2-NativeMobileDevelopmentbyShaunLewis,Mike Dunn
R3-BuildingCross-PlatformMobileandWebAppsforEngineersandScientists:AnActive Learning Approach, Pawan Lingras, Matt Triff,
R4-ApacheCordova4Programming,JohnMWargo, 2015
R5-ReactNativeCookbook,DanielWard,PacktPublishing,2ndEdition

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	2	3	-	-	-	1	1	2	1	2	3
CO2	2	1	3	2	2	-	-	-	3	2	2	3	3	2
CO3	2	2	2	1	2	-	-	-	1	1	1	1	1	1
CO4	1	3	1	1	3	-	-	-	1	1	3	2	1	3
CO5	1	1	3	1	3	-	-	-	1	1	2	1	3	2
AVG	1.6	1.8	2	1.4	2.6	-	-	-	1.4	1.2	2	1.6	2	2.2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC5317	Web Technologies	3	0	0	3
Course Objective	To understand different Internet Technologies To learn java-specific web services architecture To Develop web applications using frameworks					

Unit	Description	Instructional Hours
I	**WEBSITE BASICS, HTML5, CSS3, WEB2.0** Web Essentials: Clients, Servers and Communication – The Internet – World wide web – HTTP Request Message–HTTP Response Message –Web Clients –Web Servers –HTML5–Tables–Lists–Image–HTML5controlelements–DragandDrop–Audio–Videocontrols-CSS3–Inline,	9

	embedded and external style sheets – Rule cascading – Inheritance – Backgrounds – Border Images – Colors – Shadows – Text – Transformations – Transitions – Animations. Bootstrap Framework	
II	**CLIENT SIDE PROGRAMMING** Java Script: An introduction to JavaScript–JavaScript DOM Model-Exception Handling-Validation- Built-in objects-Event Handling- DHTML with JavaScript- JSON introduction – Syntax – Function Files.	9
III	**SERVER SIDE PROGRAMMING** Servlets: Java Servlet Architecture- Servlet Life Cycle- Form GET and POST actions- Session Handling- Understanding Cookies- DATABASE CONNECTIVITY: JDBC.	9
IV	**PHP and XML** An introduction to PHP: PHP- Using PHP- Variables- Program control- Built-in functions- Form Validation. XML: Basic XML- Document Type Definition-XML Schema, XML Parsers and Validation, XSL.	9
V	**INTRODUCTION TO ANGULAR and WEB APPLICATIONS FRAMEWORKS** Introduction to Angular JS, MVC Architecture, understanding attributes, Expressions and data binding, Conditional Directives, Style Directives, Controllers, Filters, Forms, Routers, Modules, Services; Web Applications Frameworks and Tools – Firebase- Docker- Node JS- React-Django- UI & UX.	9
	Total Instructional Hours	**45**

Course Outcome	**After successful completion of the course the student will be able to** CO1:Construct a basic website using HTML and Cascading Style Sheets CO2: Build dynamic webpage with validation using Java Script objects and by applying different event handling mechanisms. CO3: Develop server-side programs using Servlets and JSP. CO4: Construct simple web pages in PHP and to representation XML format. CO5:Develop interactive web applications

TEXT BOOKS:

T1- Deitel and Deitel and Nieto, Internet and World Wide Web-HowtoProgram,PrenticeHall,5th Edition, 2011.
T2-JeffreyCandJackson,Web Technologies A Computer Science Perspective, Pearson Education, 2011.
T3-Angular6forEnterprise-ReadyWebApplications,DoguhanUluca,1stedition, Packt Publishing

REFERENCE BOOKS:

R1- StephenWynkoopandJohnBurke"RunningaPerfectWebsite",QUE,2ndEdition,1999.
R2-ChrisBates,WebProgramming–BuildingIntranetApplications,3rdEdition,Wiley Publications, 2009.
R3-GopalanN.P.andAkilandeswariJ.,"WebTechnology",PrenticeHallofIndia,2011.
R4-UttamK.Roy,"WebTechnologies",OxfordUniversityPress,2011.
R5-Angular: Up and Running: Learning Angular, Step by Step, Shyam Seshadri, 1st edition,O'Reilly

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	3	3	-	-	-	1	3	3	1	3	3
CO2	2	2	2	1	2	-	-	-	2	2	1	3	2	2
CO3	1	1	3	2	3	-	-	-	1	2	1	1	1	1
CO4	2	3	3	1	2	-	-	-	3	1	2	2	2	2
CO5	1	2	3	2	2	-	-	-	2	1	3	1	1	2
AVG	1.8	2	2.8	1.8	2.4	-	-	-	1.8	1.8	2	1.6	1.8	2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC5318	Ethical Hacking	3	0	0	3
Course Objective	To understand the basics of computer based vulnerabilities. To explore different foot printing, reconnaissance and scanning methods. To expose the enumeration and vulnerability analysis methods. To understand hacking options available in Web and wireless applications. To explore the options for network protection. Topracticetoolstoperformethicalhackingtoexposethevulnerabilities.					

Unit	Description	Instructional Hours
I	**INTRODUCTION** Ethical Hacking Overview - Role of Security and Penetration Testers .- Penetration-Testing Methodologies- Laws of the Land - Overview of TCP/IP- The Application Layer -The Transport Layer-The Internet Layer-IP Addressing.-Network and Computer Attacks-Malware-Protecting Against Malware Attacks.- Intruder Attacks - Addressing Physical Security	9
II	**FOOTPRINTING, RECONNAISSANCE AND SCANNING NETWORKS** Foot printing Concepts – Foot printing through Search Engines, Web Services, Social Networking Sites, Website, Email - Competitive Intelligence – Foot printing through Social Engineering – Foot printing Tools - Network Scanning Concepts - Port-Scanning Tools - Scanning Techniques - Scanning Beyond IDS and Firewall	9
III	**ENUMERATIONANDVULNERABILITYANALYSIS** Enumeration Concepts - NetBIOS Enumeration – SNMP,LDAP, NTP, SMTP and DNS Enumeration-VulnerabilityAssessmentConcepts-DesktopandServerOSVulnerabilities- Windows OS Vulnerabilities - Tools for Identifying Vulnerabilities in Windows- Linux OS Vulnerabilities-Vulnerabilities of Embedded Oss	9
IV	**SYSTEMHACKING** HackingWebServers-WebApplicationComponents-Vulnerabilities-ToolsforWebAttackersand Security Testers Hacking Wireless Networks - Components of a Wireless Network – Wardriving- Wireless Hacking - Tools of the Trade.	9
V	**NETWORK PROTECTION SYSTEMS** AccessControlLists.-CiscoAdaptiveSecurityApplianceFirewall–Configuration and Risk Analysis ToolsforFirewallsandRouters-IntrusionDetectionandPreventionSystems-Network-Basedand Host-Based IDSs and IPSs - Web Filtering - Security Incident Response Teams – Honeypots.	9

Total Instructional Hours	**45**

Course Outcome	**Aftersuccessful completion of the course the student will be able to** CO1:To express knowledge on basics of computer based vulnerabilities CO2: To gain understanding on different foot printing, reconnaissance and scanning methods. CO3:To demonstrate the enumeration and vulnerability analysis methods CO4:To gain knowledge on hacking options available in Web and wireless applications. CO5:To acquire knowledge on the options for network protection. CO6:To use tools to perform ethical hacking to expose the vulnerabilities.

TEXT BOOKS:

T1- Michael T. Simpson, Kent Backman, and James E. Corley, Hands-On Ethical Hacking and Network Defense, Course Technology, Delmar Cengage Learning, 2010.

T2-TheBasicsofHackingandPenetrationTesting-PatrickEngebretson,SYNGRESS,Elsevier, 2013.

T3-The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws, DafyddStuttard and Marcus Pinto, 2011.

REFERENCE BOOKS:

R1- Black Hat Python: Python Programming for Hackers and Pentesters,JustinSeitz, 2014.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3	2	1	-	-	-	1	2	2	1	1	2
CO2	1	2	1	2	1	-	-	-	2	2	1	1	1	2
CO3	2	2	3	3	1	-	-	-	1	2	1	2	2	3
CO4	2	1	1	2	1	-	-	-	1	3	3	3	3	2
CO5	2	3	1	1	2	-	-	-	2	1	1	1	1	1
AVG	1.8	2	1.8	2	1.2	-	-	-	1.4	2	1.6	1.6	1.6	2

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SYLLABUS REVISION DETAILS FOR THE REGULATION 22 – ACADEMIC YEAR 2024-25 ODD SEMESTER

S.No	Year	Semester	Course Code and Course Name	Existing content (in academic Year 2023-24)	Revised Content (for 2024-25)	Percentage of Revision
1	III	V	22EC5201- Digital Communication	**21EC6201- Digital Communication** **DIIGITAL MODULATION TECHNIQUES** DigitalModulationFormats– CoherentModulationTechniques: ASK,BFSK-BPSK– DPSK - QPSK QAM – Non-Coherent ModulationTechniques: BFSK, DPSK – Carrier Synchronization	**22EC5201- Digital Communication** **PASSBAND TRANSMISSION** Passband Transmission model -Geometric Representation of signals -Generation, detection, PSD& BER of Coherent BPSK, BFSK & QPSK – QAM – Carrier Synchronization – Structure of Non-coherent Receivers – Principle of DPSK	20
2	III	V	22EC5203- Microprocessor and Micro controller	**21EC5201-Microprocessor and Micro controller** **THE 8085 AND 8086 MICROPROCESSOR** Introduction to 8085 – Microprocessor architecture – Addressing modes - Instruction set -Introduction to 8086 – Microprocessor architecture – Addressing modes - Instruction set- Assembly language programming – Modular Programming - Interrupts and interrupt service routines. **ARM PROCESSOR** Arcon RISC Machine – Architectural Inheritance – Core & Architectures - Registers – Pipeline - Interrupts – ARM organization - ARM processor family – Co-processors - ARM instruction set- Thumb Instruction set - Instruction cycle timings - The ARM	**22EC5203- Microprocessor and Micro controller** **THE 8085 AND 8086 MICROPROCESSORS** Overview of 8-bit microprocessor - Introduction to 8086 – Microprocessor architecture – Addressing modes – Instruction set- Assembly language programming – Modular Programming – Interrupts and interrupt service routines. **ARM PROCESSOR** Arcon RISC Machine – Architectural Inheritance – Core & Architectures – Registers – Pipeline – Interrupts – ARM organization – ARM processor family – ARM	20

				Programmer"s model.	instruction set- Thumb Instruction set – Instruction cycle timings – The ARM Programmer's model- ARM Assembly Language Programming	
3	III	V	22EC5002- Digital Communication Lab	**22EC5002- Digital Communication Lab** Time division multiplexing. Pulse Code Modulation and Demodulation Line Coding Scheme Differential pulse code modulation ASK modulator and Demodulator Delta modulation.	**22EC5002- Digital Communication Lab** **Hardware Experiments** Pulse Code Modulation and Demodulation Line Coding Schemes Differential pulse code modulation ASK modulator and Demodulator Digital Modulation –BSK, FSK **Simulation Experiments using MATLAB** Simulation of ASK, FSK, and BPSK Generation and Detection Schemes Simulation of QPSK Generation and Detection Schemes. Simulation of QAM Generation and Detection Schemes. Simulation of Linear Block and Cyclic Error Control Coding Schemes. Viterbi decoder for decoding Convolutional codes	25

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Approved by AICTE, New Delhi& Accredited by NAAC with 'A ++' Grade)
Valley Campus, Pollachi Highway, Coimbatore, Tamil Nadu

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

R-2019A Curriculum and Syllabus for ODD Semester

2021-2025 Batch

Academic Year: 2024-2025

Curriculum
R2019A

Curriculum under R2019 with Amendments
(for the batch admitted during 2021 – 2022)

SEMESTER I

S. No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	21HE1101	Technical English	HSC	2	1	0	3	40	60	100
2	21MA1103	Calculus and Differential Equations	BSC	3	1	0	4	40	60	100
THEORY WITH LAB COMPONENT										
3	21PH1151	Applied Physics	BSC	2	0	2	3	50	50	100
4	21CY1151	Chemistry for Engineers	BSC	2	0	2	3	50	50	100
5	21CS1151/ 21CS1152	Python Programming and Practices/ Object Oriented Programming using Python (IBM)	ESC	2	0	2	3	50	50	100
6	21EC1153	Electron devices and Electric Circuits	ESC	2	0	2	3	50	50	100
PRACTICAL										
7	21HE1001	Language Competency Enhancement Course-I	HSC	0	0	2	1	0	100	100
MANDATORY COURSES										
8	21HE1072	**Career Guidance Level – I** Personality, Aptitude and Career Development	EEC	2	0	0	0	100	0	100
			Total	**15**	**2**	**10**	**20**	**350**	**450**	**800**
As Per AICTE Norms 3 Weeks Induction Programme is Added in The First Semester as an Audit Course										

SEMESTER II

S. No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	21HE2101	Business English for Engineers	HSC	2	1	0	3	40	60	100
2	21MA2103	Linear Algebra, Numerical Methods and Transform Calculus	BSC	3	1	0	4	40	60	100
THEORY WITH LAB COMPONENT										
3	21PH2151	Material Science	BSC	2	0	2	3	50	50	100
4	21CY2151	Environmental Studies	BSC	2	0	2	3	50	50	100
5	212CS2152/ 21CS2153	Essentials of C&C++Programming/ Java Fundamentals (IBM)	ESC	2	0	2	3	50	50	100
6	21ME2154	Engineering Graphics	ESC	1	0	4	3	50	50	100
PRACTICAL										
7	21ME2001	Engineering Practices	ESC	0	0	4	2	50	50	100
8	21HE2001	Language Competency Enhancement Course-II	HSC	0	0	2	1	0	100	100
MANDATORY COURSES										
9	21HE2072	**Career Guidance Level – II** Personality, Aptitude and Career	EEC	2	0	0	0	100	0	100

		Development								
10	21HE2073	Entrepreneurship & Innovation	EEC	1	0	0	0	100	0	100
			Total	**1 5**	**2**	**16**	**22**	**500**	**500**	**1000**

SEMESTER III

S. No	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	21MA3102	Fourier analysis and transforms	BSC	3	1	0	4	40	60	100
2	21EC3201	Digital Electronics	PCC	3	0	0	3	40	60	100
3	21EC3202	Signals and Systems	PCC	3	1	0	4	40	60	100
4	21EC3203	Electronic Circuits	PCC	3	0	0	3	40	60	100
THEORY WITH LAB COMPONENT										
5	21CS3252/21IT3252	Oops using Java/ Relational Database Management System (IBM)	PCC	2	0	2	3	50	50	100
PRACTICAL										
6	21EC3001	Electronic circuits lab	PCC	0	0	3	1.5	50	50	100
7	21EC3002	Digital Electronics Lab	PCC	0	0	3	1.5	50	50	100
MANDATORY COURSES										
8	21MC3191	Indian Constitution	MCC	2	0	0	0	100	0	100
9	21HE3072	**Career Guidance Level – III** Personality, Aptitude and Career Development	EEC	2	0	0	0	100	0	100
10	21HE3073	Leadership Management Skills	EEC	1	0	0	0	100	0	100
			Total	**1 9**	**2**	**8**	**20**	**550**	**450**	**1000**

SEMESTER IV

S. No	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	21MA4104	Probability and Random Processes	BSC	3	1	0	4	40	60	100
2	21EC4201	Electro Magnetic Fields and waves	PCC	3	1	0	4	40	60	100
3	21EC4202	Analog Communication	PCC	3	1	0	4	40	60	100
4	21EC4203	Linear Integrated Circuits	PCC	3	0	0	3	40	60	100
THEORY WITH LAB COMPONENT										
5	21EC4251/21EC4252	Control Systems/ Design Thinking-An Introduction (IBM)	PCC	2	0	2	3	50	50	100
PRACTICAL										
6	21EC4001	Linear Integrated Circuits Lab	PCC	0	0	3	1.5	50	50	100
7	21EC4002	Analog communication Lab	PCC	0	0	3	1.5	50	50	100
MANDATORY COURSES										
8	21MC4191	Essence of Indian tradition	MCC	2	0	0	0	100	0	100

		knowledge/Value Education								
9	21HE4072	**Career Guidance Level – IV** Personality, Aptitude and Career Development	EEC	2	0	0	0	100	0	100
10	21HE4073	Ideation Skills	EEC	2	0	0	0	100	0	100
			Total	**20**	**3**	**8**	**21**	**550**	**450**	**1000**

SEMESTER V

S. No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
			THEORY							
1	21EC5201	Microprocessor and Microcontroller	PCC	3	0	0	3	40	60	100
2	21EC5202	Transmission lines and Wave Guides	PCC	3	1	0	4	40	60	100
3	21EC5203	VLSI Design	PCC	3	0	0	3	40	60	100
4	21EC53XX	**Professional Elective –I**	PEC	3	0	0	3	40	60	100
			THEORY WITH LAB COMPONENT							
5	21EC5251	Data Communication and Networks	PCC	2	0	2	3	50	50	100
6	21EC5252	Digital Signal Processing	PCC	2	0	2	3	50	50	100
7	21CS5331	Angular JS (for IBM students)	PCC	2	0	2	3	50	50	100
			PRACTICALS							
8	21EC5001	VLSI Design Lab	PCC	0	0	3	1.5	50	50	100
9	21EC5002	Microprocessors and Microcontrollers Lab	PCC	0	0	3	1.5	50	50	100
			MANDATORY COURSES							
10	21HE5071	Soft Skills - I	EEC	1	0	0	1	100	0	100
11	21HE5072	Design Thinking	EEC	1	0	0	1	100	0	100
			Total	**18**	**1**	**10**	**24**	**500**	**500**	**1000**

SEMESTER VI

S. No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
			THEORY							
1	21EC6202	Antenna and Wave Propagation	PCC	3	1	0	4	40	60	100
2	21EC6181	Principles of Management	HSC	3	0	0	3	40	60	100
3	21EC63XX/ 21CS6351	**Professional Elective – II/Node JS and Microservices (IBM)**	PEC	3	0	0	3	40	60	100
4	21XX64XX	**Open Elective– I**	OEC	3	0	0	3	40	60	100
			THEORY WITH LAB COMPONENTS							
5	21EC6251/ 21CS6255	**Embedded Systems and IOT/IOT and Spring Framework (IBM)**	PCC	2	0	2	3.	50	50	100
6	21EC6253	Digital Communication	PCC	2	0	2	3	50	50	100

				PRACTICALS						
7	21EC6003	Project Based Learning	PCC	0	0	3	2	50	50	100
				MANDATORY COURSES						
8	21EC6701	Internship	EEC	-	-	-	1	100	0	100
9	21HE6071	Soft Skills - II	EEC	1	0	0	1	100	0	100
10	21HE6072	Intellectual Property Rights (IPR)	EEC	1	0	0	1	100	0	100
			Total	**19**	**1**	**6**	**24**	**550**	**450**	**1000**

SEMESTER VII

S. No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
				THEORY						
1	21EC7201	Digital Image Processing	PCC	3	0	0	3	40	60	100
2	21EC7202	Optical and Microwave Engineering	PCC	3	0	0	3	40	60	100
3	21EC73XX/ 21EC7331	**Professional Elective-III/Block Chain (IBM)**	PEC	3	0	0	3	40	60	100
4	21XX74XX	**Open Elective – II**	OEC	3	0	0	3	40	60	100
				THEORY WITH LAB COMPONENTS						
5	21EC7251	Wireless Communication	PC	2	0	2	3	50	50	100
				PRACTICALS						
6	21EC7001	Digital Image processing Lab	PCC	0	0	3	1.5	50	50	100
7	21EC7002	Optical Communication and Microwave Lab	PCC	0	0	3	1.5	50	50	100
				PROJECT WORK						
8	21EC7901	Project Work -I	EEC	0	0	4	2	50	50	100
		Total		**14**	**0**	**12**	**20**	**300**	**500**	**800**

SEMESTER VIII

S. No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
				THEORY						
1	21EC83XX	**Professional Elective –IV**	PEC	3	0	0	3	40	60	100
2	21EC83XX	**Professional Elective- V**	PEC	3	0	0	3	40	60	100
				PROJECT WORK						
3	21CH8901	Project Work –II	EEC	0	0	16	8	100	100	200
			Total	**6**	**0**	**16**	**14**	**150**	**250**	**400**

TOTAL NO OF CREDITS: 165

CREDIT DISTRIBUTION

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	20	22	20	21	24	24	20	14	165

LIST OF PROFESSIONAL ELECTIVES

S. No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
PROFESSIONAL ELECTIVE I										
1	21EC5301	Measurements and Instrumentation	PEC	3	0	0	3	40	60	100
2	21EC5302	PCB Design	PEC	3	0	0	3	40	60	100
3	21EC5303	RF System Design	PEC	3	0	0	3	40	60	100
4	21EC5304	Network Security	PEC	3	0	0	3	40	60	100
5	21EC5181	Total Quality Management	PEC	3	0	0	3	40	60	100
PROFESSIONAL ELECTIVE II										
1	21EC6301	Medical Electronics	PEC	3	0	0	3	40	60	100
2	21EC6302	Industrial Automation	PEC	3	0	0	3	40	60	100
3	21EC6303	Mobile Communication	PEC	3	0	0	3	40	60	100
4	21EC6304	High Speed Networks	PEC	3	0	0	3	40	60	100
5	21EC6182	E-Commerce Technology	PEC	3	0	0	3	40	60	100
6	21EC6305	Virtual Reality and Augmented Reality	PEC	3	0	0	3	40	60	100
PROFESSIONAL ELECTIVE III										
1	21EC7301	Robotics	PEC	3	0	0	3	40	60	100
2	21EC7302	ASIC Design	PEC	3	0	0	3	40	60	100
3	21EC7303	Global Positioning Systems	PEC	3	0	0	3	40	60	100
4	21EC7181	Entrepreneurship Development	PEC	3	0	0	3	40	60	100
5	21EC7305	Cyber Forensics	PEC	3	0	0	3	40	60	100
6	21EC7306	Embedded Controllers	PEC	3	0	0	3	40	60	100
PROFESSIONAL ELECTIVE IV										
1	21EC8301	Neural networks and Deep learning	PEC	3	0	0	3	40	60	100
2	21EC8303	Satellite Communication	PEC	3	0	0	3	40	60	100
3	21EC8304	Wireless Sensors and Networks	PEC	3	0	0	3	40	60	100

4	21EC8181	Foundation Skills in Integrated Product Development	PEC	3	0	0	3	40	60	100
5	21EC8305	Medical Image Processing	PEC	3	0	0	3	40	60	100
6	21EC8311	Computer Communication and Internet Protocol	PEC	3	0	0	3	40	60	100
7	21EC8312	Cloud Computing	PEC	3	0	0	3	40	60	100
PROFESSIONAL ELECTIVE V										
1	21EC8306	Artificial Intelligence	PEC	3	0	0	3	40	60	100
2	21EC8307	Low Power VLSI	PEC	3	0	0	3	40	60	100
3	21EC8308	Software Defined Radio	PEC	3	0	0	3	40	60	100
4	21EC8309	Photonic Networks	PEC	3	0	0	3	40	60	100
5	21EC8182	Intellectual Property Rights and Innovations	PEC	3	0	0	3	40	60	100
6	21EC8310	Fundamentals of Nano Science	PEC	3	0	0	3	40	60	100

LIST OF INDUSTRIAL CORE COURSES

S. No.	CODE	Courses	CAT	L	T	P	C	CIA	ESE	TOTAL
1	21CS1152	Object Oriented Programming using Python	ICC	2	0	2	3	50	50	100
2	21CS2153	Java Fundamentals	ICC	2	0	2	3	50	50	100
3	21IT3252	Relational Database Management System	ICC	2	0	2	3	50	50	100
4	21EC4252	Design Thinking-An Introduction	ICC	2	0	2	3	50	50	100
5	21CS5331	Angular JS	ICC	2	0	2	3	50	50	100
6	21CS6351	Node JS and Micro services	ICC	2	0	2	3	50	50	100
7	21CS6255	IoT and Spring Framework	ICC	2	0	2	3	50	50	100
8	21EC7331	Blockchain	ICC	2	0	2	3	50	50	100

LIST OF OPEN ELECTIVES

ELECTRONICS AND COMMUNICATION ENGINEERING										
S. No.	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**	**CIA**	**ESE**	**TOTAL**
1	21EC6401	Consumer Electronics	OEC	3	0	0	3	40	60	100
2	21EC7401	Introduction to IOT	OEC	3	0	0	3	40	60	100
LIFE SKILL COURSES										
3	21LSZ401	General Studies for Competitive Examinations	OEC	3	0	0	3	40	60	100
4	21LSZ402	Human Rights, Women's Rights and Gender Equality	OEC	3	0	0	3	40	60	100
5	21LSZ403	Indian Ethos and Human Values	OEC	3	0	0	3	40	60	100
6	21LSZ404	Indian Constitution and Political	OEC	3	0	0	3	40	60	100

		System								
7	21LSZ405	Yoga for Human Excellence	OEC	3	0	0	3	40	60	100
NCC COURSES (Only forthe students' who have opted NCC subjects in Semester I, II, III & IV are eligible)										
8	21HEZ401	NCC course level 1	OEC	3	0	0	3	40	60	100
9	21HEZ402	NCC course level 2	OEC	3	0	0	3	40	60	100

Note: Z Stands for semester, students can't choose twice the course)

MINOR DEGREE VERTICAL COURSES

Vertical I

Embedded and IoT

S No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
1	22EC5601	Electronics for Embedded Systems	MDC	3	0	0	3	40	60	100
2	22EC6601	Microcontroller and its Applications	MDC	3	0	0	3	40	60	100
3	22EC6602	Sensor and Embedded Systems	MDC	3	0	0	3	40	60	100
4	22EC7601	Fundamentals of IoT	MDC	3	0	0	3	40	60	100
5	22EC7602	Industrial IoT and Industry 4.0	MDC	3	0	0	3	40	60	100
6	22EC8601	IoT for Smart Systems	MDC	3	0	0	3	40	60	100

Vertical II

Fintech and Block Chain

S No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
1	21CS5602	Financial Management	MDC	3	0	0	3	40	60	100
2	21MB6231	Fundamentals of Investment	MDC	3	0	0	3	40	60	100
3	21MB6232	Banking, Financial Services and Insurance	MDC	3	0	0	3	40	60	100
4	21MB7231	Introduction to Blockchain and its Applications	MDC	3	0	0	3	40	60	100
5	21MB7232	Fintech Personal Finance and Payments	MDC	3	0	0	3	40	60	100
6	21MB8231	Introduction to Fintech	MDC	3	0	0	3	40	60	100

Vertical III

Entrepreneurship

S No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
1	21BA5601	Foundation of Entrepreneurship	MDC	3	0	0	3	40	60	100
2	21BA6601	Introduction to Business Venture	MDC	3	0	0	3	40	60	100
3	21BA6602	Team Building & Leadership Management for Business	MDC	3	0	0	3	40	60	100
4	21BA7601	Creativity & Innovation in Entrepreneurship	MDC	3	0	0	3	40	60	100
5	21BA7602	Principles of Marketing Management for Business	MDC	3	0	0	3	40	60	100
6	21BA8601	Human Resource Management for Entrepreneurs	MDC	3	0	0	3	40	60	100
7	21BA8602	Financing New Business Ventures	MDC	3	0	0	3	40	60	100

Vertical IV

Environment and Sustainability

S No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
1	21CEXXXX	Sustainable Infrastructure Development	MDC	3	0	0	3	40	60	100
2	21AG6233	Sustainable Agriculture and Environmental Management	MDC	3	0	0	3	40	60	100
3	21BM6233	Sustainable Bio Materials	MDC	3	0	0	3	40	60	100
4	21ME7233	Materials for Energy Sustainability	MDC	3	0	0	3	40	60	100
5	21CE7233	Green Technology	MDC	3	0	0	3	40	60	100
6	21CE8232	Environmental Quality Monitoring and Analysis	MDC	3	0	0	3	40	60	100

HONOUR DEGREE VERTICAL COURSES

S. No.	Vertical-I Sensor Technologies and IoT	Vertical II Advanced Communication Systems	Vertical III Semiconductor Chip Design and Testing
1	Realtime Embedded Systems	Cognitive Radio Networks	Wide Bandgap Devices
2	Sensor for IoT applications	Remote Sensing	Validation and Testing Technology
3	Advanced Processor Architectures	Rocketry and Space Mechanics	Low Power VLSI
4	IOT Processors	Underwater Navigation Systems	VLSI Testing and Design for Testability

5	Wearable Devices	Massive MIMO Networks	Mixed Signal IC Design Testing
6	Industrial IoT and Industry 4.0	Advanced Wireless Communication Techniques	Analog IC Design

Vertical-I
Sensor Technologies and IoT

S No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
1	22EC5305	Realtime Embedded Systems	HDC	3	0	0	3	40	60	100
2	22EC6305	Sensor for IoT applications	HDC	3	0	0	3	40	60	100
3	22EC6306	Advanced Processor Architectures	HDC	3	0	0	3	40	60	100
4	22EC7304	IOT Processors	HDC	3	0	0	3	40	60	100
5	22EC7305	Wearable Devices	HDC	3	0	0	3	40	60	100
6	22EC8301	Industrial IoT and Industry 4.0	HDC	3	0	0	3	40	60	100

Vertical-II
Advanced Communication Systems

S No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
1	22EC5306	Cognitive Radio Networks	HDC	3	0	0	3	40	60	100
2	22EC6307	Remote Sensing	HDC	3	0	0	3	40	60	100
3	22EC6308	Rocketry and Space Mechanics	HDC	3	0	0	3	40	60	100
4	22EC7306	Underwater Navigation Systems	HDC	3	0	0	3	40	60	100
5	22EC7307	Massive MIMO Networks	HDC	3	0	0	3	40	60	100
6	22EC8203	Advanced Wireless Communication Techniques	HDC	3	0	0	3	40	60	100

Vertical-III
Semiconductor Chip Design and Testing

S No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
1	22EC5307	Wide Bandgap Devices	HDC	3	0	0	3	40	60	100
2	22EC6309	Validation and Testing Technology	HDC	3	0	0	3	40	60	100
3	22EC6310	Low Power VLSI	HDC	3	0	0	3	40	60	100

4	22EC7308	VLSI Testing and Design for Testability	HDC	3	0	0	3	40	60	100
5	22EC7309	Mixed Signal IC Design Testing	HDC	3	0	0	3	40	60	100
6	22EC8202	Analog IC Design	HDC	3	0	0	3	40	60	100

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SYLLABUS

Programme	Course Code	Name of the Course	L	T	P	C
BE	21EC7201	Digital Image Processing	3	0	0	3

Course Objective	The student should be able to Introduce the fundamental concepts and processes in digital image processing. Learn techniques for improving the visual appearance of images in the spatial and frequency domains. Familiar with and restoration and segmentation techniques. Understand the fundamentals of image compression and various coding techniques. Explore the use of supervised and unsupervised neural networks in pattern recognition.	
Unit	**Description**	**Instructional Hours**
I	**DIGITAL IMAGE FUNDAMENTALS** Introduction – Fundamental Steps in Digital Image Processing –Components of an Image Processing System, Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – RGB and HSI color models.	9
II	**IMAGE ENHANCEMENT** **Spatial Domain**: Gray level transformations – Histogram processing: Histogram equalization – Basics of Spatial Filtering –Smoothing and Sharpening Spatial Filtering -Homomorphic filtering, Color image enhancement **Frequency Domain**: Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters.	9
III	**IMAGE RESTORATION AND SEGMENTATION** **Restoration**: Image Restoration degradation model– Mean Filters – Inverse Filtering – Wiener filtering- Geometric transformations-spatial transformations. **Segmentation**: point, line, edge detection-Edge Linking via Hough transformation – Region based segmentation: Region Growing, Region splitting and merging - Practical applications –process an image using various segmentation techniques.	9
IV	**MORPHOLOGICAL PROCESSING AND IMAGE COMPRESSION** **Morphological processing**- Dilation and Erosion-Segmentation by morphological watersheds. **Compression**: Fundamentals – Error Free Compression – Variable Length Coding: Huffman coding, Arithmetic Coding – Compression Standards: JPEG and MPEG.	9
V	**PATTERN CLASSIFICATION** Feature extraction-Boundary representation – Chain Code, Signature, skeleton – boundary descriptor-shape number- Patterns classification methods- supervised and unsupervised neural networks in Pattern recognition.	9
	Total Instructional Hours	**45**

Course Outcome	**After completion of the course the learner will be able to** CO1: Describe the fundamental steps in digital image processing and identify the components of an image processing system. CO2: Apply gray level transformations and histogram equalization to enhance images. CO3: Implement geometric transformations for image restoration. CO4: Explain the principles of error-free compression and apply variable length coding techniques like Huffman and arithmetic coding. CO5: Extract features and represent boundaries using techniques such as chain code, signature, and skeleton.

TEXT BOOKS:

T1- Rafael C Gonzalez, Richard E Woods, "Digital Image Processing", Pearson Education Inc, Fourth Edition, 2018.

T2- Anil K- Jain, "Fundamentals of Digital Image Processing", Pearson/Prentice Hall of India,2002.

REFERENCE BOOKS:

R1- Annadurai and Shanmughalakshmi, "Fundamentals of Digital Image Processing',Pearson India,2006.

R2 - S.Jayaraman, S.Esakkirajan, T.Veerakumar, "Digital Image Processing", TMH New Delhi ,2009

R3 - Kenneth R. Castleman, "Digital Image Processing", Pearson, 2006

R4- Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, "Digital Image Processing using MATLAB ", Pearson Education, Inc., 2004.

R5- William K. Pratt, "Digital Image Processing", John Wiley, New York, 2002.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	3		-	-	3	-	-	2	3	1
CO2	3	2	3	3	3		-	-		-	-	3	3	3
CO3	3	3	3	3	2		-	-	3	2	-	2	3	3
CO4	3	2	2	3	3		-	-			-	3	3	2
CO5	3	3	3	3	2		-	-	3	2	-	2	3	2
AVG	3	3	3	3	3				3	2		2	3	2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	21EC7202	Optical and Microwave Engineering	3	0	0	3

Course Objective	The student should be able to 1. Understand the fundamental principles and components of an optical fiber communication system. 2. Examine the factors affecting signal transmission in optical fibers. 3. Learn efficient coupling techniques between LEDs and optical fibers. 4. Understand the functional behavior of microwave semiconductor devices and microwave tubes. 5. Familiarize with various microwave measurement techniques and instruments.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO OPTICAL FIBERS** Elements of an Optical fiber communication system- Optical laws and definitions- optical modes and configurations -mode analysis for optical propagation through fibers modes in planar wave guide-modes in cylindrical optical fiber - Fiber materials--single mode fiber – multimode fiber-graded index fiber.	9
II	**TRANSMISSION CHARACTERISTIC OF OPTICAL FIBER** Attenuation-absorption --scattering losses-bending losses-core and cladding losses-signal dispersion –Inter symbol interference and bandwidth-Intra model dispersion-Material dispersion- Waveguide dispersion-Polarization. mode dispersion-Intermodal dispersion-Dispersion optimization of single mode fiber-characteristics of single mode fiber-R-I Profile-cutoff wave length-dispersion calculation-mode field diameter.	9
III	**OPTICAL SOURCES, DETECTORS,RECEIVER AND COUPLING** Sources: - surface emitting LED-Edge emitting LED-quantum efficiency and power-modulation of LED –LASER diodes -modes and threshold conditions-Rate equations-external quantum efficiency- Detectors: PIN photo detector-Avalanche photo diodes- noise-SNR-detector response time-Avalanche multiplication noise-temperature effects - preamplifiers-digital receiver performance-probability of error and receiver sensitivity-quantum limit. -Lensing Schemes for Coupling Management- -LED Coupling to Single Mode Fibers	9
IV	**MICROWAVE PASSIVE COMPONENTS AND SEMICONDUCTOR DEVICES** Microwave Passive components: Directional Coupler, Power Divider, Magic Tee, attenuator, resonator, Principles of Microwave Semiconductor Devices: Gunn Diodes, IMPATT diodes, Schottky Barrier diodes, PIN diodes, Microwave tubes: Klystron, TWT, Magnetron.	9
V	**MICROWAVE MEASUREMENTS** Measuring Instruments – VSWR meter, Power meter, Spectrum Analyser, Network Analyser – Principles; Measurement of Impedance, Frequency, Power, VSWR, Q factor, Dielectric Constant, S Parameter- Hazards of microwaves	9
	Total Instructional Hours	**45**

Course Outcome	**After completion of the course the learner will be able to** CO1: Identify the key elements of an optical fiber communication system. CO2: Analyze the transmission characteristics associated with dispersion and polarization techniques. CO3: Differentiate between various optical sources such as LEDs and Laser Diodes. CO4: Describe the principles of operation for Gunn Diodes, IMPATT Diodes, and other semiconductor devices. CO5: Operate microwave measuring instruments such as VSWR meter, power meter, and spectrum analyzer.

TEXT BOOKS:

T1. GerdKeiser,"OpticalFiber Communication‖, McGraw Hill Education (India) Private Limited. Fifth Edition, Reprint 2013. (UNIT I, II, III)

T2 - Annapurna Das and Sisir K Das, "Microwave Engineering", Mc Graw Hill Inc., 2004. (UNIT IV, V)

REFERENCE BOOKS:

R1. John M.Senior, —Optical fiber communication, Pearson Education, second edition.2007. (UNIT I, II, III)

R2 - D.M.Pozar, "Microwave Engineering.", John Wiley & sons, Inc., 2006.. (UNIT IV, V)

R3- Samuel Y Liao, "Microwave Devices & Circuits", Prentice Hall of India, 2006. (UNIT IV, V)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	-		-	-	-	-	-	3	3	2
CO2	3	3	3	2	-		-	-	-	-	-	3	3	2
CO3	3	2	3	2	-		-	-	-	-	-	3	3	2
CO4	3	2	3	2	-		-	-	-	-	-	3	3	2
CO5	3	2	3	2	-		-	-	-	-	-	3	3	2
AVG	3	2.4	3	2								3	3	2

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Programme	Course Code	Name of the course	L	T	P	C
BE	21EC7251	Wireless Communication	2	0	2	3

Course Objective	The student should be able to 1.Introduce the fundamental concepts and components of wireless communication systems. 2.Learn about diversity techniques for improving wireless communication reliability. 3.Interpret the various challenges in multi carrier modulation and design issues. 4.Understand frequency reuse, channel assignment, and handoff strategies. 5.Study various Multiple Access techniques for wireless channels.	
Unit	**Description**	**Instructional Hours**
I	**Introduction to Wireless Communications** Overview of wireless systems –Wireless Spectrum –Path Loss and Shadowing –Radio wave propagation –Transmit and Receive signal Models –Free-Space path loss- ray tracing- Empirical Path Loss model path loss models- Shadow fading.	6
II	**Performance of Digital Modulation over Wireless Channel and Diversity** AWGN Channels--Fading– Outage Probability– Average Probability of Error — Combined Outage and Average Error Probability – Doppler Spread – Inter symbol Interference. Realization of Independent Fading Paths – Receiver Diversity – Selection and Threshold Combining–Transmitter Diversity – Channel known at Transmitter – Channel unknown at Transmitter – The Alamouti Scheme	6
III	**Multicarrier Modulation** Challenges in Multicarrier Systems-Data transmission using multiple carrier-Multicarrier modulation with Overlapping subchannels-Mitigation of subcarrier Fading- Discrete Implementation of Multicarrier Modulation-OFDM	6
IV	**Cellular Architecture-System Design Fundamentals** Cellular concepts, Frequency reuse, channel assignment strategies, handoff strategies, interference and system capacity, improving coverage and capacity in cellular systems.	6
V	**Multiple Access Techniques for Wireless Communication** Introduction to Multiple Access- Frequency Division Multiple Access (FDMA)-Time Division Multiple Access(TDMA)-Spread Spectrum Multiple Access-Code division Multiple Access (CDMA)-Space Division Multiple Access (SDMA)	6
	Total Hours	30
	List of Experiments	
	Study of wireless Communications using Communication Trainer Kits	
1.	To study the FHSS Modulation and Demodulation Techniques	
2.	To study the DS spread spectrum Modulation and Demodulation Technique	
3.	To study the Code Division Multiple Access (CDMA) with Multiuser	
4.	To study Baseband Communication	
5.	To study and implement Adaptive Linear Equalizer	
	Wireless Path loss Computations - Study of Propagation Path loss Models (Using Mat lab Programming)	
6.	Free Space Propagation – Path Loss Model	
7.	Link Budget Equation for Satellite Communication	

Total Instructional Hours	15
Total Hours	30+15=45

Course Outcome	**After completion of the course the learner will be able to** CO1: Demonstrate the signal propagation over wireless radio channel. CO2: Evaluate the performance of digital modulation in AWGN channels and in the presence of fading. CO3: Identify the challenges in multicarrier systems and describe data transmission using multiple carriers. CO4: Apply frequency reuse and channel assignment strategies in cellular networks. CO5: Differentiate between various multiple access techniques such as FDMA, TDMA, CDMA, and SDMA.

TEXT BOOKS

T1. Andrea Goldmith, "Wireless Communication", Cambridge University Press, 2005.

T2. T.S. Rappaport, "Wireless Communication, Principles and Practice", Pearson Education, Second Edition, 2002 .

REFERENCE BOOKS:

R1. David Tse and Pramod Viswanath, "Fundamentals of Wireless Communication", Cambridge University Press, 2005.

R2. William C Y Lee, "Wireless and Cellular Communications", Tata McGraw Hill Publishing Company Limited, Third Edition, 2006..

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	3	-	-	-	-	-	-	2	3	1
CO2	3	2	3	3	3	-	-	-	-	-	-	3	3	3
CO3	3	3	3	3	2	-	-	-	-	-	-	2	3	3
CO4	3	2	2	3	3	-	-	-	-	-	-	3	3	2
CO5	3	3	3	3	2	-	-	-	-	-	-	2	3	2
AVG	3	3	3	3	3	-	-	-	-	-	-	2	3	2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	21EC7001	Digital Image Processing Lab	0	0	3	1.5

Course Objective	The student should be able to Enhance understanding of digital image processing concepts through practical programming tasks. Develop skills to apply various image processing algorithms for enhancement. Detect and segment the boundary in an image. Compress image using coding techniques. Classify different pattern classes.

S.NO	LIST OF EXPERIMENTS

Simulation using MATLAB / EQUIVALENT SOFTWARE PACKAGE	
1.	Program for extraction of color components from RGB color image.
2.	Program for an image enhancement using pixel operation.
3.	Program for image enhancement using histogram equalization.
4.	Program to filter an image using averaging low pass filter in spatial domain and median filter.
5.	Program to sharpen an image using 2-D laplacian high pass filter in spatial domain.
6.	Program to smooth an image using low pass filter and high pass filter in frequency domain (Butterworth LPF and HPF)
7.	Program for morphological image operations-erosion, dilation, opening & closing
8.	Program for image segmentations using region-based segmentation technique
9.	Program for image compression using Huffman coding
10.	Program for Pattern classification methods.
	TOTAL HOURS 45
Course Outcome	After completion of the course the learner will be able to CO1: Demonstrate the ability to extract color components from an RGB image. CO2: Perform image enhancement using pixel operations and histogram equalization. CO3: Apply spatial and frequency domain filters to enhance and sharpen images. CO4: Implement morphological operations and region-based segmentation for image processing. CO5: Utilize Huffman coding for image compression and apply pattern classification methods .

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	3	3		-	-	2	2	-	3	3	3
CO2	3	2	3	3	3		-	-	2	2	-	3	3	3
CO3	3	2	3	3	3		-	-	2	2	-	3	3	3
CO4	3	2	3	3	3		-	-	2	2	-	3	3	3
CO5	3	2	3	3	3		-	-	2	2	-	3	3	3
AVG	3	2	3	3	3				2	2		3	3	3

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Programme	Course Code	Name of the Course	L	T	P	C
BE	**21EC7002**	**Optical Communication and Microwave Lab**	**0**	**0**	**3**	**1.5**

Course Objective	The student should be able to 1. Provide hands-on experience with optical and microwave components and systems. 2.Enhance understanding of the principles and applications of optical and microwave technologies. 3.Develop skills in performing and analyzing experimental procedures and results in optical and microwave engineering. 4.Understand the current-voltage characteristics of LEDs and PIN photodiodes. 5.Learn to measure and analyze the characteristics of Gunn diodes, Reflex Klystron and Directional Coupler
S.NO	**LIST OF EXPERIMENTS**
	OPTICAL EXPERIMENTS
1.	DC Characteristics of LED and PIN Photo diode
2.	Coupling and bending losses of Fibers
3.	Fiber optic Analog and Digital Link
4.	Numerical Aperture determination for Fibers
5.	Attenuation Measurement in Fibers
	MICROWAVE EXPERIMENTS
6.	Characteristics of Gunn diode
7.	Characteristics of Reflex Klystron
8.	Directional Coupler Characteristics.
9.	S-parameter Measurement of the following microwave components (Isolator, Circulator, E plane Tee, H Plane Tee, Magic Tee)
10.	Radiation Pattern of Horn Antenna.
	TOTAL HOURS 45
Course Outcome	**After completion of the course the learner will be able to** CO1: Analyze the performance of various microwave and optical links. CO2: Demonstrate proficiency in conducting experiments with optical and microwave components. CO3: Test microwave components CO4: Analyze the radiation of pattern of antenna CO5: Test optical components

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	3	3		-	-	2	2	-	3	3	3
CO2	3	2	3	3	3		-	-	2	2	-	3	3	3
CO3	3	2	3	3	3		-	-	2	2	-	3	3	3
CO4	3	2	3	3	3		-	-	2	2	-	3	3	3
CO5	3	2	3	3	3		-	-	2	2	-	3	3	3
AVG	3	2	3	3	3				2	2		3	3	3

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Programme	Course Code	Name of the Course	L	T	P	C
BE	21EC7901	Project Work I	0	0	4	2
Course Objective	The student should be able to 1.Work in teams to propose, formulate, and solve a challenging open-ended design problem of significant scope, depth, and breadth. 2.Understand and incorporate engineering standards and multiple realistic constraints, within realistic design time, budget, and performance objectives. 3.Develop a prototype of the proposed design and demonstrate the prototype in accordance with the specifications. 4.Effectively communicate information relating to all aspects of the design process in written, oral,and graphical form.					
S.No	Guidelines					

1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. 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 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. 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. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. 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. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. 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. 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. 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.

Course Outcome	After completion of the course the learner will be able to CO1: Formulate a real-world problem, identify the requirement and develop the design solutions. CO2: Identify technical ideas, strategies and methodologies. CO3: Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project. Test and validate through conformance of the developed prototype and analysis the cost effectiveness. CO4: Prepare report and present the oral demonstrations.

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Programme	Course Code	Name of the Course	L	T	P	C
BE	21EC7401	Introduction to IOT (Common to all Branches)	3	0	0	3

Course Objective	The student should be able to 1. To understand the fundamentals of Internet of Things. 2. To build a small low cost embedded system using Arduino / Raspberry Pi or equivalent boards. 3. To apply the concept of Internet of Things in the real world scenario 4. To model an IoT based system with specifications and requirements. 5. To construct a web based system using IoT

Unit	Description	Instructional Hours
I	**The Internet of Things: An Overview** Introduction-Characteristics-Physical design - Protocols – Logical design – Enabling technologies – IoT Levels – Domain Specific IoTs: Home Automation. IoT vs M2M.	9
II	**IoT Design Methodology** IoT systems management – IoT Platforms Design Methodology – Specifications - Integration and Application Development.	9
III	**IoT with Raspberry PI** Physical device – Raspberry Pi Interfaces – Programming – Other IoT Devices	9
IV	**Building IoT With Galileo/Arduino** Intel Galileo Gen2 - Exploring the Linux Console - Arduino IDE – Programming - The Arduino Language Reference and APIs – Servo API.	9
V	**Advanced Topics and Case Studies** IoT Physical Servers & Cloud Offerings: WAMP – Django – Amazon Web Services, Case Studies: Smart Lighting – Weather Monitoring System – Smart Irrigation - IoT Printer.	9
	Total Instructional Hours	**45**

Course Outcome	After completion of the course the learner will be able to CO1:Describe IoT with various tools. CO2:Design a portable IoT using Arduino/ equivalent boards and relevant protocols. CO3:Develop web services to access/control IoT devices. CO4:Deploy an IoT application and connect to the cloud. CO5;Analyze applications of IoT in real time scenario

TEXT BOOKS:

T1- ArshdeepBahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015. (Unit 1,2, 3 & 5)

T2- Manoel Carlos Ramon, "Intel® Galileo and Intel® Galileo Gen 2: API Features and Arduino Projects for Linux Programmers", Apress, 2014. (Unit 4).

REFERENCE BOOKS:

R1 - Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014.

R2 - Marco Schwartz, "Internet of Things with the Arduino Yun", Packt Publishing, 2014.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	2	3	-	-	-	1	1	2	1	2	3
CO2	2	1	3	2	2	-	-	-	3	2	2	3	3	2
CO3	2	2	2	1	2	-	-	-	1	1	1	1	1	1
CO4	1	3	1	1	3	-	-	-	1	1	3	2	1	3
CO5	1	1	3	1	3	-	-	-	1	1	2	1	3	2
AVG	1.6	1.8	2	1.4	2.6	-	-	-	1.4	1.2	2	1.6	2	2.2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	21EC7301	Robotics	3	0	0	3

Course Objective	The student should be able to 1. To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues. 2.To introduce the electronics and software aspects in the design of robots. 3.To bring out the different languages for programming robot. 4.To specify robot requirements in the industry. 5.To introduce latest state of the art robots.

Unit	Description	Instructional Hours

I	**SCOPE OF ROBOTS** The scope of industrial Robots - Definition of an industrial robot - Need for industrial robots – Economic and Social Issues- applications.	9
II	**ROBOT COMPONENTS** Fundamentals of Robot Technology - Automation and Robotics - Robot anatomy - Work volume - Precision of movement - End effectors - Sensors.	9
III	**ROBOT PROGRAMMING** Robot Programming - Methods - interlocks textual languages. Characteristics of Robot level languages, characteristic of task level languages.	9
IV	**ROBOT WORK CELL** Robot Cell Design and Control - Remote Center compliance - Safety in Robotics.	9
V	**FUTURE TRENDS** Telepresence robot, Autonomous mobile robots, Walker Robots, Solar-ball Robot, Underwater bots, Aerobots, Advanced robotics in Space - Specific features of space robotics systems – long term technical developments, Next generation robots.	9
	Total Instructional Hours	**45**
Course Outcome	After completion of the course the learner will be able to CO1: Ability to comprehend and appreciate the significance and role of this course in the present contemporary world. CO2: Ability to design and develop robotic based systems. CO3: Ability to develop system for industrial automation and medical applications. CO4: Ability to provide automatic solution for replacing humans in life threatening area.	

TEXT BOOKS:

T1 - Barry Leatham - Jones, "Elements of industrial Robotics", Pitman Publishing, 1987.

T2 - J. M. Selig, "Introductory Robotics", Prentice Hall, 1992.

REFERENCE BOOKS:

R1 - John Iovine, "Robots, Android and Animatronics", 2nd Edition, McGraw-Hill, 2012.

R2 - John M. Holland, "Designing Autonomous Mobile Robots-Inside the mind of an Intelligent Machine", Newnes Publication, 2004.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	2	2	-	-	1	2	2	3	2
CO2	3	3	3	3	2	2	2	-	-	1	2	2	2	2
CO3	3	3	3	3	2	2	2	-	-	1	2	2	2	2
CO4	3	3	3	3	2	2	2	-	-	1	2	2	2	2
CO5	3	3	3	3	2	2	2	-	-	1	2	2	3	3
AVG	3	3	3	3	2.2	2	2			1	2	2	2.4	2.2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	21EC7302	ASIC Design	3	0	0	3

Course Objective	1.To learn the fundamentals of ASIC and CMOS logic design 2.To familiarize with the various principles of programmable ASIC design 3.To impart knowledge on ASIC architecture and various logic synthesis techniques 4.To provide an insight on the concepts of delay models and logic simulation. 5.To familiarize with the concepts of floor planning and system partitioning

Unit	Description	Instructional Hours
I	**ASIC AND CMOS LOGIC DESIGN** Types of ASICs - Design flow - CMOS transistors - Combinational Logic Cell – Sequential logic cell - Data path logic cell - Transistors as Resistors - Transistor Parasitic Capacitance.	9
II	**PROGRAMMABLE ASIC** Anti fuse - static RAM - EPROM and EEPROM technology - Actel ACT - Xilinx LCA – Altera FLEX - Altera MAX DC & AC inputs and outputs - Clock & Power inputs - Xilinx I/O blocks.	9
III	**ASIC ARCHITECUTRE AND LOGIC SYNTHESIS** Architecture and configuration of Spartan and Virtex FPGAs- Logic Synthesis with an example-Finite State Machine Synthesis - Memory Synthesis.	9
IV	**LOGIC SIMULATION** Simulation-Logic Systems - Cell Models - Delay Models - StaticTimingAnalysis - Formal verification - Switch level and Transistor level simulation.	9
V	**ASIC CONSTRUCTION** System Partitioning – FPGA Partitioning, Partitioning Methods- Kernighan-Lin algorithm. Floor Planning - Placement-min cut & Eigen value algorithm - Routing-Global & Detailed routing.	9
	Total Instructional Hours	**45**

Course Outcome	After completion of the course, the student will be able to CO1: Understand the basic ASIC and CMOS logic design. CO2: Understand various types of Programmable ASICs. CO3: Understand the ASIC architecture and logic synthesis. CO4: Understand the various techniquesused in the logic simulation and delay models. CO5: Understand the various methods system floor planning and partitioning.

TEXT BOOKS:

T1- M.J.S.Smith, " Application - Specific Integrated Circuits", Pearson, 2003. -UNIT I,II,III,IV,V

REFERENCE BOOKS:

R1.Steve Kilts, “Advanced FPGA Design,” Wiley Inter-Science.

R2. Roger Woods, John McAllister, Dr. Ying Yi, Gaye Lightbod, “FPGA-based Implementation of Signal Processing Systems”, Wiley, 2008.

R3. Mohammed Ismail and Terri Fiez, "Analog VLSI Signal and Information Processing ", McGraw Hill, 1994

R4. Douglas J. Smith, HDL Chip Design, Madison, AL, USA: Do one Publications, 1996.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	2	-	-	-	-	-	-	3	2
CO2	3	3	3	3	3	2	-	-	-	-	-	-	2	2
CO3	3	3	3	3	3	2	-	-	-	-	-	-	2	2
CO4	3	3	3	3	3	2	-	-	-	-	-	-	2	3
CO5	3	3	3	3	3	2	-	-	-	-	-	-	2	2
AVG	3	3	3	3	3	2	-	-	-	-	-	-	2	2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	21EC7303	GLOBAL POSITIONING SYSTEM	3	0	0	3

Course Objective	The student should be able to 1. Acquire fundamental knowledge of GPS architectures 2. Extend the knowledge about GPS signal characteristics 3. Understand the receiver architecture and errors 4. Gain knowledge about Differential GPS 5. Study the applications of GPS

Unit	Description	Instructional Hours
I	**Introduction:** Basic concept, system architecture, GPS and GLONASS Overview, Satellite Navigation, Time and GPS, User position and velocity calculations, GPS, Satellite Constellation, Operation Segment, User receiving Equipment, Space Segment Phased development, GPS aided Geoaugmented navigation (GAGAN) architecture.	6+6
II	**Signal Characteristics:** GPS signal components, purpose, properties and power level, signal acquisition and tracking, Navigation information extraction, pseudorange estimation, frequency estimation, GPS satellite position calculation, Signal structure, anti-spoofing (AS), selective availability, Difference between GPS and GALILEO satellite construction.	6+3
III	**GPS Receivers & Data Errors:** Receiver Architecture, receiver design options, Antenna design, GPS error sources, SA errors, propagation errors, ionospheric error, tropospheric error, multipath, ionospheric error, estimation using dual frequency GPS receiver, Methods of multipath mitigation, Ephemeris data errors, clock errors.	6

IV	**Differential GPS:** Introduction, LADGPS, WADGPS, Wide Area Augmentation systems, GEO Uplink subsystem, GEO downlink systems, Geo Orbit determination, Geometric analysis, covariance analysis, GPS /INS Integration Architectures	6
V	**GPS Applications:** GPS in surveying, Mapping and Geographical Information System, Precision approach, Aircraft landing system, Military and Space application, intelligent transportation system. GPS orbital parameters, description of receiver independent exchange format (RINEX), Observation data and navigation message data parameters, GPS position determination, least squares method	6+6
	Total Instructional Hours	**30+15**

Course Outcome	After completion of the course the learner will be able to CO1: Understand the architecture of positioning systems CO2: Evaluate the position calculations CO3: Interpret the errors in GPS receiver data CO4: Illustrate the types of Differential GPS system CO5: understands the applications of GPS

TEXT BOOKS:

T1-Mohinder S.Grewal, Lawrence R.Weill, Angus P.Andrews, "Global positioning systems, Inertial Navigation and Integration", Wiley 2007.

T2-B.Parkinson, J.Spilker, Jr.(Eds), "GPS: Theory and Applications", Vol.I&Vol.II, AIAA, 370 L'Enfant Promenade SW, Washington, DC 20024, 1996.

REFERENCE BOOKS:

R1 E.D.Kaplan, Christopher J. Hegarty, "Understanding GPS Principles and Applications", Artech House Boston 2005.

R2 - Ahmed El-Rabbany " Introduction to GPS:The Global Positioning System" Artech House BOSTON., 2002

R3 - A.Leick, "GPS Satellites Surveying", 2nd edition, John Wiley& Sons,NewYork,1995

R4 -B.Hoffman - Wellenhof, H.Lichtenegger and J.Collins, "GPS: Theory and Practice", 4th revised edition, Springer, Wein, New york, 1997.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	-	-	-	-	-	1	1	3	2
CO2	3	3	2	2	2	-	-	-	-	-	1	1	3	2
CO3	3	2	3	2	2	-	-	-	-	-	1	1	3	3
CO4	3	3	3	2	2	-	-	-	-	-	1	1	3	3
CO5	3	3	3	2	2	-	-	-	-	-	1	1	3	3
AVG	3	2.8	2.8	2	2						1	1	3	2.6

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Programme	Course Code	Name of the Course	L	T	P	C
BE	21EC7181	Entrepreneurship Development	3	0	0	3
Course Objective	The student should be able to 1.To understand the concept of entrepreneurship. 2.To know the motivation factors for the entrepreneurs. 3.To analyze the business concepts and projects. 4.To impart knowledge about accounting and various taxes. 5.To understand the government policies towards partnerships.					

Unit	Description	Instructional Hours
I	**ENTREPRENEURSHIP** Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth.	9
II	**MOTIVATION** Major Motives Influencing an Entrepreneur – Achievement Motivation Training, Self Rating, Business Games, Thematic Apperception Test – Stress Management, Entrepreneurship Development Programs – Need, Objectives.	9
III	**BUSINESS** Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps involved in setting up a Business – identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies.	9
IV	**FINANCING AND ACCOUNTING** Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of working Capital, Costing, Break Even Analysis, Taxation – Income Tax, Excise Duty – Sales Tax.	9
V	**SUPPORT TO ENTREPRENEURS** Sickness in small Business – Concept, Magnitude, Causes and Consequences, Corrective Measures - Business Incubators – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger and Sub Contracting.	9
	Total Instructional Hours	**45**
Course Outcome	After completion of the course the learner will be able to CO1: Choose the entrepreneurial career. CO2: Defend the motivation factors for the entrepreneurship. CO3: Evaluate the effectiveness of a business plan and model. CO4: Assess the taxes and the finance of a concern. CO5: Relate the supports and partnerships with respect the given scenario.	

TEXT BOOKS:

T1-S.S.Khanka, "Entrepreneurial Development" S.Chand& Co. Ltd., Ram Nagar, New Delhi, 2013

T2- Donald F Kuratko, " Entreprenuership – Theory, Process and Practice", 9th edition, Cengage Learning 2014.

REFERENCE BOOKS:

R1 - Mathew J Manimala, "Entrepreneurship Theory at Cross Roads: paradigms and Praxis", 2nd Edition Dream Tech, 2005.

R2 - Hisrich R D, Peters M P, "Entrepreneurship" 8th Edition, Tata McGraw-Hill, 2013.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	3	3	2	2	-	-	-	2	2	2	2	2
CO 2	3	3	3	3	2	2	-	-	-	2	2	2	2	2
CO 3	3	3	3	3	2	1	-	-	-	2	2	2	2	2
CO 4	3	2	2	4	2	2	-	-	-	2	0	2	2	1
CO 5	3	2	2	3	2	1	-	-	-	2	2	2	2	1
AVG	3	2.6	2.6	3.2	2	1.6	-	-	-	2	1.6	2	2	1.6

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Programme	Course Code	Name of the Course	L	T	P	C
BE	21EC7306	Embedded Controllers	3	0	0	3

Course Objective	The student should be able to 1.Introduce the concept of RISC and CISC microcontrollers. 2.Study the architecture of PIC and RL 78 family microcontrollers. 3.Gain knowledge about multi tasking and the real time operating system. 4.Learn the features and architecture of MSP430 microcontroller. 5.Understand the programming and peripheral interface using MSP430 microcontroller families.

Unit	Description	Instructional Hours
I	**RISC PROCESSORS** RISC Vs CISC, RISC properties and evolution, Advanced RISC microcontrollers, PIC18xx microcontroller family, Architecture, Instruction set, ROM, RAM, Timer programming, Serial port programming, Interrupt programming, ADC and DAC interfacing, CCP module and programming.	9
II	**CISC PROCESSORS** RL78 16 BIT Microcontroller architecture, addressing modes, on-Chip memory, ADC, interrupts, MAC unit, Barrel shifter, internal and external clock generation, memory CRC, on chip debug function and self programming.	9
III	**MULTITASKING AND THE REAL-TIME OPERATING SYSTEM** The challenge of multitasking and real time, multitasking with sequential programming, State machines, Real time operating system, RTOS services, synchronization and messaging tools, CCS PIC C Compiler RTOS. Design example: Voltmeter with RS232 serial output.	9
IV	**MSP430 16 - BIT MICROCONTROLLER** The MSP430 Architecture, CPU Registers, Instruction Set, addressing modes, the MSP430 family viz. MSP430x2x, MSP430x4x, MSP430x5x. Low power aspects of MSP430 : low power modes, active Vs standby current consumption, FRAM Vs Flash for low power and reliability.	9
V	**PROGRAMMING AND PERIPHERAL INTERFACE USING MSP430 FAMILIES** Memory mapped peripherals, I/O pin multiplexing, Timers, RTC, watchdog timer, PWM control, Analog interfacing and data acquisition, DMA, programming with above internal peripherals using optimal power consumption. Case study: Remote control of air conditioner and home appliances.	9

	Total Instructional Hours	45
Course Outcome	After completion of the course the learner will be able to CO1: Discriminate RISC and CISC processors, and work with PIC microcontrollers. CO2: Work with the 16 bit microcontroller RL78 and design microcontroller based systems for a Real world application. CO3: Apply the concept of multitasking and RTOS in embedded system design. CO4: Gaining design knowledge and concepts on MSP430 family of Microcontroller. CO5: Ability to design and develop microcontroller based smart electronic system and home appliances.	

TEXT BOOKS:

T1- Muhammad Ali Mazidi, Rolind D. Mckinlay and Danny Causey. "PIC Microcontroller and Embedded Systems", Pearson Education, 2008.

T2-John H. Davies, "MSP 430 Micro controller basics", Elsevier, 2008.

REFERENCE BOOKS:

R1 - Alaxander G, James M. Conard, " Creating fast, Responsive and energy efficient Embedded systems using the Renesas RL78 microcontroller", Micrium press, USA, Reprinted by S.P Printers, 2011. (Unit II).

R2 - David. E. Simon, "An Embedded Software Primer", Addison-Wesley, Reprint 2015.

R3 - Tim Wilmshurst, "Designing Embedded Systems with PIC microcontrollers-Principles and Applications", Newnes Publications, 2007.

R4- Douglas V.Hall, "Microprocessor and Interfacing, Programming and Hardware", Tata Mc Graw Hill Revised, 2nd Edition 2016, 11th Reprint 2011.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	2	3	-	-	-	1	1	2	1	2	3
CO2	2	1	3	2	2	-	-	-	3	2	2	3	3	2
CO3	2	2	2	1	2	-	-	-	1	1	1	1	1	1
CO4	1	3	1	1	3	-	-	-	1	1	3	2	1	3
CO5	1	1	3	1	3	-	-	-	1	1	2	1	3	2
AVG	1.6	1.8	2	1.4	2.6	-	-	-	1.4	1.2	2	1.6	2	2.2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	21EC7305	Cyber Forensics	3	0	0	3

Course Objective	To learn cyber crime and forensics To become familiar with forensics tools To learn to analyze and validate forensics data To understand cyber laws and the admissibility of evidence with case studies To learn the vulnerabilities in network infrastructure with ethical hacking

Unit	Description	Instructional Hours
I	**UNIT I INTRODUCTION TO CYBER CRIME AND FORENSICS** Introduction to Traditional Computer Crime, Traditional problems associated with Computer Crime. Role of ECD and ICT in Cybercrime - Classification of Cyber Crime. The Present and future of Cybercrime - Cyber Forensics -Steps in Forensic Investigation - Forensic Examination Process - Types of CF techniques - Forensic duplication and investigation - Forensics Technology and Systems - Understanding Computer Investigation – Data Acquisition.	9
II	**UNIT II EVIDENCE COLLECTION AND FORENSICS TOOLS** Processing Crime and Incident Scenes – Digital Evidence - Sources of Evidence - Working with File Systems. - Registry - Artifacts - Current Computer Forensics Tools: Software/ Hardware Tools - Forensic Suite - Acquisition and Seizure of Evidence from Computers and Mobile Devices - Chain of Custody- Forensic Tools	9
III	**UNIT III ANALYSIS AND VALIDATION** Validating Forensics Data – Data Hiding Techniques – Performing Remote Acquisition – Network Forensics – Email Investigations – Cell Phone and Mobile Devices Forensics - Analysis of Digital Evidence - Admissibility of Evidence - Cyber Laws in India - Case Studies	9
IV	**UNIT IV ETHICAL HACKING** Introduction to Ethical Hacking - Footprinting and Reconnaissance - Scanning Networks - Enumeration - System Hacking - Malware Threats – Sniffing – Email Tracking	9
V	**UNIT V ETHICAL HACKING IN WEB** Social Engineering - Denial of Service - Session Hijacking - Hacking Web servers - Hacking Web Applications – SQL Injection - Hacking Wireless Networks - Hacking Mobile Platforms.	9
	Total Instructional Hours	45

Course Outcome	**CO1:** Understand the basics of cyber crime and computer forensics **CO2:** Analyze and validate forensics data **CO3:** Understand Admissibility of evidence in India with Cyber laws and Case Studies **CO4:** Identify the vulnerabilities in a given network infrastructure **CO5:** Implement real-world hacking techniques to test system security

TEXT BOOKS:

T1:Bill Nelson, Amelia Phillips, Christopher Steuart, — Guide to Computer Forensics and Investigations‖, Cengage Learning, India Sixth Edition, 2019.
T2:CEH official Certified Ethical Hacking Review Guide, Wiley India Edition, Version 11, 2021.
T3: Dejey, S. Murugan - Cyber Forensics, Oxford University Press, India, 2018

REFERENCE BOOKS:

R1:John R.Vacca, "Computer Forensics ", Cengage Learning, 2005

R2: MarjieT.Britz, “Computer Forensics and Cyber Crime: An Introduction 3rd Edition, Prentice Hall, 2013.
R3: AnkitFadia“ Ethical Hacking, Second Edition, Macmillan India Ltd, 2006
R4: KennethC.Brancik “Insider Computer Fraud‖ Auerbach Publications Taylor &Francis Group– 2008.

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	-	-	-	-	-	-	1	1	-	-	-	2	-	3
CO2	2	1	1	2	-	-	-	-	-	-	-	2	2	1
CO3	2	2	1	1	2	-	-	-	-	-	-	1	3	-
CO4	-	-	-	-	-	-	1	2	-	-	-	1	-	2
CO5	-	3	-	2	-	-	1	1	-	-	-	2	2	1
AVG	2	2	1	2	2	-	1	1	-	-	-	2	2	2

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Syllabus Offered for Minor Degree

MINOR DEGREE
Vertical I
Embedded and IoT

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22EC5231	Electronics for Embedded Systems	MDC	3	0	0	3	3
2	22EC6231	Microcontroller and its Applications	MDC	3	0	0	3	3
3	22EC6232	Sensor and Embedded Systems	MDC	3	0	0	3	3
4	22EC7231	Fundamentals of IoT	MDC	2	0	2	3	3
5	22EC7232	Industrial IoT	MDC	3	0	0	3	3
6	22EC8231	IoT for Smart Systems	MDC	3	0	0	3	3

Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC5231	**Electronics for Embedded Systems**	3	0	0	3

Course Objective	CO1: To understand the fundamentals of Electronics and Boolean logic and functions. CO2: To design and realize digital systems CO3: To study the instruction sets and operations of a processor. CO4: To study the different ways of communication with I/O devices and standard I/O Interfaces. CO5: To study the Embedded system design.

Unit	Description	Instructional Hours
I	**ELECTRONICS FUNDAMENTALS** Theory of PN junction diode- Zener diode and its characteristics. TRANSISTORS Basic principle of operation of NPN and PNP configuration JFET – Construction and working principle –E-MOSFET, D MOSFET - Comparison of JFET and MOSFET.	9
II	**DIGITAL FUNDAMENTALS** Digital Systems – Binary Numbers – Octal – Hexadecimal Conversions – Signed Binary Numbers – Complements – L1ogic Gates – Boolean Algebra – K-Maps – Standard Forms neither – NAND – NOR Implementation.	9
III	**INTRODUCTION TO EMBEDDED SYSTEMS** Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.	9
IV	**EMBEDDED C PROGRAMMING** Memory and I/O Devices Interfacing – Programming Embedded Systems in C – Need for RTOS – Multiple Tasks and Processes – Context Switching – Priority Based Scheduling Policies	9
V	**EMBEDDED FIRMWARE:** Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches and Development Languages.	9
	Total Instructional Hours	**45**

Course Outcome	**After completion of the course the learner will be able to** CO1: Understand the concepts of smart system design and its present developments. CO2: Illustrate different embedded open-source and cost-effective techniques for developing solution for real time applications. CO3: Acquire knowledge on different platforms and Infrastructure for Smart system design. CO4: Infer about smart appliances and energy management concepts. CO5: Apply and improve Employability and entrepreneurship capacity due to knowledge up gradation on embedded system technologies.

TEXT BOOKS:

T1-Thomas Bräunl, Embedded Robotics, Springer, 2003.
T2 - Grimm, Christoph, Neumann, Peter, Mahlknech and Stefan, Embedded Systems for Smart Appliances and Energy Management, Springer 2013.

REFERENCE BOOKS:

R1- Raj Kamal, Embedded Systems - Architecture, Programming and Design, McGraw- Hill, 2008

R2- NilanjanDey, Amartya Mukherjee, Embedded Systems and Robotics with Open-Source Tools, CRC press, 2016.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	-	-	-	-	-	-	-	3	2
CO2	3	3	3	2	2	-	-	-	-	-	-	-	3	2
CO3	3	3	2	2	2	-	-	-	-	-	-	-	2	1
CO4	3	3	2	2	2	-	-	-	-	-	-	-	3	3
CO5	3	3	3	3	3	-	-	-	-	-	-	-	3	3
AVG	3	3	2.6	2.2	2.2	-	-	-	-	-	-	-	2.8	2.2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC6231	Microcontroller and its Applications	3	0	0	3

Course Objective	1.Study the Architecture of 8085 and 8086 microprocessor. 2. Learn the design aspects of I/O and Memory Interfacing circuits. 3. Study about communication and bus interfacing. 4. Study the Architecture of 8051 microcontroller 5. Study the concepts of microcontroller interfacing	
Unit	Description	Instructional Hours
I	**THE 8085 AND 8086 MICROPROCESSOR** Introduction to 8085 – Microprocessor architecture – Addressing modes - Instruction set - Introduction to 8086 – Microprocessor architecture – Addressing modes - Instruction set- Assembly language programming – Modular Programming - Interrupts and interrupt service routines.	9
II	**8086 SYSTEM BUS STRUCTURE** 8086 signals – Basic configurations – System bus timing –System design using 8086 – Introduction to Multiprogramming – Multiprocessor configurations – Coprocessor, Closely coupled and loosely Coupled configurations – Introduction to advanced processor	9

III	**I/O INTERFACING** Parallel communication interface – Serial communication interface – D/A and A/D Interface – Timer Interface – Keyboard /display controller – Interrupt controller – DMA controller – Programming and applications Case studies: Traffic Light control, LED display, LCD display.	9
IV	**MICROCONTROLLER AND INTERFACING MICROCONTROLLER** Architecture of 8051 – Special Function Registers (SFRs) - I/O Pins Ports and Circuits – Instruction set - Addressing modes - Assembly language programming. Programming 8051 Timers - Serial Port Programming - Interrupts Programming – LCD & Keyboard Interfacing - ADC, DAC & Sensor Interfacing - Stepper Motor	9
V	**ARM PROCESSOR** Arcon RISC Machine – Architectural Inheritance – Core & Architectures - Registers – Pipeline - Interrupts – ARM organization - ARM processor family – Co-processors - ARM instruction set- Thumb Instruction set - Instruction cycle timings - The ARM Programmer"s model- ARM Assembly Language Programming	9
Course Outcome	**After completion of the course the learner will be able to** CO1: Design and implement programs on 8086 microprocessor. CO2: Design I/O circuits. CO3: Design Memory Interfacing circuits. CO4: Design and implement 8051 microcontroller based systems. CO5: Design various interfacing and its programming methodologies	
	Total Instructional Hours	**45**

TEXT BOOKS:

- T1-Ramesh S. Goankar, "Microprocessor Architecture, Programming and Applications with 8085", 5th Edition, Prentice Hall (Unit 1)
  T2- Yu-Cheng Liu, Glenn A.Gibson, "Microcomputer Systems: The 8086 / 8088 Family - Architecture, Programming and Design", Prentice Hall of India, 2011. (Unit 1, 2, 3)
  T3- Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", Second Edition, Pearson education, 2011 (Unit 4, 5)

REFERENCE BOOKS:

R1-Doughlas V.Hall, "Microprocessors and Interfacing, Programming and Hardware",TMH,2012
R2- Krishna Kant , "Microprocessors and microcontrollers architecture programming and system design 8085 8086 8051 8096 PHI Learning Private Limited", 2014

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	2	2	-	-	-	-	-	2	3	2
CO2	3	3	3	2	2	1	-	-	-	-	-	1	3	2
CO3	3	3	3	2	2	1	-	-	-	-	-	1	2	2
CO4	3	3	3	3	3	2	-	-	-	-	2	2	2	3
CO5	2	1	2	1	3	-	2	-	1	-	-	2	2	2
AVG	2.8	2.4	2.6	2	2.4	1.5	0.4	-	0.2	0	0.4	1.6	2.4	2.2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC6232	**Sensor and Embedded Systems**	3	0	0	3
Course Objective	CO1: To provide insight about the embedded processor and sensors required for IoT. CO2: To familiarize the design and development of embedded system based system design. CO3: To provide an insight into smart appliances and energy management concepts. CO4: To teach the architecture and requirements of UAV. CO5:To expose students to different open-source platforms and attributes.					

Unit	Description	Instructional Hours
I	**INTRODUCTION** Classification of Sensors and Actuators - Input and Output Characteristics - Sensors and Actuators- working principle of Electric and Magnetic, Mechanical, Acoustic, Chemical, Radiation and Temperature- Smart Sensors and Actuators.	9
II	**SENSORS AND ACTUATORS FOR AUTOMOTIVES** Review of sensors- sensors interface to the ECU, conventional sensors and actuators, Modern sensor and actuators - LIDAR sensor- smart sensors- MEMS/NEMS sensors and actuators for automotive	9
III	**SENSORS AND UAVS** Real time Embedded processors for UAVs - sensors-servos-accelerometer –gyros-actuators- power supply- integration, installation, configuration, and testing – MEMS/NEMS sensors and actuators for UAVs- Autopilot – AGL.	9
IV	**EMBEDDED SYSTEM ARCHITECTURE DESIGN** Overview of Design Requirements - Hardware and software selection & co-design - Smart sensors and Actuators –Communication protocols used in smart systems – Data Analytics: Need & Types – Open-source Analytics Platform for embedded systems (IFTTT &ThingSpeak) – Smart Microcontrollers - Embedded system for Smart card design and development – Recent trends.	9
V	**EMBEDDED HARDWARE DEVICES** Application of Smart Embedded Sensor Wearable's in Healthcare & Activity Monitoring Functional requirements– Selection of body sensors, Hardware platform, OS and Software platform – Selection of suitable communication protocol. Case Study: Design of a wearable collecting heart-beat, temperature and monitoring health status using a Smartphone application.	9
	Total Instructional Hours	**45**
Course Outcome	**After completion of the course the learner will be able to** CO1: Insight into the significance of the role of embedded system for automotive applications. CO2: Illustrate the need, selection of sensors and actuators and interfacing with UAV CO3: Develop the Embedded concepts for vehicle management and control systems. CO4: Demonstrate the need of Electrical vehicle and able to apply the embedded system technology for various aspects of EVs CO5: Demonstrate criteria of choice of sensors, components to build meters.	
TEXT BOOKS:		

T1-Thomas Bräunl, Embedded Robotics, Springer, 2003.

T2- Grimm, Christoph, Neumann, Peter, Mahlknech and Stefan, Embedded Systems for Smart Appliances and Energy Management, Springer 2013.

REFERENCE BOOKS:

R1. Raj Kamal, Embedded Systems - Architecture, Programming and Design, McGraw- Hill, 2008

R2. NilanjanDey, Amartya Mukherjee, Embedded Systems and Robotics with Open-Source Tools, CRC press, 2016.

R3. Karim Yaghmour, Embedded Android, O'Reilly, 2013.

R4. Steven Goodwin, Smart Home Automation with Linux and Raspberry Pi, Apress, 2013

R5. C.K.Toh, AdHoc mobile wireless networks, Prentice Hall, Inc, 2002.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3		3	3	2	2	-	-	-	-	-	-	-	3
CO2	3		3	3	2	2	-	-	-	-	-	-	-	3
CO3	3		3	2	2	2	-	-	-	-	-	-	-	2
CO4	3		3	2	2	2	-	-	-	-	-	-	-	3
CO5	3	3	3	3	3	-	-	-	-	-	-	-	3	3
AVG	3	3	2.6	2.2	2.2	-	-	-	-	-	-	-	2.8	2.2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC7231	Fundamentals of IoT	2	0	2	3
Course Objective	CO1: To apprise students with basic knowledge of IoT that paves a platform to understand physical and logical design of IOT CO2:To teach a student how to analyse requirements of various communication models and Protocols for cost-effective design of IoT applications on different IoT platforms. CO3:To introduce the technologies behind Internet of Things(IoT). CO4:To explain the students how to code for an IoT application using Arduino/Raspberry Pi open platform. CO5: To apply the concept of Internet of Things in real world scenario					

Unit	Description	Instructional Hours
I	**INTRODUCTION TO INTERNET OF THINGS** Evolution of Internet of Things – Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT Models – Simplified IoT Architecture and Core IoT Functional Stack – Fog, Edge and Cloud in IoT	9
II	**COMPONENTS IN INTERNET OF THINGS** Functional Blocks of an IoT Ecosystem – Sensors, Actuators, and Smart Objects – Control Units - Communication modules (Bluetooth, Zigbee,Wifi, GPS, GSM Modules)	9
III	**PROTOCOLS AND TECHNOLOGIES BEHIND IOT** IOT Protocols - IPv6, 6LoWPAN, MQTT, CoAP - RFID, Wireless Sensor Networks, BigData Analytics, Cloud Computing, Embedded Systems.	9
IV	**OPEN PLATFORMS AND PROGRAMMING** IOT deployment for Raspberry Pi /Arduino platform-Architecture –Programming – Interfacing – Accessing GPIO Pins – Sending and Receiving Signals Using GPIO Pins – Connecting to the Cloud.	9
V	**IOT APPLICATIONS** Business models for the internet of things, Smart city, Smart mobility and transport, Industrial IoT, Smart health, Environment monitoring and surveillance – Home Automation – Smart Agriculture	9
	Total Instructional Hours	**45**

Course Outcome	**After completion of the course the learner will be able to** CO1: Explain the concept of IoT. CO 2: Understand the communication models and various protocols for IoT. CO 3: Design portable IoT using Arduino/Raspberry Pi /open platform CO 4: Apply data analytics and use cloud offerings related to IoT. CO 5: Analyze applications of IoT in real time scenario.

TEXT BOOKS:

T1- Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017

T2- Samuel Greengard, The Internet of Things, The MIT Press, 2015

REFERENCE BOOKS:

R1-Perry Lea, "Internet of things for architects", Packt, 2018

R2- Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applications and Protocols", Wiley, 2012

R3-IOT (Internet of Things) Programming: A Simple and Fast Way of Learning, IOT Kindle Edition.

R4-Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.

R5-ArshdeepBahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press,2015

R6-. https://www.arduino.cc/https://www.ibm.com/smarterplanet/us/en/?ca=v_smarterplanet

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO 10	PO1 1	PO1 2	PSO 1	PSO 2
CO1	3	2	2	-	2	2	-	-	-	-	-	2	3	2
CO2	3	3	3	2	2	1	-	-	-	-	-	1	3	2
CO3	3	3	3	2	2	1	-	-	-	-	-	1	2	2
CO4	3	3	3	3	3	2	-	-	-	-	-	2	2	3
CO5	2	1	2	1	3	-	2	-	-	-	-	2	2	2
AVG	2.8	2.4	2.6	2	2.4	1.5	0.4	-	0	0	0	1.6	2.4	2.2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC7232	Industrial Internet of Things	3	0	0	3
	Course Objective	1. To understand the fundamentals of Internet of Things 2. To learn about the basics of IoT protocols 3. To build a small low cost embedded system using IoT 4. To learn the IoT Security Protocols 5. To apply the concept of IoT in the real world scenario				

Unit	Description	Instructional Hours
I	**INTRODUCTION AND ARCHITECTURE OF IoT** Introduction – Definition and characteristics of IoT – Physical and Logical Design of IoT - Communication models and APIs – Challenges in IoT - Evolution of IoT- Components of IoT - A Simplified IoT Architecture – Core IoT Functional Stack.	9
II	**INDUSTRIAL IoT** ›duction, Industrial IoT: Business Model and Reference Architecture: IIoT-Business ndustrial IoT- Layers: IIoT Sensing, IIoT Processing, IIoT Communication, IIoT Networking.	9
III	**IIOT ANALYTICS** Big Data Analytics and Software Defined Networks, Machine Learning and Data Science, Julia Programming, Data Management with Hadoop	9
IV	**IOT SECURITY** Industrial IoT: Security and Fog Computing - Cloud Computing in IIoT, Fog Computing in IIoT. Security in IIoT.	9

V	**CASE STUDIES** Industrial IOT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies: Milk Processing and Packaging Industries, Manufacturing Industries	9
	Total Instructional Hours	**45**
Course Outcome	**After completion of the course the learner will be able to** CO1. Understand the basic concepts and Architectures of Internet of Things. CO2. Understand various IoT Layers and their relative importance. CO3. Realize the importance of Data Analytics in IoT. CO4. Study various IoT platforms and Security. CO5. Understand the Model real-time applications using IoT concepts	

TEXT BOOKS:

T1. Industry 4.0: The Industrial Internet of Things", by Alasdair Gilchrist (Apress), 2017. (UNIT I, II, III, V)
T2. Hands-On Industrial Internet of Things: Create a powerful Industrial IoT by Giacomo Veneri, Antonio Capasso, Packt, 2018.(UNIT IV)

REFERENCE BOOKS:

R1- "Industrial Internet of Things: Cybermanufacturing Systems"by Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer), 2017.

R2- Industrial IoT Challenges, Design Principles, Applications, and Security by Ismail Butun

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	3	3	2	2	2	-	-	-	-	-	3	3	3
CO 2	3	3	3	3	2	2	-	-	-	-	-	2	3	3
CO 3	3	3	3	3	2	2	-	-	-	-	-	2	2	2
CO 4	3	3	2	2	2	2	-	-	-	-	-	2	2	2
CO 5	3	3	2	2	2	1	-	-	-	-	-	3	3	2
AVg.	3	3	2.6	2.4	2	1.8	-	-	-	-	-	2.4	2.6	2.4

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC8231	IoT for Smart Systems	3	0	0	3

Course Objective	1. To study about Internet of Things technologies and its role in real time applications. 2. To introduce the infrastructure required for IoT 3. To familiarize the accessories and communication techniques for IoT. 4. To provide insight about the embedded processor and sensors required for IoT 5. To familiarize the different platforms and Attributes for IoT

Unit	Description	Instructional Hours
I	**INTRODUCTION TO INTERNET OF THINGS** Overview, Hardware and software requirements for IOT, Sensor and actuators, Technology drivers, Business drivers, Typical IoT applications, Trends and implications.	9
II	**IOT ARCHITECTURE** IoT reference model and architecture -Node Structure - Sensing, Processing, Communication, Powering, Networking - Topologies, Layer/Stack architecture, IoT standards, Cloud computing for IoT, Bluetooth, Bluetooth Low Energy beacons	9
III	**PROTOCOLS AND WIRELESS TECHNOLOGIES FOR IOT 9 PROTOCOLS** NFC, SCADA and RFID, Zigbee MIPI, M-PHY, UniPro, SPMI, SPI, M-PCIe GSM, CDMA, LTE, GPRS, small cell. Wireless technologies for IoT: WiFi (IEEE 802.11), Bluetooth/Bluetooth Smart, ZigBee/ZigBee Smart, UWB (IEEE 802.15.4), 6LoWPAN, Proprietary systems-Recent trends	9
IV	**IOT PROCESSORS** Services/Attributes: Big-Data Analytics for IOT, Dependability,Interoperability, Security, Maintainability. Embedded processors for IOT :Introduction to Python programming - Building IOT with RASPERRY PI and Arduino.	9
V	**CASE STUDIES** Industrial IoT, Home Automation, smart cities, Smart Grid, connected vehicles, electric vehicle charging, Environment, Agriculture, Productivity Applications, IOT Defense	9
	Total Instructional Hours	**45**

Course Outcome	**After completion of the course the learner will be able to** CO1: Analyze the concepts of IoT and its present developments. CO2: Compare and contrast different platforms and infrastructures available for IoT CO3: Explain different protocols and communication technologies used in IoT CO4: Analyze the big data analytic and programming of IoT CO5: Implement IoT solutions for smart applications

TEXT BOOKS:

T1. ArshdeepBahga and VijaiMadisetti : A Hands-on Approach "Internet of Things",Universities Press 2015.
T2. Oliver Hersent , David Boswarthick and Omar Elloumi " The Internet of Things", Wiley,2016.
T3. Samuel Greengard, " The Internet of Things", The MIT press, 2015.
T4. Adrian McEwen and Hakim Cassimally"Designing the Internet of Things "Wiley,2014.

REFERENCE BOOKS:

R1- Jean- Philippe Vasseur, Adam Dunkels, "Interconnecting Smart Objects with IP: The Next Internet" Morgan Kuffmann Publishers, 2010.
R2- Adrian McEwen and Hakim Cassimally, "Designing the Internet of Things", John Wiley and sons, 2014.
R3- Lingyang Song/DusitNiyato/ Zhu Han/ Ekram Hossain," Wireless Device-to-Device Communications and Networks, CAMBRIDGE UNIVERSITY PRESS,2015.
R4- OvidiuVermesan and Peter Friess (Editors), "Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems", River Publishers Series in Communication, 2013.
R5- Vijay Madisetti , ArshdeepBahga, "Internet of Things (A Hands on-Approach)", 2014.
R6- Zach Shelby, Carsten Bormann, "6LoWPAN: The Wireless Embedded Internet", John Wiley and sons, 2009.
R7- Lars T.Berger and Krzysztof Iniewski, "Smart Grid applications, communications and security", Wiley, 2015.
R8- JanakaEkanayake, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama and Nick Jenkins, " Smart Grid Technology and Applications", Wiley, 2015
R9- UpenaDalal,"Wireless Communications & Networks,Oxford,2015

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1	3	-	-	-	-	2	3	3	3
CO 2	3	3	2	2	1	-	-	-	-	-	1	2	3	3
CO 3	3	3	3	2	1	2	-	-	-	-	3	2	3	2
CO 4	3	3	2	2	3	-	-	-	-	-	-	1	3	3
CO 5	3	2	3	3	2	1	-	-	-	-	2	1	3	2
AVg.	3	2.8	2.4	2.2	1.6	2	-	-	-	-	2	1.8	3	2.6

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Syllabus Offered for Honour Degree

Honor Degree Verticals

Vertical-I
Sensor Technologies and IoT

S No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
1	22EC5305	Realtime Embedded Systems	HDC	3	0	0	3	40	60	100
2	22EC6305	Sensor for IoT applications	HDC	3	0	0	3	40	60	100
3	22EC6306	Advanced Processor Architectures	HDC	3	0	0	3	40	60	100
4	22EC7304	IOT Processors	HDC	3	0	0	3	40	60	100
5	22EC7305	Wearable Devices	HDC	3	0	0	3	40	60	100
6	22EC8301	Industrial IoT and Industry 4.0	HDC	3	0	0	3	40	60	100

Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC5305	Realtime Embedded Systems	3	0	0	3
Course Objective	CO1: To study the architecture and programming of ARM processors CO2: To introduce the basic concepts of hard real time multiprocessing. CO3: To introduce the analytical concepts for effective programming CO4: To know about operating systems CO5: To familiarize with networks for embedded					

Unit	Description	Instructional Hours
I	**INTRODUCTION TO EMBEDDED COMPUTING AND ARM PROCESSORS** Complex systems and microprocessors – Embedded system design process – Formalism for system design– Design example: Model train controller- ARM Processor Fundamental Instruction Set and Programming using ARM Processor	9
II	**COMPUTING PLATFORM** CPU: Programming input and output – Supervisor mode, exception and traps – Coprocessor – Memory system mechanism – CPU performance – CPU power consumption- CPU buses – Memory devices – I/O devices – Component interfacing- System Level Performance Analysis Parallelism. Design Example: Data Compressor	9
III	**PROGRAM DESIGN AND ANALYSIS** Program design – Model of programs – Assembly and Linking – Basic compilation techniques – Program Optimization- Analysis and optimization of execution time, power, energy, program size – Program validation and testing- Example: Software Modem	9
IV	**PROCESS AND OPERATING SYSTEMS** Multiple tasks and Multi processes – Processes – Context Switching – Operating Systems – Priority based Scheduling- RMS and EDF - Inter Process Communication mechanisms – Evaluating operating system performance – Power optimization strategies for processes.	9
V	**HARDWARE ACCELERATORS & NETWORKS** Multiprocessors- CPUs and Accelerators – Performance Analysis- Distributed Embedded Architecture – Networks for Embedded Systems: - I2C, CAN Bus, Ethernet, Myrinet – Network based design – Internet enabled systems. Design Example: Elevator Controller.	9
	Total Instructional Hours	**45**

Course Outcome	**After Completion of the course, the students will have the ability to:** CO1: Design and develop ARM processor based systems (L5) CO2: Explain role of microcontrollers in embedded systems.(L2) CO3: Apply program design and optimization and proper scheduling of the process. (L3) CO4: Analyse the concept of process, multiprocesses and operating systems in embedded system design. (L4) CO5: Build various communication protocols in distributed embedded computing platform. (L3)

TEXT BOOKS:

T1 - Wayne Wolf, "Computers as Components - Principles of Embedded Computing System Design", Morgan Kaufmann Publisher (An imprint of Elsevier), 3rd Edition, 2008.

T2. Andrew N Sloss, Dominic Symes, Chris Wright, "ARM System Developer's Guide- Designing and Optimizing System Software", Elsevier/Morgan Kaufmann Publisher, 2008

REFERENCE BOOKS:
R1 - DavidE-Simon,"AnEmbeddedSoftwarePrime",PearsonEducation,2010. R2. TammyNoergaard,"EmbeddedSystemsArchitecture",Elsevier,2006. R3. Jane.W.S.Liu,"Real-TimeSystems",PearsonEducationAsia,2011
List of Open Source Software/ Learning website: 1 https://nptel.ac.in/courses/117106111 2 https://onlinecourses.nptel.ac.in/noc20_cs16/preview 3 https://archive.nptel.ac.in/courses/108/105/108105057/ 4 https://mrcet.com/downloads/digital_notes/ECE/IV%20Year/EMBEDDED%20SYSTEMS%20 DESIGN.pdf 5 https://nptel.ac.in/courses/117106112

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	-	-	-	-	-	-	-	3	2
CO2	3	3	3	2	2	-	-	-	-	-	-	-	3	2
CO3	3	3	2	2	2	-	-	-	-	-	-	-	2	1
CO4	3	3	2	2	2	-	-	-	-	-	-	-	3	3
CO5	3	3	3	3	3	-	-	-	-	-	-	-	3	3
AVG	3	3	2.6	2.2	2.2	-	-	-	-	-	-	-	2.8	2.2

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Honor Degree

Vertical-II

Advanced Communication Systems

S No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
1	22EC5306	Cognitive Radio Networks	HDC	3	0	0	3	40	60	100
2	22EC6307	Remote Sensing	HDC	3	0	0	3	40	60	100
3	22EC6308	Rocketry and Space Mechanics	HDC	3	0	0	3	40	60	100
4	22EC7306	Underwater Navigation Systems	HDC	3	0	0	3	40	60	100
5	22EC7307	Massive MIMO Networks	HDC	3	0	0	3	40	60	100
6	22EC8203	Advanced Wireless Communication Techniques	HDC	3	0	0	3	40	60	100

Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC5306	**Cognitive Radio Network**	3	0	0	3

Course Objective	CO1:To understand the fundamentals of Software Defined radio and compare various SDR platforms. CO2:To enable the student to understand the evolving paradigm of cognitive radio communication and the enabling technologies for its implementation. CO3:To enable the student to understand the essential functionalities and requirements in designing software defined radios and their usage for cognitive communication CO4:To analyze the various methods of implementing the Cognitive Radio functions CO5:To exemplify the research challenges in designing a Cognitive Radio Network and the applications

Unit	Description	Instructional Hours
I	**SOFTWARE DEFINED RADIO AND ITS ARCHITECTURE** Definitions and potential benefits, software radio architecture evolution, technology tradeoffs and architecture implications. Essential functions of the software radio, basic SDR, hardware architecture, Computational processing resources, software architecture, top level component interfaces, interface topologies among plug and play modules. different fusion rules, wideband spectrum	9
II	**COGNITIVE RADIOS AND ITS ARCHITECTURE** Marking radio self-aware, cognitive techniques – position awareness, environment awareness in cognitive radios, optimization of radio resources, Artificial Intelligence Techniques, Cognitive Radio – functions, components and design rules, Cognition cycle – orient, plan, decide and act phases, Inference Hierarchy, Architecture maps, Building the Cognitive Radio Architecture on Software defined Radio Architechture.	9
III	**SPECTRUM SENSING AND IDENTIFICATION** Overview-Classification-Matched Filter , waveform based sensing - cyclo stationary based sensing -Energy detector based sensing - Radio Identifier - Cooperative Sensing -Spectrum Opportunity Detection , Fundamental Trade-offs: Performance versus Constraint , MAC Layer Performance Measures, Global Interference Model, Local Interference Model, Fundamental Trade-offs: Sensing Accuracy versus Sensing Overhead.	9
IV	**USER COOPERATIVE COMMUNICATIONS** User Cooperation and Cognitive Systems , Relay Channels: General Three-Node Relay Channel, Wireless Relay Channel , User Cooperation in Wireless Networks: Two-User Cooperative Network, Cooperative Wireless Network , Multihop Relay Channel	9
V	**INFORMATION THEORETICAL LIMITS ON CR NETWORKS** Types of Cognitive Behavior, Interference-Avoiding Behavior: Spectrum Interweave, Interference-Controlled Behavior: Spectrum Underlay, Underlay in Small Networks: Achievable Rates, Underlay in Large Networks: Scaling Laws, Interference-Mitigating Behavior: Spectrum Overlay, Opportunistic Interference Cancellation, Asymmetrically Cooperating Cognitive Radio Channels.	9
	Total Instructional Hours	**45**

Course Outcome	**After Completion of the course, the students will have the ability to:** CO1: Appreciate the motivation and the necessity for cognitive radio communication strategies. CO2: Demonstrate understanding of the enabling technologies for its implementation CO3: Demonstrate understanding of the essential functionalities and requirements in designing software defined radios and their usage for cognitive communication. CO4: Evolve new techniques and demonstrate their feasibility using mathematical validations and simulation tools. CO5: Interpret the impact of the evolved solutions in future wireless network design.

TEXT BOOKS:

T1- Alexander M. Wyglinski, Maziar Nekovee, And Y. Thomas Hou, "Cognitive Radio Communications and Networks - Principles And Practice", Elsevier Inc., 2010.
T2- Kwang-Cheng Chen and Ramjee Prasad, "Cognitive Radio Networks", John Wiley & Sons, Ltd, 2009

REFERENCE BOOKS:

R1: Khattab, Ahmed, Perkins, Dmitri, Bayoumi, Magdy, "Cognitive Radio Networks - From Theory to Practice", Springer Series, Analog Circuits and Signal Processing, 2009.
R2: J. Mitola, "Cognitive Radio: An Integrated Agent Architecture for software defined radio", Doctor of Technology thesis, Royal Inst. Technology, Sweden 2000.
R3: Simon Haykin, "Cognitive Radio: Brain –empowered wireless communications", IEEE Journal on selected areas in communications, Feb 2005.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	-	-	-	-	-	-	2	3	3
CO2	3	3	3	3	-	-	-	-	3	-	-	2	3	3
CO3	3	2	2	2	-	-	-	-	2	-	-	3	3	3
CO4	3	3	3	2	-	-	-	-	3	-	-	3	3	3
CO5	3	3	2	3	-	-	-	-	3	-	-	3	3	3
AVG	3	2.8	2.4	2.4	-	-	-	-	2.75	-	-	2.6	3	3

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Honour Degree

Vertical-III

Semiconductor Chip Design and Testing

S No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
1	22EC5307	Wide Bandgap Devices	HDC	3	0	0	3	40	60	100
2	22EC6309	Validation and Testing Technology	HDC	3	0	0	3	40	60	100
3	22EC6310	Low Power VLSI	HDC	3	0	0	3	40	60	100
4	22EC7308	VLSI Testing and Design for Testability	HDC	3	0	0	3	40	60	100
5	22EC7309	Mixed Signal IC Design Testing	HDC	3	0	0	3	40	60	100
6	22EC8202	Analog IC Design	HDC	3	0	0	3	40	60	100

Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC5307	**WIDE BANDGAP DEVICES**	3	0	0	3

Course Objective	CO1: To Introduce the concept of wide band gap (WBG) devices and its application in real world CO2: To Advantages and disadvantages of WBG devices CO3: To Provide an introduction to basic operation of WBG power devices CO4: To Learn Design principles of modern power devices CO5: To Study applications of wide bandgap devices in consumer electronic

Unit	Description	Instructional Hours
I	**WBG DEVICES AND THEIR APPLICATION IN REAL WORLD** Review of semiconductor basics, Operation and characteristics of the SiC Schottky Barrier Diode, SiC DMOSFET and GaN HEMT, Review of Wide bandgap semiconductor technology -Advantages and disadvantages	9
II	**SWITCHING CHARACTERIZATION OF WBG** Turn-on and Turn-off characteristics of the device, Hard switching loss analysis, Double pulse test set-up	9
III	**DRIVERS FOR WIDE BAND GAP DEVICES** Gate driver, Impact of gate resistance, Gate drivers for wide bandgap power devices, Transient immunity integrated gate drivers	9
IV	**HIGH FREQUENCY DESIGN COMPLEXITY AND PCB DESIGNING** Effects of parasitic inductance, Effects of parasitic capacitance, EMI filter des high frequency power converters High frequency PCB design, Conventional pow design, High frequency power loop optimization, Separation of power from signa	9
V	**APPLICATIONS OF WIDE BANDGAP DEVICES** Consumer electronics applications, Wireless power transfer applications, Electric vehicle applications, Renewable energy sources applications	9
	Total Instructional Hours	**45**

Course Outcome	**After successful completion of the course the student will be able to** CO1: Understand the operation and characteristics of Wide Bandgap semiconductor devices CO2: Analyze the switching characteristics of Wide Bandgap devices and evaluate their performance in power applications CO3: Design and implement gate drivers for Wide Bandgap power devices to optimize their efficiency and reliability CO4: Evaluate the complexities of high frequency design in PCBs and implement techniques to minimize parasitic effects CO5: Identify and apply Wide Bandgap devices in various real-world applications such as consumer electronics, electric vehicles, and renewable energy sources

TEXT BOOKS:

T1- A. Lidow, J. Strydom, M. D. Rooij, D. Reusch, GaN Transistors for Efficient Power Convertion, Wiley, 2014, ISBN-13: 978-1118844762.

T2- G. Meneghesso, M. Meneghini, E. Zanoni, "Gallium Nitride-enabled High Frequency and High Efficiency Power Conversion," Springer International Publishing, 2018, ISBN: 978-3-319-77993-5.

REFERENCE BOOKS:

R1- F. Wang, Z. Zhang and E. A. Jones, Characterization of Wide Bandgap Power SemiconductorDevices, IET, ISBN-13: 978-1785614910 (2018).

R2- B.J.Baliga, "Gallium Nitride and Silicon Carbide Power Devices," World Scientific PublishingCompany (3 Feb. 2017).

R3- L. Corradini, D. Maksimovic, P. Mattavelli, R. Zane, "Digital Control of HighFrequency Switched-Mode Power Converters", Wiley, ISBN-13: 978-1118935101 (9th June, 2015).

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	2	-	-	-	-	-	-	-	1	1
CO2	3	3	3	2	2	-	-	-	-	-	-	-	1	1
CO3	3	3	2	2	2	-	-	-	-	-	-		2	2
CO4	3	3	3	3	2	-	-	-	-	-	-	-	3	2
CO5	3	2	3	3	2	-	-	-	-	-	-	-	2	2
AVG	3	3	2.6	2.6	2	-	-	-	-	-	-	-	2	2

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Syllabus for Value Added Courses

Programme	Course Code	Name of the Course	C
B.E-ECE	22VAEC01	VERILOG PROGRAMMING FOR DIGITAL CIRCUIT DESIGN	2
Course Objective	1. To impart the kn owledge on basic concepts of verilog HDL 2. owledge on basic concepts of verilog HDL 3. To understand concepts data flow modeling with combinational logic circuits 4. To familiarize with Behavioral level modeling with sequential logic circuits 5. To acquire knowledge on Gate level modeling and hardware. 6. To develop mini project using Xilinx software with different levels of modeling concepts		

Module	Titles	Description	Hours
I	Introduction to VERILOG	Verilog as HDL, Levels of Design Description, Simulation and Synthesis, Test Benches, Keywords, Identifiers, , Comments, Numbers, Strings, Logic Values **Simulation by using Xilinx software tool** Basic programming with top-down and bottom up approach models (Hands on Session)	6
II	Data flow level Modeling	Introduction, Continuous Assignment Structures, Delays and Continuous Assignments, Assignment to Vectors, Operators with combinational circuit programs **Simulation by using Xilinx software tool** Hands on for Half and full adder,multiplexer,encoder,decoder.	6
III	Behavioral Modeling	Introduction, Operations and Assignments, Initial Construct, Always Construct, Assignments with Delays, wait construct, Designs at Behavioral Level, Blocking and Non-blocking Assignments with sequential circuit programs **Simulation by using Xilinx software tool** Hands on for flip flops, shift register, counter	6
IV	Gate level Modeling	Introduction, AND Gate Primitive, Module Structure, Other Gate Primitives, Tri-State Gates, Array of Instances of Primitives with example programs and FPGA **Simulation by using Xilinx software tool** Hands on Gate level modeling programs and FPGA trainer implementation	6
V	Looping concepts with example programs and **Mini Project Submission**		8
		Total Instructional Hours	**32**
Course Outcome	**After successful completion of the course the students will be able to** CO1: Analyze the Basic programming concepts using verilog HDL CO2: Design and simulate the Data flow modeling programming with combination logic circuit concepts CO3: Design and the behavioral flow modeling programming with sequential logic circuit concepts CO4: Analyze the gate level modeling with Xilinx software and implement in FGPA trainer CO5: Design the mini projects using Xilinx software		

TEXTBOOKS:

T1- Samir Palnitkar, "Verilog HDL", Pearson Education, 2nd Edition,2003

T2- J. Bhaskar, "A Verilog Primer'', BSP, 2nd edition 2003.

REFERENCEBOOKS:

R1 - T.R. Padmanabhan and B. Bala Tripura Sundari, "Design through Verilog HDL'', WSE, IEEE Press 2008

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	2	-	-	3	-	-	3	3	3
CO2	3	3	3	3	3	2	-	-	3	-		3	3	3
CO3	3	3	3	3	3	2	-	-	3	-	-	3	3	3
CO4	3	3	3	3	3	2	-	-	3	-	-	3	3	3
CO5	3	3	3	3	3	2	-	-	3	-	-	3	3	3
AVG	3	3	3	3	3	2	-	-	3	-	-	3	3	3

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Programme	Course Code	Name of the Course	C
BE	**22VAEC02**	**Embedded Systems Design with ARM Cortex and STM32 Microcontrollers**	**2**
Course Objective	1. To Understand microcontroller architectures and peripheral interfacing. 2. To Develop embedded C programs for STM32 microcontrollers. 3. To Analyze GPIO, ADC, and DAC interfacing techniques using APIs. 4. To Implement timer functions and their applications in embedded systems. 5. To Create projects using STM32 and Arduino platforms, incorporating various peripherals.		

Unit	Description	Instructional Hours.
I	Microcontrollers, peripherals, buses- Bus architecture, types of buses, ARM architecture, ARM Cortex M Processor, STM32 controllers Architecture. Embedded C programming for STM32C103	9
II	GPIOs- embedded C programming and usage of datasheet for designing, types, interfacing GPIOS–- referring to the datasheet, selection of GPIOs, interfacing GPIO using APIs, Hands-on interfacing GPIOS. Hands-on training on interfacing GPIOS- – referring to the datasheet, selection of GPIOs, interfacing GPIO using APIs.	9
III	ADC- Embedded C Programming, usage of datasheet for designing, Hands-on Session- interfacing ADC using APIs with potentiometer. DAC- Embedded C Programming, usage of datasheet for designing, Hands-on Session - interfacing DAC using APIs.	9
IV	Timers- types of timers – specification and selection of timers, interfacing timers – using APIs. Hands-on training on interfacing timers – referring to the datasheet, selection of timers, interfacing timers using APIs.	9
V	Hands-on interfacing of peripherals in Arduino-GPIO, ADC using Arduino IDE. Interfacing GPIO, ADC in STM32. Hands-on Session: Interfacing of peripherals with Arduino-timers using Arduino IDE. Interfacing timers in STM32. Mini Project using STM32, Arduino and add-on cards	9
	Total Instructional Hours	**45**

Course Outcome	**After completion of the course the learner will be able to,** CO1: Articulate the principles and applications of ARM, ARM Cortex M, and STM32 controllers. CO2: Design and implement GPIO interfaces using embedded C programming. CO3: Interface ADC and DAC with STM32 through embedded C programming CO4: Select and interface timers, applying specifications and APIs for embedded applications. CO5: Develop and integrate peripheral interfaces in mini-projects using STM32 and Arduino platforms.

TEXT BOOKS:

1. Joseph Yiu , "The Definitive Guide to ARM Cortex M3 and Cortex M4 Processors", Third, Newnes, 2014.
2. Brown, Geoffrey. "Discovering the STM32 Microcontroller." Indiana University (2016).

REFERENCE BOOKS:

1. Steve Furber , "ARM System-on – Chip Architecture", Second Edition, Addison Wesley, Pearson Education Limited, 2000.
2. Arnold s Berger , "Embedded systems Design: An introduction to Processes, tools and Techniques", CMP books, 2002.
3. Bahga A, Madisetti V , "Internet of things : A Hands - on approach", University Press, Hyderabad, 2017.
4. Bai Y , "Practical Micro Controller Engineering with ARM technology", John Wiley and Sons, 2015.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	2	-	-	3	-	-	3	3	3
CO2	3	3	3	3	3	2	-	-	3	-		3	3	3
CO3	3	3	3	3	3	2	-	-	3	-	-	3	3	3
CO4	3	3	3	3	3	2	-	-	3	-	-	3	3	3
CO5	3	3	3	3	3	2	-	-	3	-	-	3	3	3
AVG	3	3	3	3	3	2	-	-	3	-	-	3	3	3

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Percentage Revision & New Courses Introduced in the Fourteenth BoS

Percentage revision in the syllabus

S.No	Course code	Course name	% revision
Regulation 2022			
1	22EC5203	Microprocessor and Micro controller	20
2	22EC5201	Digital Communication	20
3	22EC5001	Microprocessors and Microcontrollers Lab	10
4	22EC5002	Digital Communication Lab	25
5	22EC6307	Artificial Intelligence and Machine Learning	25
Regulation 2019A			
6	19EC7901	Project Work I	5

% Revision in the Curriculum

Total number of courses passed in this BOS	28(Regular)+(6*3=)18(Honors)+(1*6=)6 (Minor) = 52
No. of courses revised	6
% revision in courses	21%

Course introduced

S.No	Course code	Course name	% revision
Regulation 2022			
1	22EC5306	Cognitive Radio Network	100
2	22EC1152	Fundamentals of Electronics and Communication Engineering	100

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
Curriculum and ODD Semesters Syllabus for the Batch
2024 – 2028 (R2022)
2023 – 2027 (R2022)
2022 – 2026 (R2022)
2021 – 2025 (R2019 with Amendments)

(Board of Studies held on 09.12.2024)
(Academic Council Meeting held on 19.12.2024)

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Coimbatore– 641032

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

CURRICULUM&SYLLABUS

R-2022 Curriculum and Syllabus for 2024-2028 Batch

Batch: 2024-2028

REGULATIONS 2022

VISION OF THE DEPARTMENT

DV:To achieve excellence in Electronics and Communication Engineering keeping in pace with evolving technologies through quality education embedded with employability skills and ethical values for the betterment of society.

MISSION OF THE DEPARTMENT

DM1: To expand frontiers of knowledge through provision of inspiring learning environment
DM2: To develop intellectual skills towards employability by fostering innovation, and creativity in learning.
DM3: To inculcate professional ethics, values and entrepreneurial attitude addressing industrial and societal demands.

PROGRAMME OUTCOMES

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 considerations for the public health and safety, and the cultural, societal and environmental consideration.

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 modelling 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 environment.

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.

PROGRAMME SPECIFIC OUTCOMES

PSO1: Graduates will be able to analyze, design and develop solutions for real-time challenges, facilitating the creation of quality products in the Electronics and Communication industry.

PSO2: Graduates will exhibit resilience in embracing emerging technologies, nurturing innovation in Signal Processing, Communication Systems, Embedded Systems, IoT, Networking, and VLSI to address contemporary demands.

PROGRAMME EDUCATIONAL OBJECTIVES

PEO1: To prepare the graduates to solve, analyze and develop real time engineering products by providing strong foundation in the fundamentals of Electronics and Communication Engineering.

PEO2: To prepare the graduates to succeed in multidisciplinary dimensions by providing adequate trainings and exposure to emerging technologies.

PEO3: To prepare the graduates to become a successful leader and innovator following ethics with the sense of social responsibility for providing engineering solutions.

Curriculum under R2022

(for the batch admitted during 2024 – 2025)

SEMESTER I											
S. NO	COURSE CODE	COURSE TITLE	COURSE CATEGORY	L	T	P	C	TCP	CIA	ESE	TOTAL
THEORY											
1	22MA1101	MATRICES AND CALCULUS	BSC	3	1	0	4	4	40	60	100
THEORY WITH LAB COMPONENT											
2	22CY1153	CHEMISTRY FOR ELECTRICAL SCIENCES	BSC	2	0	2	3	4	50	50	100
3	22HE1151	ENGLISH FOR ENGINEERS	HSC	2	0	2	3	4	50	50	100
4	22EC1152	FUNDAMENTALS OF ELECTRONICS AND COMMUNICATION ENGINEERING (New Course)	BSC	2	0	2	3	4	50	50	100
5	22IT1151 R	PYTHON PROGRAMMING AND PRACTICES	ESC	2	0	2	3	4	50	50	100
EEC COURSES (SE/AE)											
6	22HE1072	ENTREPRENEURSHIP & INNOVATION (Common to all branches)	AEC	1	0	0	1	1	100	0	100
7	22HE1073	INTRODUCTION TO SOFT SKILLS (Common to all branches)	SEC	2	0	0	0	1	100	0	100
MANDATORY COURSE											
8	22MC1093/ 22MC1094	தமிழர்மரபு / HERITAGE OF TAMIL	MC	2	0	0	1	2	40	60	100
9	22MC1095	UNIVERSAL HUMAN VALUES (Common to all branches)	MC	2	0	0	0	2	100	0	100
			TOTAL CREDITS	**18**	**1**	**8**	**18**	**26**	**580**	**320**	**900**

SEMESTER II											
S. NO	COURSE CODE	COURSE TITLE	COURSE CATEGORY	L	T	P	C	TCP	CIA	ESE	TOTAL
THEORY											
1	22MA2102	DIFFERENTIAL EQUATIONS AND LAPLACE TRANSFORM	BSC	3	1	0	4	4	40	60	100
2	22CY2101	ENVIRONMENTAL STUDIES	ESC	2	0	0	2	3	40	60	100
3	22EC2201	ELECTRON DEVICES (New Course)	ESC	2	0	0	2	3	40	60	100
THEORY WITH LAB COMPONENT											
4	22PH2154	PHYSICS FOR ELECTRICAL AND ELECTRONICS SCIENCE	BSC	2	0	2	3	4	50	50	100
5	22HE2151	EFFECTIVE TECHNICAL COMMUNICATION	HSC	2	0	2	3	4	50	50	100
6	22CS2255	PROGRAMMING USING C	PCC	2	0	2	3	4	50	50	100

PRACTICAL											
7	22ME2001	ENGINEERING PRACTICES	ESC	0	0	4	2	2	60	40	100
EEC COURSES (SE/AE)											
8	22HE2071	DESIGN THINKING	AEC	2	0	0	2	2	100	0	100
9	22HE2072	SOFT SKILLS AND APTITUDE	SEC	1	0	0	1	1	100	0	100
MANDATORY COURSES											
10	22MC2094/22MC2095	தமிழரும் தொழில்நுட்பமும் / TAMILS AND TECHNOLOGY	MC	2	0	0	1	2	100	0	100
11	22MC2093	NCC */NSS / YRC / SPORTS / CLUBS / SOCIETY SERVICE - ENROLLMENT (COMMON)	MC	All students shall enroll, on admission, in anyone of the personality and character development programmes and undergo training for about 80 hours							
			TOTAL CREDITS	**18**	**1**	**10**	**23**	**29**	**690**	**370**	**1000**

S.NO	COURSEC- ODE	COURSETITLE	COURSE CATEGORY	L	T	P	C	TCP	CIA	ESE	TOTAL
SEMESTER III											
THEORY											
1	22MA3102	COMPLEX ANALYSIS AND TRANSFORMS (common to ECE, EEE, EIE)	BSC	3	1	0	4	4	40	60	100
2	22EC3201	ELECTRONIC CIRCUITS	PCC	3	0	0	3	3	40	60	100
3	22EC3202	SIGNALS AND SYSTEMS	PCC	3	0	0	3	3	40	60	100
4	22EC3203	DIGITAL ELECTRONICS	PCC	3	0	0	3	3	40	60	100
5	22EC3204	CIRCUITS AND NETWORKS	ESC	2	0	0	2	3	100	-	100
THEORY WITH LAB COMPONENT											
6	22EC3251	OOPS USING JAVA	ESC	2	0	2	3	3	50	50	100
PRACTICAL											
6	22EC3001	ELECTRONIC CIRCUITS LABORATORY	PCC	0	0	3	1.5	3	60	40	100
7	22EC3002	DIGITAL ELECTRONICS LABORATORY	PCC	0	0	3	1.5	3	60	40	100
EEC COURSES (SE/AE)											
9	22HE3071	SOFT SKILLS -2	SEC	1	0	0	1	1	100	0	100
10	22EC3901	MINI PROJECT 1	AEC	0	0	0	2	1	100	0	100
11	22MC3191	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	MC	2	0	0	0	2	100	0	100
			TOTAL CREDITS	**19**	**1**	**8**	**24**	**29**	**730**	**370**	**1000**

SEMESTER IV											
S.NO	COURSE CODE	COURSE TITLE	COURSE CATEGORY	L	T	P	C	TCP	CIA	ESE	TOTAL
THEORY											
1	22HE4101	IPR AND START-UPS (Common)	HSC	2	0	0	2	2	40	60	100
2	22EC4201	ELECTRO MAGNETIC FIELDS	PCC	3	0	0	3	3	40	60	100
3	22EC4202	ANALOG COMMUNICATION	PCC	3	0	0	3	3	40	60	100
4	22EC4203	LINEAR INTEGRATED CIRCUITS	PCC	3	0	0	3	3	40	60	100
5	22EC4304	TRANSMISSION LINES AND WAVEGUIDES	PCC	3	0	0	3	3	40	60	100
THEORY WITH LAB COMPONENT											
6	22EC4251	CONTROL SYSTEM	PCC	2	0	2	3	3	50	50	100
7	22EC4253	DATA COMMUNICATION AND NETWORKS	PCC	2	0	2	3	3	50	50	100
PRACTICAL											
8	22EC4001	LINEAR INTEGRATED CIRCUITS LAB	PCC	0	0	3	1.5	3	60	40	100
9	22EC4002	ANALOG COMMUNICATION LAB	PCC	0	0	3	1.5	3	60	40	100
EEC COURSES (SE/AE)											
10	22HE4071	SOFT SKILLS -3	SEC	1	0	0	1	1	100	0	100
11	22MC4091	INDIAN CONSTITUTION	MC	2	0	0	0	2	100	0	100
			TOTAL CREDITS	**21**	**0**	**10**	**24**	**29**	**620**	**480**	**1100**

SEMESTER V											
S.NO	COURSE CODE	COURSE TITLE	COURSE CATEGORY	L	T	P	C	TCP	CIA	ESE	TOTAL
THEORY											
1.	22EC5201	DIGITAL COMMUNICATION	PCC	3	0	0	3	3	40	60	100
2.	22EC5202	ANTENNA AND WAVE PROPAGATION	PCC	3	1	0	4	3	40	60	100
3.	22EC5203	MICROPROCESSORS AND MICROCONTROLLERS	PCC	3	0	0	3	3	40	60	100
4.	22EC53XX	PROFESSIONAL ELECTIVE-1	PEC	3	0	0	3	3	40	60	100
5.	22EC53XX	PROFESSIONAL ELECTIVE-2	PEC	3	0	0	3	3	40	60	100
6.	22EC53XX	PROFESSIONAL ELECTIVE-3	PEC	3	0	0	3	3	40	60	100
PRACTICAL											
7	22EC5001	MICROPROCESSORS AND MICROCONTROLLERS LAB	PCC	0	0	3	1.5	3	60	40	100
8	22EC5002	DIGITAL COMMUNICATION LAB	PCC	0	0	3	1.5	3	60	40	100
EEC COURSES (SE/AE)											
9	22HE5071	SOFT SKILLS -4 / FOREIGN LANGUAGES	SEC	1	0	0	1	1	100	0	100
			TOTAL CREDITS	**19**	**1**	**6**	**23**	**25**	**460**	**440**	**900**

SEMESTER VI												
S.NO	COURSE CODE	COURSE TITLE	COURSE CATEGORY	L	T	P	C	TCP	CIA	ESE	TOTAL
THEORY											
1	22HE6101	PROFESSIONAL ETHICS	HSC	3	0	0	3	3	40	60	100
2	22EC6201	EMBEDDED SYSTEMS AND IOT	PCC	3	0	0	3	3	40	60	100
3	22EC63XX	PROFESSIONAL ELECTIVE-4	PEC	3	0	0	3	3	40	60	100
4	22EC63XX	PROFESSIONAL ELECTIVE-5	PEC	3	0	0	3	3	40	60	100
5	22EC64XX	OPEN ELECTIVE – 1*	OEC	3	0	0	3	3	40	60	100
THEORY WITH LAB COMPONENT											
6	22EC6253	DIGITAL SIGNAL PROCESSING	PCC	2	0	2	3	4	50	50	100
7	22EC6254	VLSI DESIGN	PCC	2	0	2	3	4	50	50	100
EEC COURSES (SE/AE)											
8	22EC6901	MINI PROJECT 2	AEC	0	0	0	2	1	100	0	100
			TOTAL CREDITS	19	0	4	23	24	400	400	800

SEMESTER VII											
S.NO	COURSE CODE	COURSE TITLE	COURSE CATEGORY	L	T	P	C	TCP	CIA	ESE	TOTAL
THEORY											
1	22EC7201	WIRELESS COMMUNICATION NETWORKS	PCC	3	0	0	3	3	40	60	100
2	22EC7202	MOBILE COMMUNICATION	PCC	3	0	0	3	3	40	60	100
3	22EC7203	AUTOMATIVE ELECTRONICS	PCC	3	0	0	3	3	40	60	100
4	22EC73XX	PROFESSIONAL ELECTIVE-6	PEC/ICC	3	0	0	3	3	40	60	100
5	22EC74XX	OPEN ELECTIVE – 2*	OEC	3	0	0	3	3	40	60	100
THEORY WITH LAB COMPONENT											
6	22EC7002	OPTICAL COMMUNICATION AND MICROWAVE ENGINEERING	PCC	2	0	2	3	4	50	50	100
EEC COURSES (SE/AE)											
7	22EC7901	INTERNSHIP	AEC	-	-	-	2	1	100	0	100
			TOTAL CREDITS	17	0	2	20	20	350	350	700

SEMESTER VIII											
S.NO	COURSE CODE	COURSE TITLE	COURSE CATEGORY	L	T	P	C	TCP	CIA	ESE	TOTAL
EEC COURSES (SE/AE)											
1	22EC8901	PROJECT WORK/GRANTED PRODUCT PATENT	AEC	0	0	20	10	20	100	100	200
			TOTAL CREDITS	0	0	20	10	20	100	100	200

SEMESTER WISE CREDIT DISTRIBUTION

B.E. / B.TECH. PROGRAMMES										
S.No.	Course Area	Credits per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	HSC	3	3	-	2	-	3	-	-	**11**
2	BSC	10	7	4	-	-	-	-	-	**20**
3	ESC	3	7	3	-	-	-	-	-	**15**
4	PCC	-	3	14	20	16	6	9	-	**64**
5	PEC	-	-	-	-	6	6	3	-	**18**
6	OEC	-	-	-	-	-	6	6	-	**12**
7	EEC	1	3	3	2	1	2	2	10	**24**
8	MC	1	0							**01**
	Total	**18**	**23**	**24**	**24**	**23**	**23**	**20**	**10**	**165**

Credit Distribution R2022

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	18	23	24	24	23	23	20	10	**165**

PROFESSIONAL ELECTIVES

Vertical 1 Electronic System Design	Vertical 2 Communication Systems	Vertical 3 Wireless Networks	Vertical 4 Signal and Image Processing	Vertical 5 Biomedical Technologies	Vertical 6 Diversified Courses
Foundation Skills in Integrated Product Development	Satellite Communication	Network Security	Digital Image Processing	Medical Electronics	App Development
Measurements and Instrumentation	Global Positioning Systems	Wireless Sensors and Networks	Audio Signal Processing	Medical Informatics	Web Technologies
IoT Based System Design	Under Water Communication	High Speed Networks	Machine Vision	Medical Image Processing	Ethical Hacking
PCB Design	RF System Design	Cloud Computing	Artificial Intelligence and Machine Learning	Biometric Systems	Cryptocurrency and Blockchain Technologies
ASIC Design	Software Defined Radio	Wireless Broad Band Networks	Neural Networks and Deep Learning	Medical Robotics	3D Printing and Design

ntroduction to PLC Programming	Radar Technologies	Cyber Forensics	Virtual Reality and Augmented Reality	Human Computer Interface	4G/5G Communication Networks

PROFESSIONAL ELECTIVE COURSES: VERTICALS

Vertical 1
Electronic System Design

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1.	22EC5301	Foundation Skills in Integrated Product Development	PEC1	3	0	0	3	3
2.	22EC5302	Measurements and Instrumentation	PEC2	3	0	0	3	3
3.	22EC5303	IoT Based System Design	PEC3	3	0	0	3	3
4.	22EC6301	PCB Design	PEC4	3	0	0	3	3
5.	22EC6302	ASIC Design	PEC5	3	0	0	3	3
6.	22EC7301	Introduction to PLC Programming	PEC6	3	0	0	3	3

Vertical 2
Communication Systems

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1.	22EC5304	Satellite Communication	PEC1	3	0	0	3	3
2.	22EC5305	Global Positioning Systems	PEC2	3	0	0	3	3
3.	22EC5306	Under Water Communication	PEC3	3	0	0	3	3
4.	22EC6303	RF System Design	PEC4	3	0	0	3	3
5.	22EC6304	Software Defined Radio	PEC5	3	0	0	3	3
6.	22EC7302	Radar Technologies	PEC6	3	0	0	3	3

Vertical 3
Wireless Networks

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1.	22EC5307	Network Security	PEC1	3	0	0	3	3
2.	22EC5308	Wireless Sensors and Networks	PEC2	3	0	0	3	3
3.	22EC5309	High Speed Networks	PEC3	3	0	0	3	3
4.	22EC6305	Cloud Computing	PEC4	3	0	0	3	3
5.	22EC6306	Wireless Broad Band Networks	PEC5	3	0	0	3	3
6.	22EC7303	Cyber Forensics	PEC6	3	0	0	3	3

Vertical 4
Signal and Image Processing

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1.	22EC5310	Digital Image Processing	PEC1	3	0	0	3	3
2.	22EC5311	Audio Signal Processing	PEC2	3	0	0	3	3
3.	22EC5312	Machine Vision	PEC3	3	0	0	3	3
4.	22EC6307	Artificial Intelligence and Machine Learning	PEC4	3	0	0	3	3
5.	22EC6308	Neural Networks and Deep Learning	PEC5	3	0	0	3	3
6.	22EC7304	Virtual Reality and Augmented Reality	PEC6	3	0	0	3	3

Vertical 5
Biomedical Technologies

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1.	22EC5311	Medical Electronics	PEC1	3	0	0	3	3
2.	22EC5312	Medical Informatics	PEC2	3	0	0	3	3
3.	22EC5313	Medical Image Processing	PEC3	3	0	0	3	3
4.	22EC6309	Biometric Systems	PEC4	3	0	0	3	3
5.	22EC6310	Medical robotics	PEC5	3	0	0	3	3
6.	22EC7305	Human Computer Interface	PEC6	3	0	0	3	3

Vertical 6
Diversified courses

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1.	22EC5314	App Development	PEC1	3	0	0	3	3
2.	22EC5315	Web Technologies	PEC2	3	0	0	3	3
3.	22EC5316	Ethical Hacking	PEC3	3	0	0	3	3
4.	22EC6311	Cryptocurrency and Blockchain Technologies	PEC4	3	0	0	3	3
5.	22EC6312	3D Printing and Design	PEC5	3	0	0	3	3
6.	22EC7306	4G/5G Communication Networks	PEC6	3	0	0	3	3

OPEN ELECTIVE I
(VI SEMESTER – COMMON LIST FOR ALL THE PROGRAMS)
(EMERGING TECHNOLOGIES)

Students must choose an open elective course from the given list. The content of the course should not be related to their current program of study.

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	Strength
				L	T	P			
1	22AI6401	Artificial Intelligence and Machine Learning Fundamentals	OEC	3	0	0	3	3	65
2	22CS6401	Block chain Technology Fundamentals	OEC	3	0	0	3	3	130
3	22EC6402	IoT Concepts and Applications	OEC	3	0	0	3	3	130
4	22IT6401	Data Science and Analytics Fundamentals	OEC	3	0	0	3	3	130
5	22BM6401	3D printing	OEC	3	0	0	3	3	65
6	22AE6401	Space Science	OEC	3	0	0	3	3	65
7	22MT6401	Introduction to Industrial Engineering	OEC	3	0	0	3	3	65
8	22MT6402	Industrial Safety and Environment	OEC	3	0	0	3	3	65
9	22CE6401	Climate Change and its Impact	OEC	3	0	0	3	3	65
10	22CE6402	Environment and Social Impact Assessment	OEC	3	0	0	3	3	65
11	22ME6401	Renewable Energy System	OEC	3	0	0	3	3	65
12	22ME6402	Additive Manufacturing systems	OEC	3	0	0	3	3	65
13	22EI6401	Introduction to Industrial Instrumentation and Control	OEC	3	0	0	3	3	65
14	22AU6401	Basics of Automobile Engineering	OEC	3	0	0	3	3	65
15	22EE6401	Fundamentals of Electric vehicles	OEC	3	0	0	3	3	65
16	22FT6401	Traditional Foods	OEC	3	0	0	3	3	65
17	22AG6401	Urban Agriculture and Organic Farming	OEC	3	0	0	3	3	65
18	22CH6401	Waste to Energy conversion	OEC	3	0	0	3	3	65
19		NCC Level - I	OEC	3	0	0	3	3	65

OPEN ELECTIVE II
(VII SEMESTER - COMMON LIST FOR ALL THE PROGRAMS)
LIFE SKILL COURSES

Students shall choose any one of the Life Skill courses from the open elective courses listed below.

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTAC T PERIODS	CREDITS	Strength
				L	T	P			
1	22LS7401	General studies for competitive examinations	OEC	3	0	0	3	3	130

2	22LS7402	Human Rights, Women Rights and Gender equity	OEC	3	0	0	3	3	130
3	22LS7403	Indian ethos and Human values	OEC	3	0	0	3	3	130
4	22LS7404	Financial independence and management	OEC	3	0	0	3	3	130
5	22LS7405	Yoga for Human Excellence	OEC	3	0	0	3	3	130
6	22LS7406	Democracy and Good Governance	OEC	3	0	0	3	3	130
7	22LS7407	NCC Level - II	OEC	3	0	0	3	3	130
8	22LS7408	Cybercrime and Awareness	OEC	3	0	0	3	3	130
9	22LS7409	First Aid and Emergency care	OEC	3	0	0	3	3	130
10	22LS7410	Business Communication	OEC	3	0	0	3	3	130

Enrollment for B.E. / B. TECH. (HONOURS) / Minor Degree (optional)

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E. / B. Tech. (Honours) or Minor Degree. For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only. For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes.

Clause 4.10 of Regulation 2022 is applicable for the Enrolment of B.E. / B. TECH. (HONOURS) / Minor Degree (Optional).

HONOUR DEGREE VERTICAL COURSES

S. No.	Vertical-I Sensor Technologies and IoT	Vertical II Advanced Communication Systems	Vertical III Semiconductor Chip Design and Testing
1	Realtime Embedded Systems	Cognitive Radio Networks	Wide Bandgap Devices
2	Sensor for IoT applications	Remote Sensing	Validation and Testing Technology
3	Advanced Processor Architectures	Rocketry and Space Mechanics	Low Power VLSI
4	IOT Processors	Underwater Navigation Systems	VLSI Testing and Design for Testability
5	Wearable Devices	Massive MIMO Networks	Mixed Signal IC Design Testing
6	Industrial IoT and Industry 4.0	Advanced Wireless Communication Techniques	Analog IC Design

Vertical-I
Sensor Technologies and IoT

S No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
1	22EC5305	Realtime Embedded Systems	HDC	3	0	0	3	40	60	100
2	22EC6305	Sensor for IoT applications	HDC	3	0	0	3	40	60	100
3	22EC6306	Advanced Processor Architectures	HDC	3	0	0	3	40	60	100
4	22EC7304	IOT Processors	HDC	3	0	0	3	40	60	100
5	22EC7305	Wearable Devices	HDC	3	0	0	3	40	60	100
6	22EC8301	Industrial IoT and Industry 4.0	HDC	3	0	0	3	40	60	100

Vertical-II
Advanced Communication Systems

S No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
1	22EC5306	Cognitive Radio Networks	HDC	3	0	0	3	40	60	100
2	22EC6307	Remote Sensing	HDC	3	0	0	3	40	60	100
3	22EC6308	Rocketry and Space Mechanics	HDC	3	0	0	3	40	60	100
4	22EC7306	Underwater Navigation Systems	HDC	3	0	0	3	40	60	100
5	22EC7307	Massive MIMO Networks	HDC	3	0	0	3	40	60	100
6	22EC8203	Advanced Wireless Communication Techniques	HDC	3	0	0	3	40	60	100

Vertical-III
Semiconductor Chip Design and Testing

S No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
1	22EC5307	Wide Bandgap Devices	HDC	3	0	0	3	40	60	100
2	22EC6309	Validation and Testing Technology	HDC	3	0	0	3	40	60	100
3	22EC6310	Low Power VLSI	HDC	3	0	0	3	40	60	100
4	22EC7308	VLSI Testing and Design for Testability	HDC	3	0	0	3	40	60	100
5	22EC7309	Mixed Signal IC Design Testing	HDC	3	0	0	3	40	60	100
6	22EC8202	Analog IC Design	HDC	3	0	0	3	40	60	100

MINOR DEGREE VERTICAL COURSES
Embedded and IoT

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22EC5601	Electronics for Embedded Systems	MDC	3	0	0	3	3
2	22EC6601	Microcontroller and its Applications	MDC	3	0	0	3	3
3	22EC6602	Sensor and Embedded Systems	MDC	3	0	0	3	3
4	22EC7601	Fundamentals of IoT	MDC	3	0	0	3	3
5	22EC7602	Industrial IoT and Industry 4.0	MDC	3	0	0	3	3
6	22EC8601	IoT for Smart Systems	MDC	3	0	0	3	3

Vertical II
Fintech and Block Chain

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	21CS5602	Financial Management	MDC	3	0	0	3	3
2	21MB6231	Fundamentals of Investment	MDC	3	0	0	3	3
3	21MB6232	Banking, Financial Services andInsurance	MDC	3	0	0	3	3
4	21MB7231	Introduction to Blockchain and its Applications	MDC	3	0	0	3	3
5	21MB7232	Fintech Personal Finance and Payments	MDC	3	0	0	3	3
6	21MB8231	Introduction to Fintech	MDC	3	0	0	3	3

Vertical III
Entrepreneurship

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	21BA5601	Foundation of Entrepreneurship	MDC	3	0	0	3	3
2	21BA6601	Introduction to Business Venture	MDC	3	0	0	3	3
3	21BA6602	Team Building & Leadership Management for Business	MDC	3	0	0	3	3
4	21BA7601	Creativity & Innovation in Entrepreneurship	MDC	3	0	0	3	3
5	21BA7602	Principles of Marketing Management for Business	MDC	3	0	0	3	3
6	21BA8601	Human Resource Management for Entrepreneurs	MDC	3	0	0	3	3
7	21BA8602	Financing New Business Ventures	MDC	3	0	0	3	3

Vertical IV
Environment and Sustainability

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	21CEXXXX	Sustainable Infrastructure Development	MDC	3	0	0	3	3
2	21AG6233	Sustainable Agriculture and Environmental Management	MDC	3	0	0	3	3
3	21BM6233	Sustainable Bio Materials	MDC	3	0	0	3	3
4	21ME7233	Materials for Energy Sustainability	MDC	3	0	0	3	3
5	21CE7233	Green Technology	MDC	3	0	0	3	3
6	21CE8232	Environmental Quality Monitoring and Analysis	MDC	3	0	0	3	3

P. Hay

Chairman BoS

Chairman
ECE - HiCET

Dean Academics

Dean (Academics)
HiCET

Principal

PRINCIPAL
Hindusthan College Of Engineering & Technology
COIMBATORE - 641 032.

Programme / Sem	Course Code	Name of the Course	L	T	P	C
B.E./II	22MA2102	DIFFERENTIAL EQUATIONS AND LAPLACE TRANSFORM	3	1	0	4

Course Objective	**The learner should be able to** 1. Describe some methods to solve different types of first order ordinary differential equations. 2. Understand the various approach to find general solution of the ordinary differential equations 3. Form the various types of Partial differential equations and methods to find solution. 4. Analyze the techniques of Laplace transform. 5. Analyze the techniques of Inverse Laplace transform.

Unit	Description	Instructional Hours
I	**ORDINARY DIFFERENTIAL EQUATIONS OF FIRST ORDER** Basic concepts, separable differential equations, exact differential equations, integrating factors, linear differential equations, Bernoulli equation.	12
II	**LINEAR DIFFERENTIAL EQUATIONS OF SECOND ORDER** Second order linear differential equations with constant with RHS of the form e^{ax},x^n , sinax, cosax-e^{ax}**f(x)**– Cauchy's linear equations– Method of variation of parameters.	12
III	**PARTIAL DIFFERENTIAL EQUATIONS** Formation of partial differential equations by eliminating arbitrary constants and functions – Solution of first order partial differential equations of the form f(p,q)=0, Clairaut's equation – Lagrange's equation.	12
IV	**LAPLACE TRANSFORM** Laplace transform–Basic properties –Transforms of derivatives and integrals of functions- Periodicfunctions –**Initial and Final value problems**- Unit step function - Dirac delta function.	12
V	**INVERSE LAPLACE TRANSFORM** Inverse Laplace transform-Convolution theorem (Basic problems only) Solution of linear ODE of second order with constant coefficients using Laplacetransforms..	12
	Total Instructional Hours	**60**

Course Outcome	**At the end of the course, the learner will be able to** CO1: Apply few methods to solve different types of first order ordinary differential equations. CO2: Evaluate the solutions of second order ordinary differential equations and its properties. CO3: Compute the solution of first order partial differential equations. CO4: Apply Laplace transform and its properties to solve periodic functions. CO5: Solve certain linear differential equations using Laplace Transform.

TEXT BOOKS:

T1 - Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India Private Ltd., New Delhi, 2018

T2 - Bali. N.P and Manish Goyal& Watkins, "Advanced Engineering Mathematics", 7th Edition, Laxmi Publications Pvt Ltd, 2007

REFERENCE BOOKS :

R1- Thomas & Finney " Calculus and Analytic Geometry" , Sixth Edition,,Narosa Publishing House, New Delhi.

R2 - Weir,M.D and Joel Hass, ' Thomas Calculus" 12thEdition,Pearson India 2016.

R3 - Grewal B.S, "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, Delhi, 2012.

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CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	-	-	-	-	-	-	2
CO2	3	3	3	2	3	-	-	-	-	-	-	2
CO3	3	3	3	3	3	-	-	-	-	-	-	2
CO4	3	3	3	3	3	-	-	-	-	-	-	2
CO5	3	3	3	3	3	-	-	-	-	-	-	2
AVG	3	3	3	2.6	2.8	-	-	-	-	-	-	2

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Programme/sem	Course Code	Name of the Course	L	T	P	C
B.E.,B.TECH/ II	22CY2101	ENVIRONMENTAL STUDIES	2	0	0	2

Course Objective	1.To Introduce the basic concepts of environment, ecosystems, and biodiversity and emphasize on the biodiversity of India and its conservation. 2.To Impart knowledge on the causes, effects, and control or prevention measures of environmental pollution and natural disasters. 3.To Facilitate the understanding of global and Indian scenario of renewable and nonrenewable resources, causes of their degradation, and measures to preserve them. 4.To Gain knowledge on the scientific, technological, economic and political solutions to environmental problems. 5.To Familiarize the concept of sustainable development goals and appreciate the interdependence of economic and social aspects of sustainability, recognize and analyze climate changes, concept of carbon credit, and the challenges of environmental management.

Unit	Description	Instructional Hours
I	**ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY** Scope and objectives of environmental studies-Importance of environment – need for public awareness - Eco-system and Energy flow–ecological succession- Structure and function of the forest and ponds ecosystem – Types of biodiversity:– values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity – endangered and endemic species of India – conservation of biodiversity: Insitu and ex-situ.	6
II	**UNIT II ENVIRONMENTAL POLLUTION** Definition – causes, effects and control measures of: Air pollution- Water pollution – Water quality parameters- Soil pollution - Noise pollution- Nuclear hazards – role of an individual in prevention of pollution.	6
III	**UNIT III RENEWABLE SOURCES OF ENERGY** Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.	6
IV	**SOCIAL ISSUES AND THE ENVIRONMENT** From unsustainable to sustainable development – urban problems related to energy-environmental ethics: Issues and possible solutions – 12 Principles of green chemistry-Municipal solid waste management. Global issues – Climatic change, acid rain, greenhouse effect and ozone layer depletion – Disaster Management – Tsunami and cyclones.	6
V	**SUSTAINABILITY AND MANAGEMENT** Development, GDP, Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and protocols. Sustainable Development Goals-targets, indicators and intervention areas. Climate change- Global, Regional, and local environmental issues and possible solutions (global warming, acid rain and ozone layer depletion). Concept of Carbon Footprint.	6
	Total Instructional Hours	**30**

Course Outcome	CO1: Recognize and understand the functions of environment, ecosystems and biodiversity and their conservation. CO2: Identify the causes, effects of environmental pollution and natural disasters and contribute to the preventive measures in the society. CO3: Identify and apply the understanding of renewable and non-renewable resources and contribute to sustainable measures to preserve them for future generations. CO4: Demonstrate an appreciation for need for sustainability, management and understand the various social issues and solutions to solve the issues.

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	CO5: Recognize the different goals of sustainable development and apply them for suitable technological advancement and societal development.

TEXT BOOKS

T1 - Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers ,2018.

T2 - Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016.

REFERENCE BOOKS

R1 – Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, Third Edition, 2015.

R2 - Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	-	-	-	2	3	-	-	-	-	2
CO2	3	2	-	-	-	3	3	-	-	-	-	2
CO3	3	-	1	-	-	2	2	-	-	-	-	2
CO4	3	2	1	1	-	2	2	-	-	-	-	2
CO5	3	2	1	-	-	2	2	-	-	-	-	1
AVG	2.8	1.8	1	1	-	2.2	2.4	-	-	-	-	1.8

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC2201	ELECTRON DEVICES	2	0	0	2

Course Objectives	1. To Acquire elementary knowledge on PN junction and Zener diodes and their applications 2. To Familiarize the BJT Operation Characteristics and Configurations. 3. To Explore the Operation and Characteristics of JFET and MOSFET 4. To Interpret the basic operation of special semiconductor devices. 5. To Learn the functionality of power and display devices.
Course pre-requisites:	22EC1152-Fundamentals of Electronics and Communication Engineering

Unit	Description	Instructional Hours
I	**SEMICONDUCTOR DIODES** Theory of PN Junction Diode-Forward and Reverse Bias Characteristics- Diode Current Equations, Rectifiers: Half-wave Rectifiers, Full Wave Rectifiers and Bridge Rectifiers. Zener Diode: Characteristics-Breakdown in diodes-Zener breakdown and Avalanche breakdown.	6
II	**BIPOLAR JUNCTION TRANSISTORS** BJT Construction- NPN and PNP – Transistor Operation-Early Effect, Configurations of BJT: Input and Output Characteristics of CE, CB and CC Configurations, Limits of Operation, Transistor Amplifying Action.	6
III	**FIELD EFFECT TRANSISTOS** JFET-Construction and Operation – Drain and Transfer Characteristics -Comparison of JFET and BJT- MOSFET: Depletion Type MOSFET, Enhancement Type MOSFET - Comparison of JFET and MOSFET.	6
IV	**SPECIAL SEMICONDUCTOR DEVICES** Schottky Barrier Diodes- Varactor Diodes–Power Diodes-Tunnel Diodes-Photo Diodes-Photo conductive Cells - Light- Emitting Diodes, Liquid-Crystal Displays- Solar Cells-Thermistors.	6
V	**POWER DEVICES AND DISPLAY DEVICES** Silicon-Controlled Rectifier-Construction, Operation and Characteristics, Applications-DIAC-TRIAC- Unijunction Transistors-Photo Transistors.	6
	Total Instructional Hours	**30**

Course Outcomes	Upon successful completion of the course, the students will have the ability to: CO1: Describe the structure and working principle of PN junction and Zener diodes. CO2: Demonstrate the characteristics of different types of BJT and compare CO3: Infer and compare the characteristics of JFET and MOSFET CO4: Relate various special semiconductor devices CO5: Interpret and associate the usage of different power and display devices

TEXTBOOKS:

T1.Robert Boylestad and Louis Nashelsky, "Electron Devices and Circuit Theory" Pearson Education India, 11th edition, July 2015.

REFERENCEBOOKS:

R1-R.S.Sedha,—A Textbook of Applied Electronics S.Chand Publications,2006.

R2- J Millman. CCHalkias, Satyabrata Jit, "Electronic Devices & Circuits", Tata McGraw Hill, 2010.

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CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1	3	3	2	3	2	2	-	-	-	-	2	2	3	2
CO2	3	3	2	3	2	2	-	-	-	-	2	2	3	2
CO3	3	2	3	3	2	2	-	-	-	-	2	2	3	2
CO4	3	2	3	2	2	2	-	-	-	-	2	2	3	2
CO5	3	2	3	3	2	2	-	-	-	-	2	2	3	3
AVG	3	2.4	2.6	2.8	2	2	-	-	-	-	2	2	3	2.2

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Programme / Semester	Course Code	Name of the Course	L	T	P	C
B.E. / II	22PH2154	PHYSICS FOR ELECTRICAL AND ELECTRONICS SCIENCE	2	0	2	3

Course Objective	To Extend the knowledge about fiber optics in engineering field. To Acquire knowledge on basics of electrical properties of solid materials. To Gain knowledge about mechanical properties of materials. To Enhance the basics of wave properties of light. To Acquire fundamental and application of superconducting materials.

Unit	Description	Instructional Hours
I	**BASICS OF FIBRE OPTICS** Principle and propagation of light through optical fibers – Derivation of numerical aperture and acceptance angle – Classification of optical fibers (based on refractive index, modes and materials) – Fiber optical communication link – Fiber optic sensors – Temperature and displacement sensors. **Determination of acceptance angle and numerical aperture in an optical fiber.** **Visit to IDA lab.**	9
II	**ELECTRICAL PROPERTIES OF MATERIALS** Classical free electron theory - Expression for electrical conductivity – Thermal conductivity, expression – Widemann - Franz law – Success and failures – Quantum theory – Postulates - Fermi - Dirac statistics – Effect of temperature on fermi function – Density of energy states – concentration of electrons.	6
III	**MECHANICS OF MATERIALS** Elasticity – Hooke's law –stress-strain diagram – bending moment – depression of a cantilever – derivation of young's modulus of the material of the beam by uniform bending - theory and experiment. Twisting couple - Torsion pendulum: theory and experiment. **Determination of Young's modulus by uniform bending method** **Determination of Rigidity modulus – Torsion pendulum**	12
IV	**PHOTONICS** Spontaneous emission and stimulated emission – Population inversion – Pumping methods – Type of lasers – Nd:YAG laser and CO_2laser. Laser Applications - Industrial applications of laser. Interference - Conditions for sustained Interference – air wedge and it's applications. **Determination of Wavelength and particle size using Laser** **Determination of thickness of a thin wire – Air wedge method** **V-Lab- https://vlab.amrita.edu/?sub=1&brch=189&sim=342&cnt=1**	12
V	**MAGNETIC AND SUPERCONDUCTING MATERIALS** Origin of magnetic moment – Bohr magnetron – comparison of Dia, Para and Ferro magnetism – Domain theory – Hysteresis – soft and hard magnetic materials. Superconductivity: properties (Messiner effect, effect of magnetic field, effect of current and isotope effects) – Type I and Type II superconductors – Applications of superconductors –SQUID, Cryotron and magnetic levitation.	6
	Total Instructional Hours	45

Course Outcome	At the end of the course, the learner will be able to CO1: Relate the basics of fiber optics and its applications CO2 Familiarize knowledge on basics of electrical properties of solid materials. CO3: Relate mechanical properties of materials and applications CO4: Recall the basics of wave properties of light. CO5: Relate the Superconducting material and their applications

TEXTBOOKS:

T1 - Rajendran V, Applied Physics, Tata McGraw Hill Publishing Company Limited, New Delhi, 2017.

T2 - Gaur R.K. and Gupta S.L.. Engineering Physics, 8th edition, DhanpatRai Publications (P) Ltd.. New Delhi, 2015.

REFERENCEBOOKS:

R1 - M.N Avadhanulu and PG Kshirsagar "A Text Book of Engineering physics" S. Chand and Company ltd., New Delhi 2018

R2 - Halliday, D., Resnick, R. and Walker, J. "Principles of Physics". Wiley, 2020.

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WEB REFERENCES

1. https://nptel.ac.in/courses/104104085/
2. https://nptel.ac.in/courses/112106227/
3. https://en.wikipedia.org/wiki/Aerospace_materials/
4. https://nptel.ac.in/courses/105105177/
5. https://nptel.ac.in/courses/104104085/

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	1	2	1	1	-	1	-	2	2
CO2	3	3	3	2	2	-	3	-	-	-	-	3
CO3	2	3	2	1	2	1	1	-	2	-	2	3
CO4	2	3	3	2	2	1	1	-	1	-	2	2
CO5	3	3	3	2	2	-	3	-	-	-	-	3
AVG	2.6	2.8	2.8	1.6	2.0	1.0	1.8	-	1.3	-	2.0	2.6

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Programme/ Sem	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech/II	22HE2151	EFFECTIVE TECHNICAL COMMUNICATION	2	0	2	3
Course Objective	The learner should be able to: 1. Extend the knowledge about fiber optics in engineering field. 2. Acquire knowledge on basics of electrical properties of solid materials. 3. Gain knowledge about mechanical properties of materials. 4. Enhance the basics of wave properties of light. 5. Acquire fundamental and application of superconducting materials.					

Unit	Description	Instructional Hours
I	**BASICS OF FIBRE OPTICS** Principle and propagation of light through optical fibers – Derivation of numerical aperture and acceptance angle – Classification of optical fibers (based on refractive index, modes and materials) – Fiber optical communication link – Fiber optic sensors – Temperature and displacement sensors. **Determination of acceptance angle and numerical aperture in an optical fiber. Visit to IDA lab.**	9
II	**ELECTRICAL PROPERTIES OF MATERIALS** Classical free electron theory - Expression for electrical conductivity – Thermal conductivity, expression – Widemann - Franz law – Success and failures – Quantum theory – Postulates - Fermi - Dirac statistics – Effect of temperature on fermi function – Density of energy states – concentration of electrons.	6
III	**MECHANICS OF MATERIALS** Elasticity – Hooke's law –stress-strain diagram – bending moment – depression of a cantilever – derivation of young's modulus of the material of the beam by uniform bending - theory and experiment. Twisting couple - Torsion pendulum: theory and experiment. **Determination of Young's modulus by uniform bending method** **Determination of Rigidity modulus – Torsion pendulum**	12
IV	**PHOTONICS** Spontaneous emission and stimulated emission – Population inversion – Pumping methods – Type of lasers – Nd:YAG laser and CO_2laser. Laser Applications - Industrial applications of laser. Interference - Conditions for sustained Interference – air wedge and it's applications. **Determination of Wavelength and particle size using Laser** **Determination of thickness of a thin wire – Air wedge method** **V-Lab- https://vlab.amrita.edu/?sub=1&brch=189&sim=342&cnt=1**	12
V	**MAGNETIC AND SUPERCONDUCTING MATERIALS** Origin of magnetic moment – Bohr magnetron – comparison of Dia, Para and Ferro magnetism – Domain theory – Hysteresis – soft and hard magnetic materials. Superconductivity: properties (Messiner effect, effect of magnetic field, effect of current and isotope effects) – Type I and Type II superconductors – Applications of superconductors –SQUID, Cryotron and magnetic levitation.	6
	Total Instructional Hours	**45**

Course Outcome	At the end of the course, the learner will be able to CO1: Relate the basics of fiber optics and its applications CO2 Familiarize knowledge on basics of electrical properties of solid materials. CO3: Relate mechanical properties of materials and applications CO4: Recall the basics of wave properties of light. CO5: Relate the Superconducting material and their applications

TEXTBOOKS:

T1 - Rajendran V, Applied Physics, Tata McGraw Hill Publishing Company Limited, New Delhi, 2017.

T2 - Gaur R.K. and Gupta S.L., Engineering Physics, 8th edition, DhanpatRai Publications (P) Ltd., New Delhi, 2015.

REFERENCEBOOKS:

R1 - M.N Avadhanulu and PG Kshirsagar "A Text Book of Engineering physics" S. Chand and Company ltd., New Delhi 2018

R2 - Halliday, D., Resnick, R. and Walker, J. "Principles of Physics", Wiley, 2020.

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PROGRAMME	COURSE CODE	NAME OF THE COURSE	L	T	P	C
B.E/B.Tech	22CS2255	PROGRAMMING USING C	2	0	2	3

Course Objective	1. To develop simple algorithms for arithmetic and logical problems. 2. To understand and implement the fundamental concepts in a program. 3. To enable how to implement conditional branching, iteration and recursion. 4. To understand how to decompose a problem into functions and synthesize a complete program and to enable them to use arrays, pointers, strings and structures in solving problems. 5. To understand the use files to perform read and write operations

Unit	Description	Instructional Hours
I	**Basics of C Programming** Structure of C program-C programming: Data Types–Keywords–Variables -Operators: Precedence and Associativity-Expressions–Input/ Output statements Decision making statements - Looping statements – Pre-processor directives -Compilation process	5+4(P)
II	**Arrays and Strings** Introduction to Arrays: Declaration, Initialization–One dimensional array–Two dimensional arrays– String operations and String functions	5+4(P)
III	**Functions and Pointers** Introduction to functions: Function prototype, function definition, function call - Parameter passing: Pass by value, Pass by reference – Recursion – Pointers –Pointer operators–Pointer arithmetic–Arrays and pointers	5+4(P)
IV	**Structures and Unions** Structure - Nested structures– Array of structures –Self-referential structures – Dynamic memory allocation – Typedef-Unions –Union of Structures	7+2(P)
V	**File Processing** Files–Types of file processing: Sequential access, Random access–Sequential access file-Random access file – Command line arguments	7+2(P)
	TOTAL INSTRUCTIONAL HOURS	45

S.No	List of Experiments
1	Programs using I/O statements and expressions
2	Write a program to find whether the given year is leap year or Not
3	Design a calculator to perform the operations, namely, addition, subtraction, multiplication and division
4	Write a program to find Sum of Digits of two number
5	Check whether a given number is Armstrong number or not
6	Write a program to find addition of two Matrix.
7	Write a program for compute transpose of a matrix.
8	Write a program to find Palindrome of a given String
9	Find a factorial of a number using recursion
10	Sort the list of numbers using pass by reference
11	Compute internal marks of students for five different subjects using structures
12	Generate salary slip of employees
13	Write a program to copy the content of file to another file
14	Find the total number of characters, words and lines in given file.
15	Write a program to swap operation using command line arguments for input
Course Outcome	At the end of the course, the learner will be able to CO1: Develop simple algorithms for arithmetic and logical problems. CO2: Test and execute the programs and correct syntax and logical errors. CO3: Implement conditional branching, iteration and recursion. CO4: Decompose a problem into functions and synthesize a complete program and use arrays, pointers, strings and structures to formulate algorithms and programs. CO5: Use files to perform read and write operations

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TEXT BOOKS:
T1:Balagurusamy, "Programming in ANSI C", Tata McGraw, 7th Edition, 2001. ISBN 13:9789339219666
T2: Behrouz A. Forouzan, Richard F. Gilberg, J. Jaya, S. Shankar, I. Jasmine SelvakumariJeya, M. Ramya Devi, "Computer Programming in C", Cengage Learning, 2022.
T3: Byron Gottfried, "Programming with C", Schaum's Outlines Series, McGraw Hill Education, 3rd edition, 2017.

REFERENCE BOOKS:
R1: Schildt Herbert, "C: The Complete Reference", Tata McGraw Hill Education, 4th edition, 2014.
R2: R. S. Bichkar, "Programming with C", Universities Press, 2nd edition 2012.
R3: YashvantKanetkar, "Exploring C", BPB Publishers, 2nd edition, 2003.
R4: W. Kernighan Brian, Dennis M. Ritchie, "The C Programming Language", PHI Learning, 2nd edition, 1988

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Programme	Course Code	Name of the Course	L	T	P	C
B.E/B.Tech	22ME2001	**ENGINEERING PRACTICES (Common to all branches)**	0	0	4	2

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

Unit — **Description of the Experiments**

GROUP A (CIVILAND MECHANICAL)

1. Preparation of Single pipe line and Double pipe line connection by using valves, taps, couplings, unions, reducers and elbows.
2. Arrangement of bricks using English Bond for one brick thick wall for right angle corner junction and T- junction
3. Arrangement of bricks using English Bond for one and a half brick thick wall for right angle corner and T- junction
4. Preparation of arc welding of Butt joints, Lap joints and Tee joints.
5. Practice on sheet metal Models– Trays and funnels
6. Hands-on-exercise in wood work, joints by sawing, planning and cutting.
7. Practice on simple step turning, taper turning and drilling.
8. Demonstration on Smithy operation.
9. Demonstration on Foundry operation.
10. Demonstration on Power tools.

GROUP B (ELECTRICAL ENGINEERING)

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring.
4. Measurement of Electrical quantities – voltage, current, power & power factor in single phase circuits.
5. Measurement of energy using single phase energy meter.
6. Soldering practice using general purpose PCB.
7. Measurement of Time, Frequency and Peak Value of an Alternating Quantity using CRO and Function Generator.
8. Study of Energy Efficient Equipment's and Measuring Instruments.

Total Instructional Hours 45

Course Outcome
- Fabricate wooden components and pipe connections including plumbing works.
- Fabricate simple weld joints.
- Fabricate different electrical wiring circuits and understand the AC Circuits.

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS0 1	PS0 2
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	1	1	-	-	-	-	1
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AVG	3	-	-	-	-	-	-	1	1	-	-	-	-	1

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Programme	Course Code	Name of the Course	L	T	P	C
B.E/ B.TECH	22HE2071	DESIGN THINKING	2	0	0	2

Course Objective	**The student should be able to** 1. To expose students to the design process 2. To develop and test innovative ideas through a rapid iteration cycle. 3. To provide an authentic opportunity for students to develop teamwork and leadership skills	
Unit	**Description**	**Instructional Hours**
I	**DESIGN ABILITY** Asking Designers about what they Do – Deconstructing what Designers Do – Watching what Designers Do – Thinking about what Designers Do – The Natural Intelligence of Design Sources	6
II	**DESIGNING TO WIN** Formula One Designing – Radical Innovations – City Car Design – Learning From Failures – Design Process and Working Methods	5
III	**DESIGN TO PLEASE AND DESIGNING TOGETHER** Background – Product Innovations – Teamwork versus Individual work – Roles and Responsibilities – Avoiding and Resolving Conflicts.	6
IV	**DESIGN EXPERTISE** Design Process – Creative Design - Design Intelligence – Development of Expertise – Novice to Expert. Critical Thinking – Case studies: Brief history of Albert Einstein, Isaac Newton and Nikola Tesla	6
V	**DESIGN THINKING TOOLS AND METHODS** Purposeful Use of Tools and Alignment with Process - Journey Mapping - Value Chain Analysis - Mind Mapping – Brainstorming - Design Thinking Application: Design Thinking Applied to Product Development	7
	Total Instructional Hours	30
Course Outcome	**After completion of the course the learner will be able to** CO1: Develop a strong understanding of the Design Process CO2: Learn to develop and test innovative ideas through a rapid iteration cycle. CO3: Develop teamwork and leadership skills	

TEXT BOOKS:

T1 - 1. Nigel Cross, "Design Thinking", Kindle Edition.

REFERENCE BOOKS:

R1 - Tom Kelley, "Creative Confidence", 2013.
R2 - 3. Tim Brown, "Change by Design", 2009.

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CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	3	1	3	2	1	-	-	2	-	-	1	1	-
CO2	3	2	1	3	2	3	-	1	2	-	-	2	1	1
CO3	3	3	1	3	2	1	-	1	2	-	-	1	1	1
CO4	3	2	1	3	-	1	-	1	-	-	-	2	1	1
CO5	3	1	1	3	2	2	-	-	2	-	-	1	1	-
AVG	3	2	1	3	2	2	-	1	2	-	-	1	1	1

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Programme	Course Code	Name of the Course	L	T	P	C
B.E/ B.TECH	22HE2072	SOFT SKILLS AND APTITUDE	1	0	0	1

Course Objective	**The student should be able to** 1. To develop and nurture the soft skills of the students through instruction, knowledge acquisition demonstration and practice. 2. To enhance the student's ability to deal with numerical and quantitative skills. 3. To identify the core skills associated with critical thinking. 4. To develop and integrate the use of English language skills

Unit	Description	Instructional Hours
I	**Lessons on excellence** Skill introspection, Skill acquisition, consistent practice	2
II	**Logical Reasoning** Problem Solving - Critical Thinking- Lateral Thinking - Coding and Decoding – Series – Analogy - Odd Man Out - Visual Reasoning - Sudoku puzzles - Attention to detail	10
III	**Quantitative Aptitude** Addition and Subtraction of bigger numbers - Square and square roots - Cubes and cube roots - Vedic maths techniques - Multiplication Shortcuts - Multiplication of 3 and higher digit numbers – Simplifications - Comparing fractions - Shortcuts to find HCF and LCM - Divisibility tests shortcuts - Algebra and functions	10
IV	**Recruitment Essentials** Resume Building - Impression Management	4
V	**Verbal Ability** Nouns and Pronouns – Verbs - Subject-Verb Agreement - Pronoun-Antecedent – Agreement - Punctuations	4
	Total Instructional Hours	**30**

Course Outcome	**After completion of the course the learner will be able to** CO1: Students will analyze interpersonal communication skills. public speaking skills. CO2: Students will exemplify tautology, contradiction and contingency by logical thinking. CO3: Students will be able to develop an appropriate integral form to solve all sorts of quantitative problems. CO4: Students can produce a resume that describes their education, skills, experiences and measurable achievements with proper grammar. format and brevity CO5: Students will be developed to acquire the ability to use English language with an error while making optimum use of grammar.

REFERENCE BOOKS:

R1 - Quantitative Aptitude – Dr. R S Agarwal
R2 -Speed Mathematics: Secret Skills for Quick Calculation - Bill Handley
R3 -Verbal and Non – Verbal Reasoning – Dr. R S Agarwal
R4- Objective General English – S.P.Bakshi

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	பாடநெறி குறியீடு	பாடத்தின் பெயர்	L	T	P	C
பி.இ/ க	22MC2094/2095	தமிழரும்தொழில்நுட்பமும் (முதலாம் ஆண்டு பி.இ பொது பாடப்பிரிவு)	2	0	0	0

பாடத்தின் நோக்கம்	கற்றவர்இயலவேண்டும் 1. சங்க காலத்தில் தொழில்துறை பற்றிய அறிவைப் பெறுதல். 2. சங்க காலத்தில் வீட்டின் பொருள் சிற்பங்கள் மற்றும் கோவில்கள் வடிவமைப்பு பற்றி கூட்டு கற்றல் 3. வரலாறு மற்றும் தொல்லியல் சான்றுகளின் ஆதாரமாக உலோகவியல் ஆய்வுகளில் அறிவை வளர்த்துக் கொள்ளுங்கள். 4. வேளாண்மை மற்றும் வேளாண் செயலாக்கத்தில் பயன்படுத்தப்படும் பண்டைய நுட்பங்களைப் பற்றிய அறிவைப் பெறுதல். 5. தமிழ் மொழியின் மென்பொருள் பற்றி அறிதல்

அலகு	விளக்கம்	பயிற்சிநேரம்
I	**நெசவுமற்றும்பானைத்தொழில்நுட்பம்** சங்க காலத்தில் நெசவுத் தொழில் - பானைத் தொழில்நுட்பம்-கருப்பு சிவப்பு பாண்டங்கள் - பாண்டங்களில் கீறல் குறியீடுகள்.	3
II	**வடிவமைப்புமற்றும்கட்டிடத்தொழில்நுட்பம்** சங்க இலக்கியத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் மற்றும்சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு -சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும்- சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும் கோவில்களும் - சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிப்பாடுத் தளங்கள் - நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் - செட்டி நாட்டு வீடுகள் - பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ-சாரோச்செனிக் கட்டிடக் கலை.	3
III	**உற்பத்தி தொழில்நுட்பம்** கப்பல் கட்டும் கலை உலோகவியல் - இரும்புத் தொழிற்சாலை - இரும்பை உருகுதல் எஃகு - வரலாற்றுசாலை சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் - நாணயங்கள் அச்சடித்தல் - மணி உருவாக்கும் தொழிற்சாலைகள் - கல்மணிகள் - கண்ணாடிமணிகள் - சுடுமண் மணிகள் - சங்கு மணிகள் - எலும்புத்துண்டுகள் - தொல்லியல் சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின்வகைகள்	3
IV	**வேளாண்மைமற்றும்நீர்பாசனத்தொழில்நுட்பம்** அணை, ஏரி, குளங்கள், மதகு - சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு - கால்நடைகளுக்காக வடிவமைக்க பட்ட கிணறுகள் - வேளாண்மை மற்றும் வேளாண்மை சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு - மீன்வளம் - முத்து மற்றும் முத்துக்குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசார் சமூகம்.	3
V	**அறிவியல்தமிழ்மற்றும்கணித்தமிழ்** அறிவியல் தமிழின் வளர்ச்சி - கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம் - தமிழ் இணைய கல்விக்கழகம் - தமிழ் மின் நூலகம் - இணையத்தில் தமிழ் அகராதிகள் - சொற்குவைத் திட்டம்	3
	மொத்தபயிற்றுவிக்கும்நேரம்	**15**

பாடத்தின்முடிவு	பாடநெறியின்முடிவில்கற்றவர்கற்றபின் பா மு1 பண்டைய தொழில்நுப்பதை அடையாளம் கொள்ள தெரியும் பா மு2 சங்க கால கட்டுமானப் பொருட்கள்- சிற்ப வகைகளை வேறுபடுத்த முடியும் பா மு3 வரலாறு மற்றும் தொல்லியல் சான்றுகளின் ஆதாரமாக உலோகவியல் ஆய்வுகளில் பட்டியலிட்டு அடையாளம் காண முடியும் பா மு4 விவசாயம் மற்றும் வேளாண் செயலாக்கத்தில் பயன்படுத்தப்படும் பழங்கால நுட்பங்களைப் பற்றி விளக்கத்துடன் நிரூபிக்க முடியும் பா மு5 தமிழ் மொழியின் புதிய மென்பொருள் பற்றி உருவாக்கக் கூடிய திறன் மேம்படுத்துதல்.

உரைபுத்தகங்கள்

உ1 தமிழக வரலாறு - மக்களும் பண்பாடும் - கே கே பிள்ளை (வெளியீடு தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
உ2 எஸ்.கே சிங், இடைக்கால இந்தியாவின் வரலாறு, புது தில்லி ஆக்சிஸ் புக்ஸ் பிரைவேட் லிமிடெட், 2013

குறிப்புகள்

கு1 கணிதத்தமிழ் -முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்)
கு2 கீழடி வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு

ஆய்வுவாரிய தலைவர்
Chairman - ECE - HiCET

Chairman

டீன் கல்வியாளர் / முதல்வர்
Dean (Academics) HiCET

Programme	Course Code	Name of the Course	L	T	P	C
B.E/ B.TECH	22MC2094/2095	TAMILS AND TECHNOLOGY	2	0	0	1

Course Objective	To Acquiring knowledge of industry during the Sangam Period. To Collaborate learning about house design, sculpture and temples during Sangam Period. To Develop Knowledge in metallurgical studies as a source of historical and archaeological evidence. To Acquiring knowledge about ancient techniques used in agriculture and agro processing To Interpret Knowledge of Tamil language literature.	
Unit	Description	Instructional Hours
I	**WEAVING AND CERAMIC TECHNOLOGY** Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.	6
II	**DESIGN AND CONSTRUCTION TECHNOLOGY** 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.	5
III	**MANUFACTURING TECHNOLOGY** 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.	6
IV	**AGRICULTURE AND IRRIGATION TECHNOLOGY** 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.	6
V	**SCIENTIFIC TAMIL & TAMIL COMPUTING** 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.	7
	Total Instructional Hours	30
Course Outcome	**After completion of the course the learner will be able to** CO1:Recognize ancient business CO2: Distinguish Sangam period building material and types of sculpture. CO3: Identify the source of historical and archaeological CO4: Demonstrate the techniques used in agriculture and agro processing. CO5:Understand the new software of Tamil language.	

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CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	3	-	-	-	-	-	2	-	-	2
CO2	2	3	3	-	-	-	-	-	2	-	-	2
CO3	2	3	3	-	-	-	-	-	2	-	-	2
CO4	2	3	-	-	-	-	-	-	2	-	-	2
CO5	2	3	-	-	-	-	-	-	2	-	-	2
AVG	2	3	3	-	-	-	-	-	2	-	-	2

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Programme	Course Code	Name of the Course	L	T	P	C
BE/BTECH	22MC2093	SOCIAL SERVICES AND COMMUNITY DEVELOPMENT	1	0	0	1
Course Objectives	To Acquire the knowledge and active participate in social service and community development activities. To Understand the concept of disaster management and role of NCC cadets in disaster management. To Understand the concept thinking and reasoning process. To Understand about maps and use of bearing and service protector To Know about the principles of flight and Aero foil structure and ATC procedures.					

Unit	Description	Instructional Hours
I	**SOCIAL SERVICES AND COMMUNITY DEVELOPMENT** Basics of social services and its need - Rural development programs - Contribution of youth towards social welfare - NGOs in social services Swach bharath Abhiyan - Social evils - Mission Indradanush – Betibacho Betipado - Digital awareness - Constitution day.	3
II	**DISASTER MANAGEMENT** Organization of Disaster management -Types of emergencies - Natural and manmade disasters - fire service and fire fighting - prevention of fire.	3
III	**PERSONALITY DEVELOPMENT** Introduction to personality development - public speaking Intra and Inter personal skills -self awareness - critical thinking - Decision making and problem solving.	3
IV	**MAP READING** Types of maps - conventional signs - scales and Grid system - relief and contour gradient - cardinal points - Types of North - types of bearing and use of service protector - Prismatic compass and its uses - setting of map - finding North and own position.	3
V	**PRINCIPLES OF FLIGHT AND AIRMANSHIP** Introduction to principle of flight - Forces acting on the aircraft - Angle of attack - Angle of incidence - Newton's - law of motion - Bernauli's theorem and Venturi effect - Aerofoil - Airfield layout - ATC (Air Traffic Control) - circuit procedures - Aviation medicine.	3
	Total Instructional Hours	15
Course Outcome	**After completion of the course the learner will be able to** CO1: Perform the social services on various occasions for better community and social life CO2: Appreciate the need and requirement for disaster management and NCC role in disaster management activities. CO3: Define thinking, reasoning, critical thinking and creative thinking CO4: Use of bearing and service protector and locate the places and objects on the ground. CO5: Understand the principles of flight and Aerofoil structure	

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Text Books:

1. NCC cadet Guide (SD/SW) Army
2. NCC cadet Guide (SD/SW) Airforce.
3. ANOs Guide (SD/SW) by DG NCC, Ministry of Defence, New Delhi
4. Digital Forum App 1.0 & 2.0, by DG NCC DG NCC, Ministry of Defence, New Delhi

Reference Books:

1. UGC and AICTE circulated syllabus

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(An Autonomous Institution)

Coimbatore– 641032

DEPARTMENT OF ELECTRONICS AND COMMUNICATION

CURRICULUM & SYLLABUS

AY-2023-2024

Batch: 2023-2027

REGULATIONS 2022

SEMESTER I											
S. NO	COURSE CODE	COURSE TITLE	COURSE CATEGORY	L	T	P	C	TCP	CIA	ESE	TOTAL
THEORY											
1	22MA1101	MATRICES AND CALCULUS	BSC	3	1	0	4	4	40	60	100
THEORY WITH LAB COMPONENT											
2	22CY1151	CHEMISTRY FOR CIRCUIT ENGINEERING	BSC	2	0	2	3	4	50	50	100
3	22HE1151	ENGLISH FOR ENGINEERS	HSC	2	0	2	3	4	50	50	100
4	22EC1151	ELECTRON DEVICES	ESC	2	0	2	3	4	50	50	100
5	22IT1151/ 22CS1152	PYTHON PROGRAMMING AND PRACTICES/ OBJECT ORIENTED PROGRAMMING USING PYTHON (IBM STUDENTS ONLY)	ESC/ICC	2	0	2	3	4	50	50	100
EEC COURSES (SE/AE)											
6	22HE1071	UHV	AEC	2	0	0	2	3	40	60	100
7	22HE1072	ENTREPRENEURSHIP & INNOVATION	AEC	1	0	0	1	1	100	0	100
MANDATORY COURSE											
8	22MC1091/ 22MC1092	தமிழரும்தொழில்நுட்பமும்/Indian Constitution	MC	2	0	0	0	2	100	0	100
			TOTAL	**16**	**1**	**8**	**19**	**26**	**480**	**320**	**800**

SEMESTER II											
S. NO	COURSE CODE	COURSE TITLE	COURSE CATEGORY	L	T	P	C	TCP	CIA	ESE	TOTAL
THEORY											
1	22MA2102	DIFFERENTIAL EQUATIONS AND LAPLACE TRANSFORM	BSC	3	1	0	4	4	40	60	100
2	22CY2101	ENVIRONMENTAL STUDIES	ESC	2	0	0	2	3	40	60	100
3	22PH2101	BASICS OF MATERIAL SCIENCE	BSC	2	0	0	2	3	40	60	100
THEORY WITH LAB COMPONENT											
4	22PH2151	PHYSICS FOR CIRCUIT ENGINEERING PROGRAMME	BSC	2	0	2	3	4	50	50	100
5	22HE2151	EFFECTIVE TECHNICAL COMMUNICATION	HSC	2	0	2	3	4	50	50	100
6	22CS2255	PROGRAMMING USING C	PCC	2	0	2	3	4	50	50	100
	22CS2253	JAVA FUNDAMENTALS (IBM STUDENTS ONLY)	ICC								
PRACTICAL											
7	22ME2001	ENGINEERING PRACTICES	ESC	0	0	4	2	2	60	40	100
EEC COURSES (SE/AE)											
8	22HE2071	DESIGN THINKING	AEC	1	0	2	2	2	100	0	100

10	22MC2091 22MC2092	□□□□□□□□□□□/ **Heritage of Tamils**	MC	2	0	0	0	2	100	0	100
11	22MC2093	NCC */NSS / YRC / SPORTS / CLUBS / SOCIETY SERVICE - ENROLLMENT (COMMON)	MC	All students shall enroll, on admission, in anyone of the personality and character development programmes and undergo training for about 80 hours							
			TOTAL	**17**	**1**	**12**	**22**	**29**	**630**	**370**	**1000**

SEMESTER III											
S.NO	**COURSECODE**	**COURSETITLE**	**COURSE CATEGORY**	**L**	**T**	**P**	**C**	**TCP**	**CIA**	**ESE**	**TOTAL**
THEORY											
1	22MA3102	COMPLEX ANALYSIS AND TRANSFORMS (common to ECE, EEE, EIE)	BSC	3	1	0	4	4	40	60	100
2	22EC3201	ELECTRONIC CIRCUITS	PCC	3	0	0	3	3	40	60	100
3	22EC3202	SIGNALS AND SYSTEMS	PCC	3	0	0	3	3	40	60	100
4	22EC3203	DIGITAL ELECTRONICS	PCC	3	0	0	3	3	40	60	100
5	22EC3204	CIRCUITS AND NETWORKS	ESC	2	0	0	2	3	100	-	100
THEORY WITH LAB COMPONENT											
6	22EC3251	OOPS USING JAVA	ESC	2	0	2	3	3	50	50	100
PRACTICAL											
7	22EC3001	ELECTRONIC CIRCUITS LABORATORY	PCC	0	0	3	1.5	3	60	40	100
8	22EC3002	DIGITAL ELECTRONICS LABORATORY	PCC	0	0	3	1.5	3	60	40	100
EEC COURSES (SE/AE)											
9	22HE3071	SOFT SKILLS -2	SEC	1	0	0	1	1	100	0	100
10	22EC3901	MINI PROJECT 1	AEC	0	0	0	2	1	100	0	100
11	22MC3191	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	MC	2	0	0	0	2	100	0	100
			TOTAL	**19**	**1**	**8**	**24**	**29**	**730**	**370**	**1100**

SEMESTER IV											
S.NO	**COURSE CODE**	**COURSE TITLE**	**COURSE CATEGORY**	**L**	**T**	**P**	**C**	**TCP**	**CIA**	**ESE**	**TOTAL**
THEORY											
1	22HE4101	IPR AND START-UPS	HSC	2	0	0	2	2	40	60	100
2	22EC4201	ELECTRO MAGNETIC FIELDS	PCC	3	0	0	3	3	40	60	100
3	22EC4202	ANALOG COMMUNICATION	PCC	3	0	0	3	3	40	60	100
4	22EC4203	LINEAR INTEGRATED CIRCUITS	PCC	3	0	0	3	3	40	60	100
5	22EC4304	TRANSMISSION LINES AND WAVEGUIDES	PCC	3	0	0	3	3	40	60	100

THEORY WITH LAB COMPONENT											
6	22EC4251	CONTROL SYSTEM	PCC	2	0	2	3	3	50	50	100
7	22EC4253	DATA COMMUNICATION AND NETWORKS	PCC	2	0	2	3	3	50	50	100
PRACTICAL											
8	22EC4001	LINEAR INTEGRATED CIRCUITS LAB	PCC	0	0	3	1.5	3	60	40	100
9	22EC4002	ANALOG COMMUNICATION LAB	PCC	0	0	3	1.5	3	60	40	100
EEC COURSES (SE/AE)											
10	22HE4071	SOFT SKILLS -3	SEC	1	0	0	1	1	100	0	100
11	22MC4091	INDIAN CONSTITUTION	MC	2	0	0	0	2	100	0	100
			TOTAL	**21**	**0**	**10**	**24**	**29**	**620**	**480**	**1100**

SEMESTER V

S.NO	COURSE CODE	COURSE TITLE	COURSE CATEGORY	L	T	P	C	TCP	CIA	ESE	TOTAL
THEORY											
1	22EC5201	DIGITAL COMMUNICATION	PCC	3	0	0	3	3	40	60	100
2	22EC5202	ANTENNA AND WAVE PROPAGATION	PCC	3	1	0	4	3	40	60	100
3	22EC5203	MICROPROCESSORS AND MICROCONTROLLERS	PCC	3	0	0	3	3	40	60	100
4	22EC53XX	PROFESSIONAL ELECTIVE-1	PEC	3	0	0	3	3	40	60	100
5	22EC53XX	PROFESSIONAL ELECTIVE-2	PEC	3	0	0	3	3	40	60	100
6	22EC53XX	PROFESSIONAL ELECTIVE-3	PEC	3	0	0	3	3	40	60	100
PRACTICAL											
7	22EC5001	MICROPROCESSORS AND MICROCONTROLLERS LAB	PCC	0	0	3	1.5	3	60	40	100
8	22EC5002	DIGITAL COMMUNICATION LAB	PCC	0	0	3	1.5	3	60	40	100
EEC COURSES (SE/AE)											
9	22HE5071	SOFT SKILLS -4 / FOREIGN LANGUAGES	SEC	1	0	0	1	1	100	0	100
			TOTAL	**19**	**1**	**6**	**23**	**25**	**460**	**440**	**900**

SEMESTER VI

S.NO	COURSE CODE	COURSE TITLE	COURSE CATEGORY	L	T	P	C	TCP	CIA	ESE	TOTAL
THEORY											
1	22HS6101	PROFESSIONAL ETHICS	HSC	3	0	0	3	3	40	60	100
2	22EC6201	EMBEDDED SYSTEMS AND IOT	PCC	3	0	0	3	3	40	60	100
3	22EC63XX	PROFESSIONAL ELECTIVE-4	PEC/ICC	3	0	0	3	3	40	60	100
4	22EC63XX	PROFESSIONAL ELECTIVE-5	PEC/ICC	3	0	0	3	3	40	60	100

5	22EC64XX	OPEN ELECTIVE – 1*	OEC	3	0	0	3	3	40	60	100
		THEORY WITH LAB COMPONENT									
6	22EC6253	DIGITAL SIGNAL PROCESSING	PCC	2	0	2	3	4	50	50	100
7	22EC6254	VLSI DESIGN	PCC	2	0	2	3	4	50	50	100
		EEC COURSES (SE/AE)									
8	22EC6901	MINI PROJECT 2	AEC	0	0	0	2	1	100	0	100
			TOTAL	**19**	**0**	**4**	**23**	**26**	**400**	**400**	**800**

SEMESTER VII

S.NO	COURSE CODE	COURSE TITLE	COURSE CATEGORY	L	T	P	C	TCP	CIA	ESE	TOTAL
		THEORY									
1	22EC7201	WIRELESS COMMUNICATION NETWORKS	PCC	3	0	0	3	3	40	60	100
2	22EC7202	MOBILE COMMUNICATION	PCC	3	0	0	3	3	40	60	100
3	22EC7203	AUTOMATIVE ELECTRONICS	PCC	3	0	0	3	3	40	60	100
4	22EC73XX/ 22EC7351	PROFESSIONAL ELECTIVE-6	PEC/ICC	3	0	0	3	3	40	60	100
5	22EC74XX	OPEN ELECTIVE – 2*	OEC	3	0	0	3	3	40	60	100
		THEORY WITH LAB COMPONENT									
6	22EC7001	OPTICAL COMMUNICATION AND MICROWAVE ENGINEERING	PCC	2	0	2	3	4	50	50	100
		EEC COURSES (SE/AE)									
7	22EC7901	INTERNSHIP	AEC	-	-	-	2	1	100	0	100
			TOTAL	**17**	**0**	**2**	**20**	**20**	**350**	**350**	**700**

SEMESTER VIII

S.NO	COURSE CODE	COURSE TITLE	COURSE CATEGORY	L	T	P	C	TCP	CIA	ESE	TOTAL
		EEC COURSES (SE/AE)									
1	22EC8901	PROJECT WORK/GRANTED PRODUCT PATENT	AEC	0	0	20	10	20	100	100	200
			TOTAL	**0**	**0**	**20**	**10**	**20**	**100**	**100**	**200**

Note:

1. *As per the AICTE guideline, in Semesters I, II, III & IV NCC one credit subject is added as Value Added Course with Extra Credit. Further, the students who enrolled his/her name in HICET NCC and Air Wing are eligible to undergo this subject. The earned extra credits printed in the Consolidated Mark sheet as per the regulation.
2. NCC course level 1 & Level 2 will be added in the list of open elective subjects in the appropriate semester. Further, the students' who have opted NCC subjects in Semester I, II, III & IV are eligible to undergo NCC Open Elective Subjects.
3. The above-mentioned NCC Courses will be offered to the students who are going to be admitted in the Academic Year 2021 – 22 onwards.

SEMESTER WISE CREDIT DISTRIBUTION

B.E. / B.TECH. PROGRAMMES										
S.No.	**Course Area**	**Credits per Semester**								**Total Credits**
		I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	
1	HSC	3	3	-	2	-	3	-	-	**11**
2	BSC	7	9	4	-	-	-	-	-	**20**
3	ESC	6	4	5	-	-	-	-	-	**15**
4	PCC	-	3	12	21	13	9	9	-	**67**
5	PEC	-	-	-	-	9	6	3	-	**18**
6	OEC	-	-	-	-	-	3	6	-	**9**
7	EEC	3	3	3	1	1	2	2	10	**25**
8	MC	✓	✓							
	Total	**19**	**22**	**24**	**24**	**23**	**23**	**20**	**10**	**165**

Credit Distribution R2022

Semester	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**Total**
Credits	19	22	24	24	23	23	20	10	**165**

LIST OF INDUSTRIAL CORE COURSES

S. No.	CODE	Courses	CAT	L	T	P	C	CIA	ESE	TOTAL
1	22CS1152	Object Oriented Programming using Python	ICC	2	0	2	3	50	50	100
2	22CS2153	Java Fundamentals	ICC	2	0	2	3	50	50	100
3	22EC3252	Relational Database Management System	ICC	2	0	2	3	50	50	100
4	22EC4252	Design Thinking-An Introduction	ICC	2	0	2	3	50	50	100
5	22EC5251	Angular JS	ICC	2	0	2	3	50	50	100
6	22EC6251	Node JS and Micro services	ICC	2	0	2	3	50	50	100
7	22EC6252	IoT and Spring Framework	ICC	2	0	2	3	50	50	100
8	22EC7251	Blockchain	ICC	2	0	2	3	50	50	100

PROFESSIONAL ELECTIVES

Vertical 1 Electronic System Design	Vertical 2 Communication Systems	Vertical 3 Wireless Networks	Vertical 4 Signal and Image Processing	Vertical 5 Biomedical Technologies	Vertical 6 Diversified Courses
Foundation Skills in Integrated Product Development	Satellite Communication	Network Security	Digital Image Processing	Medical Electronics	App Development
Measurements and Instrumentation	Global Positioning Systems	Wireless Sensors and Networks	Audio Signal Processing	Medical Informatics	Web Technologies
IoT Based System Design	Under Water Communication	High Speed Networks	Machine Vision	Medical Image Processing	Ethical Hacking
PCB Design	RF System Design	Cloud Computing	Artificial Intelligence and Machine Learning	Biometric Systems	Cryptocurrency and Blockchain Technologies
ASIC Design	Software Defined Radio	Wireless Broad Band Networks	Neural Networks and Deep Learning	Medical Robotics	3D Printing and Design
Introduction to PLC Programming	Radar Technologies	Cyber Forensics	Virtual Reality and Augmented Reality	Human Computer Interface	4G/5G Communication Networks

PROFESSIONAL ELECTIVE COURSES: VERTICALS

Vertical 1
Electronic System Design

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1.	22EC5301	Foundation Skills in Integrated Product Development	PEC1	3	0	0	3	3
2.	22EC5302	Measurements and Instrumentation	PEC2	3	0	0	3	3
3.	22EC5303	IoT Based System Design	PEC3	3	0	0	3	3
4.	22EC6301	PCB Design	PEC4	3	0	0	3	3
5.	22EC6302	ASIC Design	PEC5	3	0	0	3	3
6.	22EC7301	Introduction to PLC Programming	PEC6	3	0	0	3	3

Vertical 2
Communication Systems

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1.	22EC5304	Satellite Communication	PEC1	3	0	0	3	3

2.	22EC5305	Global Positioning Systems	PEC2	3	0	0	3	3
3.	22EC5306	Under Water Communication	PEC3	3	0	0	3	3
4.	22EC6303	RF System Design	PEC4	3	0	0	3	3
5.	22EC6304	Software Defined Radio	PEC5	3	0	0	3	3
6.	22EC7302	Radar Technologies	PEC6	3	0	0	3	3

Vertical 3

Wireless Networks

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1.	22EC5307	Network Security	PEC1	3	0	0	3	3
2.	22EC5308	Wireless Sensors and Networks	PEC2	3	0	0	3	3
3.	22EC5309	High Speed Networks	PEC3	3	0	0	3	3
4.	22EC6305	Cloud Computing	PEC4	3	0	0	3	3
5.	22EC6306	Wireless Broad Band Networks	PEC5	3	0	0	3	3
6.	22EC7303	Cyber Forensics	PEC6	3	0	0	3	3

Vertical 4

Signal and Image Processing

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1.	22EC5310	Digital Image Processing	PEC1	3	0	0	3	3
2.	22EC5311	Audio Signal Processing	PEC2	3	0	0	3	3
3.	22EC5312	Machine Vision	PEC3	3	0	0	3	3
4.	22EC6307	Artificial Intelligence and Machine Learning	PEC4	3	0	0	3	3
5.	22EC6308	Neural Networks and Deep Learning	PEC5	3	0	0	3	3
6.	22EC7304	Virtual Reality and Augmented Reality	PEC6	3	0	0	3	3

Vertical 5

Biomedical Technologies

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1.	22EC5311	Medical Electronics	PEC1	3	0	0	3	3
2.	22EC5312	Medical Informatics	PEC2	3	0	0	3	3
3.	22EC5313	Medical Image Processing	PEC3	3	0	0	3	3
4.	22EC6309	Biometric Systems	PEC4	3	0	0	3	3

5.	22EC6310	Medical robotics	PEC5	3	0	0	3	3
6.	22EC7305	Human Computer Interface	PEC6	3	0	0	3	3

Vertical 6

Diversified courses

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1.	22EC5314	App Development	PEC1	3	0	0	3	3
2.	22EC5315	Web Technologies	PEC2	3	0	0	3	3
3.	22EC5316	Ethical Hacking	PEC3	3	0	0	3	3
4.	22EC6311	Cryptocurrency and Blockchain Technologies	PEC4	3	0	0	3	3
5.	22EC6312	3D Printing and Design	PEC5	3	0	0	3	3
6.	22EC7306	4G/5G Communication Networks	PEC6	3	0	0	3	3

OPEN ELECTIVE I
(VI SEMESTER – COMMON LIST FOR ALL THE PROGRAMS)
(EMERGING TECHNOLOGIES)

Students must choose an open elective course from the given list. The content of the course should not be related to their current program of study.

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	Strength
				L	T	P			
1	22AI6401	Artificial Intelligence and Machine Learning Fundamentals	OEC	3	0	0	3	3	65
2	22CS6401	Block chain Technology Fundamentals	OEC	3	0	0	3	3	130
3	22EC6402	IoT Concepts and Applications	OEC	3	0	0	3	3	130
4	22IT6401	Data Science and Analytics Fundamentals	OEC	3	0	0	3	3	130
5	22BM6401	3D printing	OEC	3	0	0	3	3	65
6	22AE6401	Space Science	OEC	3	0	0	3	3	65
7	22MT6401	Introduction to Industrial Engineering	OEC	3	0	0	3	3	65
8	22MT6402	Industrial Safety and Environment	OEC	3	0	0	3	3	65
9	22CE6401	Climate Change and its Impact	OEC	3	0	0	3	3	65
10	22CE6402	Environment and Social Impact Assessment	OEC	3	0	0	3	3	65
11	22ME6401	Renewable Energy System	OEC	3	0	0	3	3	65
12	22ME6402	Additive Manufacturing systems	OEC	3	0	0	3	3	65

13	22EI6401	Introduction to Industrial Instrumentation and Control	OEC	3	0	0	3	3	65
14	22AU6401	Basics of Automobile Engineering	OEC	3	0	0	3	3	65
15	22EE6401	Fundamentals of Electric vehicles	OEC	3	0	0	3	3	65
16	22FT6401	Traditional Foods	OEC	3	0	0	3	3	65
17	22AG6401	Urban Agriculture and Organic Farming	OEC	3	0	0	3	3	65
18	22CH6401	Waste to Energy conversion	OEC	3	0	0	3	3	65
19		NCC Level - I	OEC	3	0	0	3	3	65

OPEN ELECTIVE II
(VII SEMESTER - COMMON LIST FOR ALL THE PROGRAMS)
LIFE SKILL COURSES

Students shall choose any one of the Life Skill courses from the open elective courses listed below.

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTAC T PERIODS	CREDITS	Strength
				L	T	P			
1	22LS7401	General studies for competitive examinations	OEC	3	0	0	3	3	130
2	22LS7402	Human Rights, Women Rights and Gender equity	OEC	3	0	0	3	3	130
3	22LS7403	Indian ethos and Human values	OEC	3	0	0	3	3	130
4	22LS7404	Financial independence and management	OEC	3	0	0	3	3	130
5	22LS7405	Yoga for Human Excellence	OEC	3	0	0	3	3	130
6	22LS7406	Democracy and Good Governance	OEC	3	0	0	3	3	130
7	22LS7407	NCC Level - II	OEC	3	0	0	3	3	130
8	22LS7408	Cybercrime and Awareness	OEC	3	0	0	3	3	130
9	22LS7409	First Aid and Emergency care	OEC	3	0	0	3	3	130
10	22LS7410	Business Communication	OEC	3	0	0	3	3	130

Enrollment for B.E. / B. TECH. (HONOURS) / Minor Degree (optional)

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E. / B. Tech. (Honours) or Minor Degree. For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only. For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes.

Clause 4.10 of Regulation 2022 is applicable for the Enrolment of B.E. / B. TECH. (HONOURS) / Minor Degree (Optional).

HONOUR DEGREE VERTICAL COURSES

S. No.	Vertical-I Sensor Technologies and IoT	Vertical II Advanced Communication Systems	Vertical III Semiconductor Chip Design and Testing
1	Realtime Embedded Systems	Cognitive Radio Networks	Wide Bandgap Devices
2	Sensor for IoT applications	Remote Sensing	Validation and Testing Technology
3	Advanced Processor Architectures	Rocketry and Space Mechanics	Low Power VLSI
4	IOT Processors	Underwater Navigation Systems	VLSI Testing and Design for Testability
5	Wearable Devices	Massive MIMO Networks	Mixed Signal IC Design Testing
6	Industrial IoT and Industry 4.0	Advanced Wireless Communication Techniques	Analog IC Design

Vertical-I
Sensor Technologies and IoT

S No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
1	22EC5305	Realtime Embedded Systems	HDC	3	0	0	3	40	60	100
2	22EC6305	Sensor for IoT applications	HDC	3	0	0	3	40	60	100
3	22EC6306	Advanced Processor Architectures	HDC	3	0	0	3	40	60	100
4	22EC7304	IOT Processors	HDC	3	0	0	3	40	60	100
5	22EC7305	Wearable Devices	HDC	3	0	0	3	40	60	100
6	22EC8301	Industrial IoT and Industry 4.0	HDC	3	0	0	3	40	60	100

Vertical-II
Advanced Communication Systems

S No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
1	22EC5306	Cognitive Radio Networks	HDC	3	0	0	3	40	60	100
2	22EC6307	Remote Sensing	HDC	3	0	0	3	40	60	100
3	22EC6308	Rocketry and Space Mechanics	HDC	3	0	0	3	40	60	100
4	22EC7306	Underwater Navigation Systems	HDC	3	0	0	3	40	60	100
5	22EC7307	Massive MIMO Networks	HDC	3	0	0	3	40	60	100
6	22EC8203	Advanced Wireless Communication Techniques	HDC	3	0	0	3	40	60	100

Vertical-III
Semiconductor Chip Design and Testing

S No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
1	22EC5307	Wide Bandgap Devices	HDC	3	0	0	3	40	60	100
2	22EC6309	Validation and Testing Technology	HDC	3	0	0	3	40	60	100
3	22EC6310	Low Power VLSI	HDC	3	0	0	3	40	60	100
4	22EC7308	VLSI Testing and Design for Testability	HDC	3	0	0	3	40	60	100
5	22EC7309	Mixed Signal IC Design Testing	HDC	3	0	0	3	40	60	100
6	22EC8202	Analog IC Design	HDC	3	0	0	3	40	60	100

MINOR DEGREE VERTICAL COURSES
Embedded and IoT

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22EC5601	Electronics for Embedded Systems	MDC	3	0	0	3	3
2	22EC6601	Microcontroller and its Applications	MDC	3	0	0	3	3
3	22EC6602	Sensor and Embedded Systems	MDC	3	0	0	3	3
4	22EC7601	Fundamentals of IoT	MDC	3	0	0	3	3
5	22EC7602	Industrial IoT and Industry 4.0	MDC	3	0	0	3	3
6	22EC8601	IoT for Smart Systems	MDC	3	0	0	3	3

Vertical II
Fintech and Block Chain

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22CS5602	Financial Management	MDC	3	0	0	3	3
2	22MB6231	Fundamentals of Investment	MDC	3	0	0	3	3
3	22MB6232	Banking, Financial Services andInsurance	MDC	3	0	0	3	3
4	22MB7231	Introduction to Blockchain and its Applications	MDC	3	0	0	3	3
5	22MB7232	Fintech Personal Finance and Payments	MDC	3	0	0	3	3
6	22MB8231	Introduction to Fintech	MDC	3	0	0	3	3

Vertical III
Entrepreneurship

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22BA5601	Foundation of Entrepreneurship	MDC	3	0	0	3	3
2	22BA6601	Introduction to Business Venture	MDC	3	0	0	3	3
3	22BA6602	Team Building & Leadership Management for Business	MDC	3	0	0	3	3
4	22BA7601	Creativity & Innovation in Entrepreneurship	MDC	3	0	0	3	3
5	22BA7602	Principles of Marketing Management for Business	MDC	3	0	0	3	3
6	22BA8601	Human Resource Management for Entrepreneurs	MDC	3	0	0	3	3
7	22BA8602	Financing New Business Ventures	MDC	3	0	0	3	3

Vertical IV
Environment and Sustainability

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22CEXXXX	Sustainable Infrastructure Development	MDC	3	0	0	3	3
2	22AG6233	Sustainable Agriculture and Environmental Management	MDC	3	0	0	3	3
3	22BM6233	Sustainable Bio Materials	MDC	3	0	0	3	3
4	22ME7233	Materials for Energy Sustainability	MDC	3	0	0	3	3
5	22CE7233	Green Technology	MDC	3	0	0	3	3
6	22CE8232	Environmental Quality Monitoring and Analysis	MDC	3	0	0	3	3

Chairman Bos
Chairman - Bos
ECE - HiCET

Dean-Academics
Dean (Academics)
HiCET

Principal
PRINCIPAL
Hindusthan College Of Engineering & Technology
COIMBATORE - 641 032.

Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC4204	TRANSMISSION LINES AND WAVE GUIDES	3	0	0	3

Course Objectives	1. To introduce the general theory of transmission lines and understand the various parameters 2. To understand the characteristics of transmission lines at radio frequencies. 3. To provide knowledge on impedance matching techniques and problem solving using the Smith Chart. 4. To study the behavior of guided waves between parallel planes 5. To impart knowledge on wave propagation in rectangular and circular waveguides.
Course pre-requisites:	22EC3204-Circuits and Networks

Unit	Description	Instructional Hours
I	**INTRODUCTION** General theory of Transmission lines: the transmission line - general solution - Infinite line - Wavelength, velocity of propagation - Waveform distortion – Distortion less line - Loading and different methods of loading - Line not terminated in Z_0 - Reflection coefficient - calculation of current, voltage, power delivered and efficiency of transmission - Input and transfer impedance - reflection factor and reflection loss	9
II	**TRANSMISSION LINE CHARACTERISTICS** Transmission line equations at radio frequencies - Line of Zero dissipation - Voltage and current on the dissipation-less line, Standing Waves, Nodes, Standing Wave Ratio - Input impedance of the dissipation-less line - Open and short-circuited lines - Power and impedance measurement on lines - Reflection losses - Measurement of VSWR and wavelength.	9
III	**IMPEDANCE MATCHING** Impedance matching: Quarter wave transformer - Impedance matching by stubs - Single stub and double stub matching - Smith chart - Solutions of problems using Smith chart - Single and double stub matching using Smith chart.	9
IV	**GUIDED WAVES** Waves between parallel planes-Transverse Electric Waves-Transverse Magnetic Waves- Characteristics of TE and TM waves-Transverse Electromagnetic waves- Velocity of propagation-Attenuation in parallel plane guides- Wave Impedances	9
V	**WAVEGUIDES** Rectangular Waveguides - TM Waves in Rectangular guides -TE Waves in Rectangular Waveguides - Impossibility of TEM waves in waveguides -Bessel functions -TM and TE waves in Circular waveguides -Wave Impedance and Characteristic Impedances.	9
	Total Instructional Hours	**45**

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Course Outcomes	Upon successful completion of the course, the students will have the ability to: 1. Interpret the fundamental concepts and behavior of transmission lines under various operational scenarios. 2. Analyze the performance and characteristics of transmission lines at radio frequencies. 3. Utilize impedance matching methods and solve problems using the Smith Chart effectively. 4. Gain in-depth knowledge of guided waves and analyze their characteristics. 5. Evaluate the wave propagation mechanisms in rectangular and circular waveguides.

TEXT BOOKS:

T1- John D Ryder, "Networks Lines and Fields", Prentice Hall of India, New Delhi, 2015.
T2- Edward C. Jordan & Keith G. Balmain, "Electromagnetic waves and Radiating Systems", Second Edition, Prentice-Hall Electrical Engineering Series, 2012.

REFERENCE BOOKS:

R1-Reinhold Ludwig and Powel Bretchko, RF Circuit Design – Theory and Applications‖, Pearson Education Asia, First Edition,2001.
R2 - D. K. Misra, —Radio Frequency and Microwave Communication Circuits- Analysis and Design, John Wiley & Sons, 2004.
R3 - Mathew M. Radmanesh, —Radio Frequency & Microwave Electronics‖, Pearson Education Asia, Second Edition,2015.
R4 - G.S.N Raju, "Electromagnetic Field Theory and Transmission Lines Pearson Education, First edition 2009.

CO/ PO	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	2	2	2	2	2	2	-	1	-	-	-	1	-	3
CO2	3	2	2	2	2	2	-	1	-	-	-	1	-	3
CO3	3	2	2	2	2	2	-	1	-	-	-	1	-	3
CO4	3	2	2	2	2	2	-	1	-	-	-	1	-	3
CO5	3	2	2	2	2	2	-	1	-	-	-	1	-	3
Avg.	2.8	2	2	2	2	2	-	1	-	-	-	1	-	3

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC4202	ANALOG COMMUNICATION	3	0	0	3
Course Objectives	1. To interpret the concepts of Amplitude Modulation and methods to generate and detect AM waves. 2. To develop the concepts of Angle Modulation and its spectral characteristics 3. To classify the different types of Radio Transmitters and receivers. 4. To impart knowledge on the impact of noises on various analog communication systems 5. To demonstrate the concepts of analog pulse modulation techniques.					
Course pre-requisites:	22EC3201-Electronic Circuits 22EC3202-Signals and Systems					

Unit	Description	Instructional Hours
I	**AMPLITUDE MODULATION SYSTEMS:** Communication system model - Need for modulation -Amplitude Modulation – DSBSC, SSB, VSB– Amplitude modulator circuits- Balanced modulator, Ring modulator-Amplitude Demodulator circuits –Envelope detectors, square law demodulator.	9
II	**ANGLE MODULATION SYSTEMS:** Angle modulation –FM and PM –Narrow band, Wideband FM– Bandwidth requirements- Carson's Rule - Pre emphasis, De-emphasis - Generation and demodulation of FM waves -Indirect and Direct FM generation, Balanced Frequency Discriminator and PLL demodulator.	9
III	**TRANSMITTERS AND RECEIVERS:** AM broadcasting transmitters- Low Level and High-Level transmitters - Pilot carrier SSB Transmitter- FM transmitters- Armstrong FM systems. AM Receivers Tuned radio frequency receiver - Super heterodyne receiver - FM receiver – Multiplexing-Diversity reception techniques-TDM, FDM	9
IV	**NOISE IN CONTINUOUS WAVE MODULATION SYSTEMS:** Random variables, Random Process, Power Spectral Density-Friis Transmission equation -Noise Sources -Noise Figure, Effective Noise Temperature and Noise Bandwidth- Noise in CW Modulation systems- Noise in Linear Receiver using coherent detection, Noise in AM receivers using envelope Detection - Noise in FM receivers	9
V	**ANALOG PULSE MODULATION SYSTEMS** Sampling, Quantization–Generation and Detection- Pulse-amplitude modulation – Pulse-Width modulation – Pulse Position Modulation - -noise trade off-Noise consideration in Pulse modulation systems.	9
	Total Instructional Hours	45

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Course Outcomes

Upon successful completion of the course, the students will have the ability to:

1. Analyze the concepts in selecting suitable amplitude modulation techniques for various applications
2. Analyze the concepts in selecting appropriate angle modulation techniques for a message signal.
3. Apply the impact of noise on analog communication systems
4. Discuss the concepts of modulation schemes and apply in the design of communication systems.
5. Analyze the concepts in selecting appropriate analog pulse modulation technique for various applications

TEXT BOOKS:

T1-Simon Haykin "Communication Systems", Fifth edition by Wiley, 2021.

T2-Dennis Roddy, John Coolen ,"Electronic Communications", 4th edition, Pearson Education, 2021.

REFERENCE BOOKS :

R1-John. G. Proakis, Masoud Salehi, "Fundamentals of Communication Systems", Pearson Education, 6th edition, 2011.

R1-Wayne Tomasi ," Electronic Communications Systems –Fundamentals through advanced",5th edition, Pearson Education 2009

R3-Lathi B P, "Introduction to Communication Systems", BS publications, New Delhi, 2001.

R4-Kennedy G, "Electronic Communication systems", Tata McGraw Hill, New Delhi, 2009.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	-	3	-	-	-	-	-	3	3	3
CO2	3	3	3	3	-	3	-	-	-	-	-	3	3	3
CO3	3	3	3	3	-	3	-	-	-	-	-	3	3	3
CO4	3	3	3	3	-	2	-	-	-	2	-	3	3	3
CO5	3	3	3	3	-	3	-	-	-	-	-	3	3	3
AVG	3	3	3	3	-	3	-	-	-	2	-	3	3	3

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC4251	CONTROL SYSTEMS	2	0	2	3

Course Objectives	1. To understand the concept of modeling of control systems. 2. To summarize the knowledge of time response analysis for first- and second-order systems. 3. To examine the various frequency response plots. 4. To enumerate the concept of different stability analysis techniques. 5. To interpret the concept of state variable analysis.
Course pre-requisites	22MA2101-Differential Equations and Laplace Transform.

Unit	Description	Instructional Hours
I	**MATHEMATICAL MODELING OF CONTROL SYSTEMS** Basic components of Control System – Open loop and Closed loop systems – Introduction to Differential equation -Transfer function- Modeling of Electrical and Mechanical systems- Block diagram reduction methods - Signal flow graph. **Experimental study- Digital simulation of linear systems.**	6+3
II	**TIME RESPONSE ANALYSIS** Time response - Order and Type of the Systems – Standard test signals-Unit step Response analysis of first and second order systems – Time domain specifications-Steady state errors. Introduction to P, PI, PID Controllers. **Experimental study- Time response analysis of unit step and impulse signal.**	6+3
III	**FREQUENCY RESPONSE ANALYSIS** Frequency Response –Introduction to frequency Domain specifications - Bode Plot, Polar Plot, Nyquist Plot **Experimental study- Frequency response analysis of bode plot.**	6+3
IV	**STABILITY ANALYSIS** Concept of stability -bounded input-bounded output stability, Routh-Hurwitz Criterion, Root Locus Technique, Construction of Root Locus. **Experimental study- Stability analysis of linear system using root locus.**	6+3
V	**STATE VARIABLE ANALYSIS** State space representation of Continuous Time systems – State equations – Phase and Canonical variable forms-Transfer function from State Variable Representation- Concepts of Controllability and Observability. **Experimental study- State space representation of Continuous Time systems.**	6+3
	Total Instructional Hours	**30+15=45**

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Course Outcomes	Upon successful completion of the course, the students will have the ability to: CO1: Compute the mathematically modeling of control systems. CO2: Analyze the time domain specifications and steady state errors concept. CO3: Interpret the concepts of various frequency response plots. CO4: Analyze the stability using root locus and Routh Hurwitz. CO5: Identify and analyze state variables in continuous-time systems.

TEXT BOOKS:

T1- Norman S Nise , "Control System Engineering" 8th Edition 2024

T2- J.Nagrath and M.Gopal, "Control System Engineering", New Age International Publishers, 6th Edition, 2018.

T3- Benjamin.C.Kuo, "Automatic control systems", Wiley,9th Edition,2014.

REFERENCE BOOKS:

R1- KatsushikoOgata,"ModernControlEngineering",PearsonEducation,5th Edition, 2010.

R2- Schaum's Outline Series, "Feed Back and Control Systems" ,Tata McGraw-Hill, 2nd Edition,2013.

R3- A.Nagoorkani,"Control Systems Engineering",RBAPublications, First edition,2014.

R4- John J.DAzzo&ConstantineH.Houpis, "Linear Control System Analysis and Design", TMH, 2003.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	2	2	-	-	-	-	-	-	2	2
CO2	3	3	3	3	2	2	-	-	-	-	-	-	2	2
CO3	3	3	3	2	2	3	-	-	-	-	-	-	2	2
CO4	3	3	3	3	2	3	-	-	-	-	-	-	2	2
CO5	3	3	3	3	2	2	-	-	-	-	-	-	2	2
AVG	3	3	3	3	2	2	-	-	-	-	-	-	2	2

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Course Outcomes	Upon successful completion of the course, the students will have the ability to: CO1: Compute the mathematically modeling of control systems. CO2: Analyze the time domain specifications and steady state errors concept. CO3: Interpret the concepts of various frequency response plots. CO4: Analyze the stability using root locus and Routh Hurwitz. CO5: Identify and analyze state variables in continuous-time systems.

TEXT BOOKS:

T1- Norman S Nise , "Control System Engineering" 8th Edition 2024

T2- J.Nagrath and M.Gopal, "Control System Engineering", New Age International Publishers, 6th Edition, 2018.

T3- Benjamin.C.Kuo, "Automatic control systems", Wiley,9th Edition,2014.

REFERENCE BOOKS:

R1- KatsushikoOgata,"ModernControlEngineering",PearsonEducation,5th Edition, 2010.

R2- Schaum's Outline Series, "Feed Back and Control Systems" ,Tata McGraw-Hill, 2nd Edition,2013.

R3- A.Nagoorkani,"Control Systems Engineering",RBAPublications, First edition,2014.

R4- John J.DAzzo&ConstantineH.Houpis, "Linear Control System Analysis and Design", TMH, 2003.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	2	2	-	-	-	-	-	-	2	2
CO2	3	3	3	3	2	2	-	-	-	-	-	-	2	2
CO3	3	3	3	2	2	3	-	-	-	-	-	-	2	2
CO4	3	3	3	3	2	3	-	-	-	-	-	-	2	2
CO5	3	3	3	3	2	2	-	-	-	-	-	-	2	2
AVG	3	3	3	3	2	2	-	-	-	-	-	-	2	2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC4251	CONTROL SYSTEMS	2	0	2	3

Course Objectives	1. To understand the concept of modeling of control systems. 2. To summarize the knowledge of time response analysis for first- and second-order systems. 3. To examine the various frequency response plots. 4. To enumerate the concept of different stability analysis techniques. 5. To interpret the concept of state variable analysis.
Course pre-requisites	22MA2101-Differential Equations and Laplace Transform.

Unit	Description	Instructional Hours
I	**MATHEMATICAL MODELING OF CONTROL SYSTEMS** Basic components of Control System – Open loop and Closed loop systems – Introduction to Differential equation -Transfer function- Modeling of Electrical and Mechanical systems- Block diagram reduction methods - Signal flow graph. **Experimental study- Digital simulation of linear systems.**	6+3
II	**TIME RESPONSE ANALYSIS** Time response - Order and Type of the Systems – Standard test signals-Unit step Response analysis of first and second order systems – Time domain specifications-Steady state errors. Introduction to P, PI, PID Controllers. **Experimental study- Time response analysis of unit step and impulse signal.**	6+3
III	**FREQUENCY RESPONSE ANALYSIS** Frequency Response –Introduction to frequency Domain specifications - Bode Plot, Polar Plot, Nyquist Plot **Experimental study- Frequency response analysis of bode plot.**	6+3
IV	**STABILITY ANALYSIS** Concept of stability -bounded input-bounded output stability, Routh-Hurwitz Criterion, Root Locus Technique, Construction of Root Locus. **Experimental study- Stability analysis of linear system using root locus.**	6+3
V	**STATE VARIABLE ANALYSIS** State space representation of Continuous Time systems – State equations – Phase and Canonical variable forms-Transfer function from State Variable Representation- Concepts of Controllability and Observability. **Experimental study- State space representation of Continuous Time systems.**	6+3
	Total Instructional Hours	**30+15=45**

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC4201	ELECTRO MAGNETIC FIELDS	3	0	0	3

Course Objectives	1. To explore the basic laws and concepts of electromagnetism 2. To acquire a profound understanding of electric field and potentials due to static charges 3. To comprehend the magnetic fields for simple configurations under static conditions along with fundamental laws. 4. To perceive Maxwell's equations in different forms and wave propagation in different media. 5. To interpret wave characteristics in perfect conductor and dielectric media.	
Course pre-requisites	22MA1101- MATRICES AND CALCULUS	
Unit	**Description**	**Instructional Hours**
I	**INTRODUCTION** Different co-ordinate systems- Vectorcalculus – Gradient, Divergence and Curl - Divergence theorem, Theorems and applications:Stoke's theorem.Coulomb's law,Electric field intensity, Electric flux density, Gauss's law,ApplicationsofGauss's law.	9
II	**ELECTROSTATIC FIELDS** Electric potential,Potential difference andpotential, Dipole, Current and current density, Continuity of currentequation, Boundary conditions: Conductors,dielectric materials, Nature of dielectric materials, Capacitance, Parallel plate capacitor, Poisson's and Laplace's equations.	9
III	**MAGNETOSTATIC FIELDS:** Biot Savart law, Ampere's Circuital law, Magnetic flux and magnetic fluxdensity, Scalar and vector magnetic potentials, Nature of magnetic materials, Magnetization andpermeability, Magnetic boundary conditions, Self-inductance and mutual inductance, Solenoid and Toroid.	9
IV	**MAXWELL'S EQUATIONS AND WAVE PROPAGATION:** Faraday's law, Displacement current, Maxwell's equations in point form, Maxwell's equations in integral form, Wave equations for free space and conducting medium, Uniform plane wave equation, Wave propagation in free space, dielectrics and in good Skin effect, Wave polarization.	9
V	**WAVE CHARACTERISTICS:** Normal incidence of waves on perfect conductor and dielectric, Oblique incidence of waves on perfect conductor and dielectric, Brewster angle, Surface impedance, Poynting theorem and Poynting vector.	9
	Total Instructional Hours	**45**

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Course Outcomes	Upon successful completion of the course, the students will have the ability to: CO1: Interpret complex electromagnetic phenomena, applying concepts such as vector calculus, integral theorems and fundamental laws. CO2: Analyze electric field characteristics in conductors and dielectrics. CO3: Apply the magnetic field laws to calculate the magnetic potentials. CO4: Apply the concepts of Maxwell's equations to analyze and predict electromagnetic wave propagation. CO5: Interpret the behavior of electromagnetic waves under normal and oblique incidences on perfect conductors and dielectrics.

TEXT BOOKS:

T1- Mathew.N.O.Sadiku, "Elements of Electromagnetics", 7th Edition, Oxford University press, 2021

T2- William H. Hayt and John A. Buck, "Engineering Electromagnetics"8th edition, TMH,2012.

REFERENCE BOOKS :

R1- Edward.C.Jordan & Keith.G.Balmain,"Electromagnetic Waves and Radiating Systems", 2nd Edition, Prentice Hall of India,2009

R2-. K.A.Gangadhar," Electromagnetic Field Theory', Khanna Publishers: Sixteenth Edition Eighth Reprint: 2015

R3-. David K.Cheng, "Field and Wave Electromagnetics" ,2nd Edition, Pearson Education, 2013

R4-. Joseph.A.Edminister," Schaum'sOutline f Electromagnetics, 5th edition, McGraw Hill, 2018.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	-	3	2	2	2	2	-	2	2	3
CO2	3	3	3	3	-	3	2	2	2	2	-	2	3	3
CO3	3	3	3	3	-	3	2	2	2	2	-	2	3	3
CO4	3	3	3	3	-	3	2	2	2	2	-	2	3	3
CO5	3	2	2	2	-	3	2	2	2	2	-	2	3	3
AVG	3	2.6	2.6	2.6	-	3	2	2	2	2	-	2	2.6	3

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Programme	Course Code	Course Title	L	T	P	C
BE/BTECH	22HE4101	**INTELLECTUAL PROPERTY RIGHTS (IPR) AND START-UPS**	2	0	0	2

Course Objectives	1. To impart knowledge of intellectual property types, their importance, and the role of international organizations, agencies, and treaties in IPR protection. 2. To explore the elements of patentability, non-patentable subject matter, and the registration procedure. 3. To analyze the function and acquisition of trademark rights, protectable matters, and the processes involved in trademark registration. 4. To interpret various types of trademarks, their applications, and registration procedures. 5. To acquire the procedures for registering designs and geographical indications.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO INTELLECTUAL PROPERTY** Introduction, Types of Intellectual Property, International Organizations, Agencies and Treaties, Importance of Intellectual Property Rights.	6
II	**PATENTS** Patents -Elements of Patentability: Novelty, Non-Obviousness (Inventive Steps), Industrial Application -Non -Patentable Subject Matter -Registration Procedure, Rights and Duties of Patentee, Assignment and license.	6
III	**COPYRIGHTS** Purpose And Function Of Trade Marks, Acquisition Of Trade Mark Rights, Protectable Matter, Selecting And Evaluating Trade Mark, Trade Mark Registration Processes.	6
IV	**TRADEMARKS** Concept of Trademarks -Different kinds of marks (brand names, logos, signatures, symbols, well known marks, certification marks and service marks) -Non-Registrable Trademarks -Registration of Trademarks.	6
V	**DESIGN AND GEOGRAPHICAL INDICATION** Design: meaning and concept of novel and original -Procedure for registration. Geographical indication: meaning, and difference between GI and trademarks - Procedure for registration.	6
	Total Instructional Hours	30

Course Outcomes	Upon successful completion of the course, the students will have the ability to: CO1 Demonstrate a clear understanding of framework of Intellectual Property Rights CO2 Apply patentability principles to assess inventions CO3 Analyze the purpose, acquisition, and registration steps for trademarks and copyrights. CO4 Analyze trademarks and its registration process. CO5 Evaluate the design protection for novel designs and geographical indications.

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TEXT BOOKS:
T1: Richard Stim, Intellectual Property: Patents, Copyrights, Trademarks, and Other Rights, *8th edition, NOLO, 2023* T2: Siva Vaidhyanathan, Intellectual Property: A Very Short Introduction, 2nd edition, Oxford University Press, 2023.
REFERENCE BOOKS:
R1: Peter Goodhart, *Principles of Intellectual Property*, 2nd edition, Butterworth-Heinemann, 2020. R2: David I. Bainbridge, *Intellectual Property*, 10th edition, Pearson Education, 2022. R3: Jeremy Phillips and Michael R. Kitchin, *Intellectual Property and Innovation Management in Small Firms*, 3rd edition, Routledge, 2021

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	2	-	-	3	-	2	-	2	-	3	2	3
CO2	3	-	2	-	-	3	-	2	-	2	-	3	2	3
CO3	3	-	2	-	-	3	-	2	-	2	-	3	2	3
CO4	3	-	2	-	-	3	-	2	-	2	-	3	2	3
CO5	3	-	2	-	-	3	-	2	-	2	-	3	2	3
AVG	3	-	2	-	-	3	-	2	-	2	-	3	2	3

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC4203	LINEAR INTEGRATED CIRCUITS	3	0	0	3

Course Objective	1. To Understand the fundamental concepts of Operational Amplifiers. 2. To design and analyze a wide range of op-amp circuits used in real-world applications. 3. To Illustrate the principles and applications of comparators and various waveform generators. 4. To interpret of the principles, designs, and applications of Digital-to-Analog (D/A) and Analog-to-Digital (A/D) converters. 5. To Interpret the PLL, voltage regulators and applications of AM and FM.	
Course pre-requisites:	1. 22EC3201-Electronic Circuits 2. 22EC3204-Circuits and Networks 3..22EC3202-Signals and Systems	
Unit	**Description**	**Instructional Hours**
I	**BASICS OF OPERATIONAL AMPLIFIERS** Basic information about op-amps – Ideal Operational Amplifier - General operational amplifier stages, DC and AC performance characteristics, slew rate, Open and closed loop configurations.	9
II	**APPLICATIONS OF OPERATIONAL AMPLIFIERS** Sign Changer, Scale Changer, Phase Shift Circuits, Voltage Follower, V-to-I and I-to-V converters, adder, subtractor, Instrumentation amplifier, Integrator, Differentiator, Precision rectifier, clipper and clamper, Low-pass, high-pass and band-pass Butterworth filters.	9
III	**COMPARATORS AND WAVEFORM GENERATORS** Comparators, Schmitt trigger, Sine-wave generators, MultivibratorsMultivibratorsusing IC 555, Frequency to Voltage and Voltage to Frequency converters.	9
IV	**ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS** D/A converter – specifications - weighted resistor type, R-2R Ladder type, Voltage Mode and Current-Mode -R - 2RLadder types - switches for D/A converters, A/D Converters – specifications - Flash type - Successive Approximation type - Single Slope type – Dual Slope type.	9
V	**PLL AND VOLTAGE REGULATORS** Operation of the basic PLL, Voltage controlled oscillator, Application of PLL for AM detection, FM detection, IC Voltage regulators – Three terminal fixed and adjustable voltage regulators.	9
	Total Instructional Hours	**45**
Course Outcome	Upon successful completion of this course, students will be able to CO1: Identify and describe the essential components and principles of operational amplifiers CO2: Design and analyze op-amp circuits for basic signal manipulation. CO3: Design and analyze comparator Waveform Generators, frequency conversion, and digital timing. CO4: Evaluate and troubleshoot D/A and A/D converter circuits. CO5: Analyze the PLL and voltage regulators with their applications of AM and FM	

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TEXT BOOKS:
T1-D. Roy Choudhry, Shail Jain, "Linear Integrated Circuits", Wiley Eastern, New Delhi, 2nd Edition. T2-Ramakant A. Gayakwad, "OP-AMP and Linear ICs", 4th Edition, Pearson Education.
REFERENCE BOOKS:
R1-S. Salivahanan & V.S. Kanchana Bhaskaran, "Linear Integrated Circuits", 2nd edition McGraw Hill, 2018. R2-Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", 3rd Edition, Tata McGraw-Hill, 2007. R3-Robert F.Coughlin, Frederick F.Driscoll, "Operational Amplifiers and Linear Integrated Circuits", Sixth Edition, PHI, 2022.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	2	3	2	-	2	-	-	-	-	-	3	3	2
CO2	3	3	3	3	2	2	2	-	-	-	-	3	3	2
CO3	3	3	3	2	2	3	-	-	-	-	-	3	3	2
CO4	3	3	3	3	2	3	-	-	-	-	-	3	3	2
CO5	3	3	3	3	2	2	-	-	-	-	-	3	3	2
AVG	3	3	3	2.6	2	2.4	2	-	-	-	-	3	3	2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC4001	LINEAR INTEGRATED CIRCUITS LAB	0	0	3	1.5
Course Objectives	1. To examine about amplifiers and filters using 741 Op-Amp 2. To analyze multivibrators using 741 Op-Amp 3. To design and analyze multivibrators using NE555 timer 4. To develop circuits using SPICE for amplifiers. 5. To interpret and utilize SPICE software for converters for analog and digital.					
Exp.No.	Description of the Experiments					
Design and Test the following experiments						
1	Voltage Follower, Inverting & Non inverting amplifiers using 741 op-amp.					
2	Active low-pass, High-pass and band-pass filters using 741 op-amp.					
3	Astable multivibrator, Monostable multivibrator and Schmitt Trigger using 741 op-amp.					
4	Phase shift and Wien bridge oscillators using 741 op-amp.					
5	Astable and Mono stable multivibrators using NE555 Timer.					
6	Function Generator using ICL8038.					
Simulate the following experiments						
7	Integrator, Differentiator and Instrumentation Amplifier using SPICE.					
8	Astable & Monostable multivibrators with NE555 Timer using SPICE.					
9	Phase shift and Wien bridge oscillators with op-amp using SPICE.					
10	D/A and A/D converters using SPICE.					
Total Practical Hours					45	
Course Outcomes	Upon successful completion of the course, the students will have the ability to: CO1: Design and analyze 741 Op-amp for amplifiers and filters CO2: Examine about multivibrator circuits using 741 Op-Amp CO3 : Construct various multivibrator circuits using NE555 timer CO4 :Interpret about amplifiers using SPICE CO5: Develop applications of analog and digital converters.					

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CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	2	1	3	3	1	-	3	2	3
CO2	3	3	3	3	3	2	1	3	3	1	-	3	2	3
CO3	3	3	3	3	3	2	1	3	3	1	-	3	2	3
CO4	3	3	3	3	3	2	1	3	3	1	-	3	2	3
CO5	3	3	3	3	3	2	1	3	3	1	-	3	2	3

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Programme	Course Code	Name of the Course	L	T	P	C
B.E	22EC4002	ANALOG COMMUNICATION LABORATORY	0	0	3	1.5
Course Objectives	1.To understand different modulation and demodulation schemes. 2.To analyze the impact of transmitter and receiver characteristics 3.ToAssess Pulse amplitude modulation and time division multiplexing 4.To interpret the design of circuits using MATLAB for modulation 5.To develop simulation for pulse width and pulse position modulation					
Exp.No.	Description of the Experiments					
1	Design and testing of Amplitude Modulation and Demodulation					
2	Design and testing of Frequency Modulation and Demodulation.					
3	Design and testing of Pre-Emphasis - De Emphasis Circuits					
4	Design and testing of Mixer Circuit					
5	AM Transmitter and Super heterodyne Receiver					
6	Pulse Amplitude Modulation					
7	Time Division Multiplexing.					
Simulation Experiments using MATLAB						
8	DSB SC Modulation					
9	SSB Modulation					
10	Pulse Width and Pulse Position modulation					
	Total Practical Hours		45			
Course Outcomes	Upon successful completion of the course, the students will have the ability to: CO1: Analyze the performance of various modulation and demodulation methods. CO2:Design the Transmitters and Receivers for analog communication and analyze the impact of noise in analog communication. CO3: Interpret about multiplexing techniques for time division multiplexing and pulse amplitude modulation CO4:Utilize design of circuits using MATLAB for SSB and DSB modulation CO5:Assess about simulation for pulse width and position modulation					

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CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	3	3	3	3	3	2	1	3	3	1	-	3	2	3
CO2	3	3	3	3	3	2	1	3	3	1	-	3	2	3
CO3	3	3	3	3	3	2	1	3	3	1	-	3	2	3
CO4	3	3	3	3	3	2	1	3	3	1	-	3	2	3
CO5	3	3	3	3	3	2	1	3	3	1	-	3	2	3

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC4253	DATA COMMUNICATION AND NETWORKS	2	0	2	3
Course Objectives	To Introduce data communication fundamentals and state-of-the-art in network models Explain the role of Data Link layer protocols in data transmission To Describe the functions of Network Layer To Be exposed to the required functionality of each network application. To Acquire knowledge in Wide Area Networks.					
Course pre-requisites:	1. 22EC3203-Digital Electronics 2. 22EC4202-Analog communication					

Unit	Description	Instructional Hours
I	**PHYSICAL LAYER** OSI reference model , TCP/IP Protocol suite.Line Configuration, Encoding and Decoding, Multiplexing-transmission media - Circuit Switching, Packet Switching, Message Switching. **Simulation of Network Topology – Star, Bus and Ring**	9
II	**LINK LAYER ALGORITHMS AND PROTOCOLS** Flow control and error control, stop and wait, Sliding windows , Local Area Networks -IEEE 802 standards, LLC, MAC layer protocols – CSMA/CD Ethernet, Token Ring,FDDI. **Study And Compare the performance of Stop And Wait Protocol, Study And Compare the performance of Selective Repeat Protocol,Go Back N Protocol**	9
III	**ROUTING ALGORITHMS AND PROTOCOLS** Routing Algorithms- RIP, OSPF, BGP, multicast routing (DVMRP, PIM)- IPv4 - IPv6. UDP-TCP-congestion Control Algorithms. **Simulation of Distance Vector Routing Algorithm,Link State Routing Algorithm,Study of Network Simulator (Ns) ,Simulation of Congestion Control Algorithms Using Ns.**	9
IV	**APPLICATION LAYER** Domain Name system – Remote logging, Electronic Mail, File Transfer - WWW and HTTP- Simple Network Management Protocol – Data Security.	9
V	**WIDE AREA NETWORKS** Integrated Services Digital Network (ISDN), *B-ISDN*, Frame delay and Asynchronous Transfer Mode (ATM) Protocol	9
	Total Instructional Hours	**45**

Course Outcomes	Upon successful completion of the course, the students will have the ability to: CO1: Demonstrate the networking strategies. CO2: Identify the technical issues related to networking technologies. CO3: Discriminate various routing techniques. CO4: Illustrate the web applications CO5: Implement various network algorithms and protocols

TEXT BOOKS:

T1 - Behrouz A Forouzan , "Data Communication and Networking", McGraw-Hill, New Delhi, 2012.

T2 - Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", Fifth Edition, MorganKaufmann Publishers, 2011

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REFERENCE BOOKS:
R1 - Andrew S Tanenbaum, "Computer networks", Prentice Hall of India, New Delhi, 2010. R2 - William Stallings, "Data and Computer Communication", Prentice Hall of India, New Delhi, 2007

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	2-	3	2	2	3	2	2	3	3	2
CO2	3	3	3	3	3	3	2	2	3	2	2	3	3	3
CO3	3	3	3	3	3	2	3	2	3	2-	2	3	3	3
CO4	3	3	3	3	2	2	2	2	3	2	2	3	3	3
CO5	3	3	3	3	3	3	2	2	3	2	2	3	3	3
AVG	3	3	3	3	2.75	2.6	2.2	2	3	2	2	3	3	2.8

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Programme/ Sem	CourseCode	Name of the Course	L	T	P	C
B.E./B.Tech/ IV	22MC4091	INDIAN CONSTITUTION (Common to all branches)	2	0	0	0

Course Objectives	1.To introduce students to the foundational aspects of the Indian Constitution. 2.To explore the scope, significance, and limitations of Fundamental Rights in the Constitution of India. 3.To explain the framework of **the** parliamentary system of government in India as enshrined in the Constitution. 4.To examine the role and structure of local governance in India, particularly focusing on rural and urban local bodies. 5.To analyze the role of political parties, pressure groups, and civil society in protecting rights and promoting social justice

Unit	Description	Instructional Hours
I	**BASIC FEATURES AND FUNDAMENTAL PRINCIPLES** Meaning of the constitution law and constitutionalism–Historical perspective of the constitution of India– salient features and characteristic of the constitution of India.	6
II	**FUNDAMENTAL RIGHTS** Scheme of the fundamental rights–fundamental duties and its legislative status–The directive principles of state policy–its importance and implementation-Federal structure and distribution Of legislative and financial powers between the union and states.	6
III	**PARLIAMENTARY FORM OF GOVERNMENT** The constitution powers and the status of the president in India.–Amendment of the constitutional Powers and procedures–The historical perspective of the constitutional amendment of India–Emergency provisions: National emergency, President rule, Financial emergency.	6
IV	**LOCALGOVERNANCE** Local self-government-Rural Local Government-Panchayath Raj, Elections of Panchayat-State Election Commission- Urban Local Government-Amendment Act, Urban Local Government Structures in India	6
V	**INDIANSOCIETY** Constitutional Remedies for citizens–Political Parties and Pressure Groups; Right of Women, Children and Scheduled Castes and Scheduled Tribes and other Weaker Sections.	6
	Total Instructional Hours	**30**

Course Outcome	Upon successful completion of this course, students will have the ability to CO1: Students will gain an understanding of the evolution of the Indian Constitution, its basic features, and the principles. CO2: Students will be able to identify the different categories of Fundamental Rights. CO3: Students will understand the structure of the **Indian parliamentary system**, the division of power, and the relationship between different branches of government. CO4: Students will learn about the framework and functioning of local governance in India, including Panchayat Raj and Urban Local Bodies. CO5: Students will critically analyze the challenges in the implementation of these provisions

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TEXTBOOKS:
T1: DurgaDasBasu,"IntroductiontotheConstitutionofIndia",PrenticeHallofIndia,NewDelhi,1997. T2: Agarwal R C.,"Indian Political System", S.Chand and Company, NewDelhi,1997. T3: MaciverandPage,"Society:AnIntroductionAnalysis",MacMilanIndiaLtd.,NewDelhi. T4: Sharma K L., "Social Stratification in India: Issues and Themes ", Jawaharlal NehruUniversity,NewDelhi,1997.
REFERENCEBOOKS:
R1-Sharma,Brij Kishore,"Introduction to the Constitution of India:, Prentice Hall of India, New Delhi. R2-GahaiUR.,"IndianPoliticalSystem",NewAcademicPublishingHouse, Jalaendhar. R3-Sharma R N., "Indian Social Problems",Media Promoters and Publishers Pvt. Ltd.

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SYLLABUS REVISION DETAILS FOR THE REGULATION 22 – ACADEMIC YEAR 2024-25 EVEN SEMESTER

S. No	Year	Semester	Course Code and Course Name	Existing content (in academic Year 2023-24)	Revised Content (for 2024-25)	Percentage of Revision
1	II	IV	22EC4251-Control System	Time response - Order and Type of the Systems – Standard test signals-Unit step Response analysis of first and second order systems – Time domain specifications-Steady state errors. **Experimental study- Response of Proportional controllers.** Frequency Response - Frequency Domain specifications -Bode Plot, Polar Plot – Constant M and N Circles – Introduction to Lead, Lag, and Lead Lag Compensators. **Experimental study- Frequency response analysis of bode plot.**	**TIME RESPONSE ANALYSIS** Time response - Order and Type of the Systems – Standard test signals-Unit step Response analysis of first and second order systems – Time domain specifications-Steady state errors. Introduction to P, PI, PID Controllers. **Experimental study- Time response analysis of unit step and impulse signal.** **FREQUENCY RESPONSE ANALYSIS** Frequency Response –Introduction to frequency Domain specifications -Bode Plot, Polar Plot, Nyquist Plot **Experimental study- Frequency response analysis of bode plot.**	15

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COLLEGE OF ENGINEERING ANDTECHNOLOGY

(An Autonomous Institution)

Coimbatore– 641032

DEPARTMENT OF ELECTRONICS AND COMMUNICATION

CURRICULUM & SYLLABUS

AY-2022-2023

Batch: 2022-2026

REGULATIONS 2022

SEMESTER I											
S. NO	COURSE CODE	COURSE TITLE	COURSE CATEGORY	L	T	P	C	TCP	CIA	ESE	TOTAL
THEORY											
1	22MA1101	MATRICES AND CALCULUS	BSC	3	1	0	4	4	40	60	100
THEORY WITH LAB COMPONENT											
2	22CY1151	CHEMISTRY FOR CIRCUIT ENGINEERING	BSC	2	0	2	3	4	50	50	100
3	22HE1151	ENGLISH FOR ENGINEERS	HSC	2	0	2	3	4	50	50	100
4	22EC1151	ELECTRON DEVICES	ESC	2	0	2	3	4	50	50	100
5	22IT1151/ 22CS1152	PYTHON PROGRAMMING AND PRACTICES/ OBJECT ORIENTED PROGRAMMING USING PYTHON (IBM STUDENTS ONLY)	ESC/ICC	2	0	2	3	4	50	50	100
EEC COURSES (SE/AE)											
6	22HE1071	UHV	AEC	2	0	0	2	3	40	60	100
7	22HE1072	ENTREPRENEURSHIP & INNOVATION	AEC	1	0	0	1	1	100	0	100
MANDATORY COURSE											
8	22MC1091/ 22MC1092	தமிழரும்தொழில்நுட்பமும்/Indian Constitution	MC	2	0	0	0	2	100	0	100
			TOTAL	**16**	**1**	**8**	**19**	**26**	**480**	**320**	**800**

SEMESTER II											
S. NO	COURSE CODE	COURSE TITLE	COURSE CATEGORY	L	T	P	C	TCP	CIA	ESE	TOTAL
THEORY											
1	22MA2102	DIFFERENTIAL EQUATIONS AND LAPLACE TRANSFORM	BSC	3	1	0	4	4	40	60	100
2	22CY2101	ENVIRONMENTAL STUDIES	ESC	2	0	0	2	3	40	60	100
3	22PH2101	BASICS OF MATERIAL SCIENCE	BSC	2	0	0	2	3	40	60	100
THEORY WITH LAB COMPONENT											
4	22PH2151	PHYSICS FOR CIRCUIT ENGINEERING PROGRAMME	BSC	2	0	2	3	4	50	50	100
5	22HE2151	EFFECTIVE TECHNICAL COMMUNICATION	HSC	2	0	2	3	4	50	50	100
6	22CS2255	PROGRAMMING USING C	PCC	2	0	2	3	4	50	50	100
	22CS2253	JAVA FUNDAMENTALS (IBM STUDENTS ONLY)	ICC								
PRACTICAL											
7	22ME2001	ENGINEERING PRACTICES	ESC	0	0	4	2	2	60	40	100
EEC COURSES (SE/AE)											
8	22HE2071	DESIGN THINKING	AEC	1	0	2	2	2	100	0	100

9	22HE2072	SOFT SKILLSAND APTITUDE -1	SEC	1	0	0	1	1	100	0	100
MANDATORY COURSES											
10	22MC2091 22MC2092	தமிழர்மரபு/ **Heritage of Tamils**	MC	2	0	0	0	2	100	0	100
11	22MC2093	NCC */NSS / YRC / SPORTS / CLUBS / SOCIETY SERVICE - ENROLLMENT (COMMON)	MC	All students shall enroll, on admission, in anyone of the personality and character development programmes and undergo training for about 80 hours							
			TOTAL	**17**	**1**	**12**	**22**	**29**	**630**	**370**	**1000**

SEMESTER III											
S.NO	**COURSECODE**	**COURSETITLE**	**COURSE CATEGORY**	**L**	**T**	**P**	**C**	**TCP**	**CIA**	**ESE**	**TOTAL**
THEORY											
1	22MA3102	COMPLEX ANALYSIS AND TRANSFORMS (common to ECE,EEE,EIE)	BSC	3	1	0	4	4	40	60	100
2	22EC3201	ELECTRONIC CIRCUITS	PCC	3	0	0	3	3	40	60	100
3	22EC3202	SIGNALS AND SYSTEMS	PCC	3	0	0	3	3	40	60	100
4	22EC3203	DIGITAL ELECTRONICS	PCC	3	0	0	3	3	40	60	100
5	22EC3204	CIRCUITS AND NETWORKS	ESC	2	0	0	2	3	100	-	100
THEORY WITH LAB COMPONENT											
6	22EC3251/ 22IT3252	OOPS USING JAVA/RELATIONAL DATABASE MANAGEMENT SYSTEM (IBM STUDENTS ONLY)	ESC/ICC	2	0	2	3	3	50	50	100
PRACTICAL											
7	22EC3001	ELECTRONIC CIRCUITS LABORATORY	PCC	0	0	3	1.5	3	60	40	100
8	22EC3002	DIGITAL ELECTRONICS LABORATORY	PCC	0	0	3	1.5	3	60	40	100
EEC COURSES (SE/AE)											
9	22HE3071	SOFT SKILLS -2	SEC	1	0	0	1	1	100	0	100
10	22EC3901	MINI PROJECT 1	AEC	0	0	0	2	1	100	0	100
11	22MC3191	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	MC	2	0	0	0	2	100	0	100
			TOTAL	**17**	**1**	**8**	**24**	**28**	**730**	**410**	**1100**

SEMESTER IV											
S.NO	**COURSE CODE**	**COURSE TITLE**	**COURSE CATEGORY**	**L**	**T**	**P**	**C**	**TCP**	**CIA**	**ESE**	**TOTAL**
THEORY											
1	22HE4101	IPR AND START-UPS	HSC	2	0	0	2	2	40	60	100
2	22EC4201	ELECTRO MAGNETIC FIELDS	PCC	3	0	0	3	3	40	60	100
3	22EC4202	ANALOG COMMUNICATION	PCC	3	0	0	3	3	40	60	100
4	22EC4203	LINEAR INTEGRATED CIRCUITS	PCC	3	0	0	3	3	40	60	100
5	22EC4304	TRANSMISSION LINES AND WAVEGUIDES	PCC	3	0	0	3	3	40	60	100

THEORY WITH LAB COMPONENT											
6	22EC4251/ 22EC4252	CONTROL SYSTEMS/DESIGN THINKING-AN INTRODUCTION (IBM STUDENTS ONLY)	PCC/ICC	2	0	2	3	3	50	50	100
7	22EC4253	DATA COMMUNICATION AND NETWORKS	PCC	2	0	2	3	3	50	50	100
PRACTICAL											
8	22EC4001	LINEAR INTEGRATED CIRCUITS LAB	PCC	0	0	3	1.5	3	60	40	100
9	22EC4002	ANALOG COMMUNICATION LAB	PCC	0	0	3	1.5	3	60	40	100
EEC COURSES (SE/AE)											
10	22HE4071	SOFT SKILLS -3	SEC	1	0	0	1	1	100	0	100
			TOTAL	**19**	**3**	**10**	**24**	**27**	**400**	**500**	**900**

SEMESTER V											
S.NO	**COURSE CODE**	**COURSE TITLE**	**COURSE CATEGORY**	**L**	**T**	**P**	**C**	**TCP**	**CIA**	**ESE**	**TOTAL**
THEORY											
1	22EC5201	DIGITAL COMMUNICATION	PCC	3	0	0	3	3	40	60	100
2	22EC5202	ANTENNA AND WAVE PROPAGATION	PCC	3	1	0	4	3	40	60	100
3	22EC5203	MICROPROCESSORS AND MICROCONTROLLERS	PCC	3	0	0	3	3	40	60	100
4	22EC53XX/ 22EC5351	PROFESSIONAL ELECTIVE-1/ ANGULAR JS (IBM STUDENTS ONLY)	PEC/ICC	3	0	0	3	3	40	60	100
5	22EC53XX	PROFESSIONAL ELECTIVE-2	PEC	3	0	0	3	3	40	60	100
6	22EC53XX	PROFESSIONAL ELECTIVE-3	PEC	3	0	0	3	3	40	60	100
PRACTICAL											
7	22EC5001	MICROPROCESSORS AND MICROCONTROLLERS LAB	PCC	0	0	3	1.5	3	60	40	100
8	22EC5002	DIGITAL COMMUNICATION LAB	PCC	0	0	3	1.5	3	60	40	100
EEC COURSES (SE/AE)											
9	22HE5071	SOFT SKILLS -4 / FOREIGN LANGUAGES	SEC	1	0	0	1	1	100	0	100
			TOTAL	**19**	**1**	**6**	**23**	**25**	**440**	**460**	**900**

SEMESTER VI											
S.NO	**COURSE CODE**	**COURSE TITLE**	**COURSE CATEGORY**	**L**	**T**	**P**	**C**	**TCP**	**CIA**	**ESE**	**TOTAL**
THEORY											
1	22HE6101	PROFESSIONAL ETHICS	HSC	3	0	0	3	3	40	60	100
2	22EC6201	EMBEDDED SYSTEMS AND IOT	PCC	3	0	0	3	3	40	60	100
3	22EC63XX/ 22EC6351	PROFESSIONAL ELECTIVE-4/ NODE JS AND MICRO SERVICES (IBM STUDENTS ONLY)	PEC/ICC	3	0	0	3	3	40	60	100

THEORY WITH LAB COMPONENT											
6	22EC4251	CONTROL SYSTEMS	PCC/ICC	2	0	2	3	3	50	50	100
7	22EC4253	DATA COMMUNICATION AND NETWORKS	PCC	2	0	2	3	3	50	50	100
PRACTICAL											
8	22EC4001	LINEAR INTEGRATED CIRCUITS LAB	PCC	0	0	3	1.5	3	60	40	100
9	22EC4002	ANALOG COMMUNICATION LAB	PCC	0	0	3	1.5	3	60	40	100
EEC COURSES (SE/AE)											
10	22HE4071	SOFT SKILLS -3	SEC	1	0	0	1	1	100	0	100
			TOTAL	**19**	**3**	**10**	**24**	**27**	**620**	**480**	**900**

SEMESTER V											
S.NO	**COURSE CODE**	**COURSE TITLE**	**COURSE CATEGORY**	**L**	**T**	**P**	**C**	**TCP**	**CIA**	**ESE**	**TOTAL**
THEORY											
1	22EC5201	DIGITAL COMMUNICATION	PCC	3	0	0	3	3	40	60	100
2	22EC5202	ANTENNA AND WAVE PROPAGATION	PCC	3	1	0	4	3	40	60	100
3	22EC5203	MICROPROCESSORS AND MICROCONTROLLERS	PCC	3	0	0	3	3	40	60	100
4	22EC53XX/ 22EC5351	PROFESSIONAL ELECTIVE-1/ ANGULAR JS (IBM STUDENTS ONLY)	PEC/ICC	3	0	0	3	3	40	60	100
5	22EC53XX	PROFESSIONAL ELECTIVE-2	PEC	3	0	0	3	3	40	60	100
6	22EC53XX	PROFESSIONAL ELECTIVE-3	PEC	3	0	0	3	3	40	60	100
PRACTICAL											
7	22EC5001	MICROPROCESSORS AND MICROCONTROLLERS LAB	PCC	0	0	3	1.5	3	60	40	100
8	22EC5002	DIGITAL COMMUNICATION LAB	PCC	0	0	3	1.5	3	60	40	100
EEC COURSES (SE/AE)											
9	22HE5071	SOFT SKILLS -4 / FOREIGN LANGUAGES	SEC	1	0	0	1	1	100	0	100
			TOTAL	**19**	**1**	**6**	**23**	**25**	**460**	**440**	**900**

SEMESTER VI											
S.NO	**COURSE CODE**	**COURSE TITLE**	**COURSE CATEGORY**	**L**	**T**	**P**	**C**	**TCP**	**CIA**	**ESE**	**TOTAL**
THEORY											
1	22HE6101	PROFESSIONAL ETHICS	HSC	3	0	0	3	3	40	60	100
2	22EC6201	EMBEDDED SYSTEMS AND IOT	PCC	3	0	0	3	3	40	60	100
3	22EC63XX/ 22EC6351	PROFESSIONAL ELECTIVE-4/ NODE JS AND MICRO SERVICES (IBM STUDENTS ONLY)	PEC/ICC	3	0	0	3	3	40	60	100

4	22EC63XX / 22EC6352	PROFESSIONAL ELECTIVE-5/ IOT AND SPRING FRAMEWORK (IBM STUDENTS ONLY)	PEC/ICC	3	0	0	3	3	40	60	100
5	22EC64XX	OPEN ELECTIVE – 1*	OEC	3	0	0	3	3	40	60	100
THEORY WITH LAB COMPONENT											
6	22EC6253	DIGITAL SIGNAL PROCESSING	PCC	2	0	2	3	4	50	50	100
7	22EC6254	VLSI DESIGN	PCC	2	0	2	3	4	50	50	100
EEC COURSES (SE/AE)											
8	22EC6901	MINI PROJECT 2	AEC	0	0	0	2	1	100	0	100
			TOTAL	**19**	**0**	**4**	**23**	**24**	**400**	**400**	**800**

SEMESTER VII											
S.NO	**COURSE CODE**	**COURSE TITLE**	**COURSE CATEGORY**	**L**	**T**	**P**	**C**	**TCP**	**CIA**	**ESE**	**TOTAL**
THEORY											
1	22EC7201	WIRELESS COMMUNICATION NETWORKS	PCC	3	0	0	3	3	40	60	100
2	22EC7202	MOBILE COMMUNICATION	PCC	3	0	0	3	3	40	60	100
3	22EC7203	AUTOMATIVE ELECTRONICS	PCC	3	0	0	3	3	40	60	100
4	22EC73XX/ 22EC7351	PROFESSIONAL ELECTIVE-6/ BLOCK CHAIN (IBM STUDENTS ONLY)	PEC/ICC	3	0	0	3	3	40	60	100
5	22EC74XX	OPEN ELECTIVE – 2*	OEC	3	0	0	3	3	40	60	100
THEORY WITH LAB COMPONENT											
6	22EC7001	OPTICAL COMMUNICATION AND MICROWAVE ENGINEERING	PCC	2	0	2	3	4	50	50	100
EEC COURSES (SE/AE)											
7	22EC7901	INTERNSHIP	AEC	-	-	-	2	1	100	0	100
			TOTAL	**17**	**0**	**2**	**20**	**20**	**350**	**350**	**700**

SEMESTER VIII											
S.NO	**COURSE CODE**	**COURSE TITLE**	**COURSE CATEGORY**	**L**	**T**	**P**	**C**	**TCP**	**CIA**	**ESE**	**TOTAL**
EEC COURSES (SE/AE)											
1	22EC8901	PROJECT WORK/GRANTED PRODUCT PATENT	AEC	0	0	20	10	20	100	100	200
			TOTAL	**0**	**0**	**20**	**10**	**20**	**100**	**100**	**200**

Note:

1. *As per the AICTE guideline, in Semesters I, II, III & IV NCC one credit subject is added as Value Added Course with Extra Credit. Further, the students who enrolled his/her name in HICET NCC and Air Wing are eligible to undergo this subject. The earned extra credits printed in the Consolidated Mark sheet as per the regulation.
2. NCC course level 1 & Level 2 will be added in the list of open elective subjects in the appropriate semester. Further, the students' who have opted NCC subjects in Semester I, II, III & IV are eligible to undergo NCC Open Elective Subjects.
3. The above-mentioned NCC Courses will be offered to the students who are going to be admitted in the Academic Year 2021 – 22 onwards.

4	22EC63XX / 22EC6352	PROFESSIONAL ELECTIVE-5/ IOT AND SPRING FRAMEWORK (IBM STUDENTS ONLY)	PEC/ICC	3	0	0	3	3	40	60	100
5	22EC64XX	OPEN ELECTIVE – 1*	OEC	3	0	0	3	3	40	60	100
THEORY WITH LAB COMPONENT											
6	22EC6253	DIGITAL SIGNAL PROCESSING	PCC	2	0	2	3	4	50	50	100
7	22EC6254	VLSI DESIGN	PCC	2	0	2	3	4	50	50	100
EEC COURSES (SE/AE)											
8	22EC6901	MINI PROJECT 2	AEC	0	0	0	2	1	100	0	100
			TOTAL	19	0	4	23	24	400	400	800

SEMESTER VII											
S.NO	COURSE CODE	COURSE TITLE	COURSE CATEGORY	L	T	P	C	TCP	CIA	ESE	TOTAL
THEORY											
1	22EC7201	WIRELESS COMMUNICATION NETWORKS	PCC	3	0	0	3	3	40	60	100
2	22EC7202	MOBILE COMMUNICATION	PCC	3	0	0	3	3	40	60	100
3	22EC7203	AUTOMATIVE ELECTRONICS	PCC	3	0	0	3	3	40	60	100
4	22EC73XX/ 22EC7351	PROFESSIONAL ELECTIVE-6/ BLOCK CHAIN (IBM STUDENTS ONLY)	PEC/ICC	3	0	0	3	3	40	60	100
5	22EC74XX	OPEN ELECTIVE – 2*	OEC	3	0	0	3	3	40	60	100
THEORY WITH LAB COMPONENT											
6	22EC7001	OPTICAL COMMUNICATION AND MICROWAVE ENGINEERING	PCC	2	0	2	3	4	50	50	100
EEC COURSES (SE/AE)											
7	22EC7901	INTERNSHIP	AEC	-	-	-	2	1	100	0	100
			TOTAL	17	0	2	20	20	350	350	700

SEMESTER VIII											
S.NO	COURSE CODE	COURSE TITLE	COURSE CATEGORY	L	T	P	C	TCP	CIA	ESE	TOTAL
EEC COURSES (SE/AE)											
1	22EC8901	PROJECT WORK/GRANTED PRODUCT PATENT	AEC	0	0	20	10	20	100	100	200
			TOTAL	0	0	20	10	20	100	100	200

Note:

1. *As per the AICTE guideline, in Semesters I, II, III & IV NCC one credit subject is added as Value Added Course with Extra Credit. Further, the students who enrolled his/her name in HICET NCC and Air Wing are eligible to undergo this subject. The earned extra credits printed in the Consolidated Mark sheet as per the regulation.
2. NCC course level 1 & Level 2 will be added in the list of open elective subjects in the appropriate semester. Further, the students' who have opted NCC subjects in Semester I, II, III & IV are eligible to undergo NCC Open Elective Subjects.
3. The above-mentioned NCC Courses will be offered to the students who are going to be admitted in the Academic Year 2021 – 22 onwards.

SEMESTER WISE CREDIT DISTRIBUTION

B.E. / B.TECH. PROGRAMMES										
S.No.	**Course Area**	**Credits per Semester**								**Total Credits**
		I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	
1	HSC	3	3	-	2	-	3	-	-	**11**
2	BSC	7	9	4	-	-	-	-	-	**20**
3	ESC	6	4	5	-	-	-	-	-	**15**
4	PCC	-	3	12	21	13	9	12	-	**70**
5	PEC	-	-	-	-	9	6	3	-	**18**
6	OEC	-	-	-	-	-	3	3	-	**6**
7	EEC	3	3	3	1	1	2	2	10	**25**
8	MC	-	-	-	-	-	-	-	-	-
	Total	**19**	**22**	**24**	**24**	**23**	**23**	**20**	**10**	**165**

Credit Distribution R2022

Semester	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**Total**
Credits	19	22	24	24	23	23	20	10	**165**

LIST OF INDUSTRIAL CORE COURSES

S. No.	CODE	Courses	CAT	L	T	P	C	CIA	ESE	TOTAL
1	22CS1152	Object Oriented Programming using Python	ICC	2	0	2	3	50	50	100
2	22CS2153	Java Fundamentals	ICC	2	0	2	3	50	50	100
3	22EC3252	Relational Database Management System	ICC	2	0	2	3	50	50	100
4	22EC4252	Design Thinking-An Introduction	ICC	2	0	2	3	50	50	100
5	22EC5351	Angular JS	ICC	2	0	2	3	50	50	100
6	22EC6351	Node JS and Micro services	ICC	2	0	2	3	50	50	100
7	22EC6352	IoT and Spring Framework	ICC	2	0	2	3	50	50	100
8	22EC7351	Blockchain	ICC	2	0	2	3	50	50	100

PROFESSIONAL ELECTIVES

Vertical 1 Electronic System Design	Vertical 2 Communication Systems	Vertical 3 Wireless Networks	Vertical 4 Signal and Image Processing	Vertical 5 Biomedical Technologies	Vertical 6 Diversified Courses
Foundation Skills in Integrated Product Development	Satellite Communication	Network Security	Digital Image Processing	Medical Electronics	App Development
Measurements and Instrumentation	Global Positioning Systems	Wireless Sensors and Networks	Audio Signal Processing	Medical Informatics	Web Technologies
IoT Based System Design	Under Water Communication	High Speed Networks	Machine Vision	Medical Image Processing	Ethical Hacking
PCB Design	RF System Design	Cloud Computing	Artificial Intelligence and Machine Learning	Biometric Systems	Cryptocurrency and Blockchain Technologies
ASIC Design	Software Defined Radio	Wireless Broad Band Networks	Neural Networks and Deep Learning	Medical Robotics	3D Printing and Design
Introduction to PLC Programming	Radar Technologies	Cyber Forensics	Virtual Reality and Augmented Reality	Human Computer Interface	4G/5G Communication Networks

PROFESSIONAL ELECTIVE COURSES: VERTICALS

Vertical 1
Electronic System Design

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1.	22EC5301	Foundation Skills in Integrated Product Development	PEC1	3	0	0	3	3
2.	22EC5302	Measurements and Instrumentation	PEC2	3	0	0	3	3
3.	22EC5303	IoT Based System Design	PEC3	3	0	0	3	3
4.	22EC6301	PCB Design	PEC4	3	0	0	3	3
5.	22EC6302	ASIC Design	PEC5	3	0	0	3	3
6.	22EC7301	Introduction to PLC Programming	PEC6	3	0	0	3	3

Vertical 2
Communication Systems

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1.	22EC5304	Satellite Communication	PEC1	3	0	0	3	3
2.	22EC5305	Global Positioning Systems	PEC2	3	0	0	3	3

3.	22EC5306	Under Water Communication	PEC3	3	0	0	3	3
4.	22EC6303	RF System Design	PEC4	3	0	0	3	3
5.	22EC6304	Software Defined Radio	PEC5	3	0	0	3	3
6.	22EC7302	Radar Technologies	PEC6	3	0	0	3	3

Vertical 3

Wireless Networks

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1.	22EC5307	Network Security	PEC1	3	0	0	3	3
2.	22EC5308	Wireless Sensors and Networks	PEC2	3	0	0	3	3
3.	22EC5309	High Speed Networks	PEC3	3	0	0	3	3
4.	22EC6305	Cloud Computing	PEC4	3	0	0	3	3
5.	22EC6306	Wireless Broad Band Networks	PEC5	3	0	0	3	3
6.	22EC7303	Cyber Forensics	PEC6	3	0	0	3	3

Vertical 4

Signal and Image Processing

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1.	22EC5310	Digital Image Processing	PEC1	3	0	0	3	3
2.	22EC5311	Audio Signal Processing	PEC2	3	0	0	3	3
3.	22EC5312	Machine Vision	PEC3	3	0	0	3	3
4.	22EC6307	Artificial Intelligence and Machine Learning	PEC4	3	0	0	3	3
5.	22EC6308	Neural Networks and Deep Learning	PEC5	3	0	0	3	3
6.	22EC7304	Virtual Reality and Augmented Reality	PEC6	3	0	0	3	3

Vertical 5

Biomedical Technologies

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1.	22EC5311	Medical Electronics	PEC1	3	0	0	3	3
2.	22EC5312	Medical Informatics	PEC2	3	0	0	3	3
3.	22EC5313	Medical Image Processing	PEC3	3	0	0	3	3
4.	22EC6309	Biometric Systems	PEC4	3	0	0	3	3
5.	22EC6310	Medical robotics	PEC5	3	0	0	3	3
6.	22EC7305	Human Computer Interface	PEC6	3	0	0	3	3

Vertical 6

Diversified courses

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1.	22EC5314	App Development	PEC1	3	0	0	3	3
2.	22EC5315	Web Technologies	PEC2	3	0	0	3	3
3.	22EC5316	Ethical Hacking	PEC3	3	0	0	3	3
4.	22EC6311	Cryptocurrency and Blockchain Technologies	PEC4	3	0	0	3	3
5.	22EC6312	3D Printing and Design	PEC5	3	0	0	3	3
6.	22EC7306	4G/5G Communication Networks	PEC6	3	0	0	3	3

OPEN ELECTIVE I
(VI SEMESTER – COMMON LIST FOR ALL THE PROGRAMS)
(EMERGING TECHNOLOGIES)

Students must choose an open elective course from the given list. The content of the course should not be related to their current program of study.

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	Strength
				L	T	P			
1	22AI6401	Artificial Intelligence and Machine Learning Fundamentals	OEC	3	0	0	3	3	65
2	22CS6401	Block chain Technology Fundamentals	OEC	3	0	0	3	3	130
3	22EC6402	IoT Concepts and Applications	OEC	3	0	0	3	3	130
4	22IT6401	Data Science and Analytics Fundamentals	OEC	3	0	0	3	3	130
5	22BM6401	3D printing	OEC	3	0	0	3	3	65
6	22AE6401	Space Science	OEC	3	0	0	3	3	65
7	22MT6401	Introduction to Industrial Engineering	OEC	3	0	0	3	3	65
8	22MT6402	Industrial Safety and Environment	OEC	3	0	0	3	3	65
9	22CE6401	Climate Change and its Impact	OEC	3	0	0	3	3	65
10	22CE6402	Environment and Social Impact Assessment	OEC	3	0	0	3	3	65
11	22ME6401	Renewable Energy System	OEC	3	0	0	3	3	65
12	22ME6402	Additive Manufacturing systems	OEC	3	0	0	3	3	65
13	22EI6401	Introduction to Industrial Instrumentation and Control	OEC	3	0	0	3	3	65
14	22AU6401	Basics of Automobile Engineering	OEC	3	0	0	3	3	65
15	22EE6401	Fundamentals of Electric vehicles	OEC	3	0	0	3	3	65

16	22FT6401	Traditional Foods	OEC	3	0	0	3	3	65
17	22AG6401	Urban Agriculture and Organic Farming	OEC	3	0	0	3	3	65
18	22CH6401	Waste to Energy conversion	OEC	3	0	0	3	3	65
19		NCC Level - I	OEC	3	0	0	3	3	65

OPEN ELECTIVE II
(VII SEMESTER - COMMON LIST FOR ALL THE PROGRAMS)
LIFE SKILL COURSES

Students shall choose any one of the Life Skill courses from the open elective courses listed below.

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTAC T PERIODS	CREDITS	Strength
				L	T	P			
1	22LS7401	General studies for competitive examinations	OEC	3	0	0	3	3	130
2	22LS7402	Human Rights, Women Rights and Gender equity	OEC	3	0	0	3	3	130
3	22LS7403	Indian ethos and Human values	OEC	3	0	0	3	3	130
4	22LS7404	Financial independence and management	OEC	3	0	0	3	3	130
5	22LS7405	Yoga for Human Excellence	OEC	3	0	0	3	3	130
6	22LS7406	Democracy and Good Governance	OEC	3	0	0	3	3	130
7	22LS7407	NCC Level - II	OEC	3	0	0	3	3	130
8	22LS7408	Cybercrime and Awareness	OEC	3	0	0	3	3	130
9	22LS7409	First Aid and Emergency care	OEC	3	0	0	3	3	130
10	22LS7410	Business Communication	OEC	3	0	0	3	3	130

Enrollment for B.E. / B. TECH. (HONOURS) / Minor Degree (optional)

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E. / B. Tech. (Honours) or Minor Degree. For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only. For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes.

Clause 4.10 of Regulation 2022 is applicable for the Enrolment of B.E. / B. TECH. (HONOURS) / Minor Degree (Optional).

HONOUR DEGREE VERTICAL COURSES

S. No.	Vertical-I Sensor Technologies and IoT	Vertical II Advanced Communication Systems	Vertical III Semiconductor Chip Design and Testing
1	Realtime Embedded Systems	Cognitive Radio Networks	Wide Bandgap Devices
2	Sensor for IoT applications	Remote Sensing	Validation and Testing Technology
3	Advanced Processor Architectures	Rocketry and Space Mechanics	Low Power VLSI
4	IOT Processors	Underwater Navigation Systems	VLSI Testing and Design for Testability
5	Wearable Devices	Massive MIMO Networks	Mixed Signal IC Design Testing
6	Industrial IoT and Industry 4.0	Advanced Wireless Communication Techniques	Analog IC Design

Vertical-I
Sensor Technologies and IoT

S No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
1	22EC5371	Realtime Embedded Systems	HDC	3	0	0	3	40	60	100
2	22EC6371	Sensor for IoT applications	HDC	3	0	0	3	40	60	100
3	22EC6372	Advanced Processor Architectures	HDC	3	0	0	3	40	60	100
4	22EC7371	IOT Processors	HDC	3	0	0	3	40	60	100
5	22EC7372	Wearable Devices	HDC	3	0	0	3	40	60	100
6	22EC8371	Industrial IoT and Industry 4.0	HDC	3	0	0	3	40	60	100

Vertical-II
Advanced Communication Systems

S No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
1	22EC5372	Cognitive Radio Networks	HDC	3	0	0	3	40	60	100
2	22EC6373	Remote Sensing	HDC	3	0	0	3	40	60	100
3	22EC6374	Rocketry and Space Mechanics	HDC	3	0	0	3	40	60	100
4	22EC7373	Underwater Navigation Systems	HDC	3	0	0	3	40	60	100
5	22EC7374	Massive MIMO Networks	HDC	3	0	0	3	40	60	100
6	22EC8372	Advanced Wireless Communication Techniques	HDC	3	0	0	3	40	60	100

Vertical-III
Semiconductor Chip Design and Testing

S No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
1	22EC5373	Wide Bandgap Devices	HDC	3	0	0	3	40	60	100
2	22EC6375	Validation and Testing Technology	HDC	3	0	0	3	40	60	100
3	22EC6376	Low Power VLSI	HDC	3	0	0	3	40	60	100
4	22EC7375	VLSI Testing and Design for Testability	HDC	3	0	0	3	40	60	100
5	22EC7376	Mixed Signal IC Design Testing	HDC	3	0	0	3	40	60	100
6	22EC8373	Analog IC Design	HDC	3	0	0	3	40	60	100

MINOR DEGREE VERTICAL COURSES
Embedded and IoT

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22EC5471	Electronics for Embedded Systems	MDC	3	0	0	3	3
2	22EC6471	Microcontroller and its Applications	MDC	3	0	0	3	3
3	22EC6472	Sensor and Embedded Systems	MDC	3	0	0	3	3
4	22EC7471	Fundamentals of IoT	MDC	3	0	0	3	3
5	22EC7472	Industrial IoT	MDC	3	0	0	3	3
6	22EC8471	IoT for Smart Systems	MDC	3	0	0	3	3

Vertical II
Fintech and Block Chain

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22CS5602	Financial Management	MDC	3	0	0	3	3
2	22MB6231	Fundamentals of Investment	MDC	3	0	0	3	3
3	22MB6232	Banking, Financial Services and Insurance	MDC	3	0	0	3	3
4	22MB7231	Introduction to Blockchain and its Applications	MDC	3	0	0	3	3
5	22MB7232	Fintech Personal Finance and Payments	MDC	3	0	0	3	3
6	22MB8231	Introduction to Fintech	MDC	3	0	0	3	3

Vertical III
Entrepreneurship

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22BA5601	Foundation of Entrepreneurship	MDC	3	0	0	3	3
2	22BA6601	Introduction to Business Venture	MDC	3	0	0	3	3
3	22BA6602	Team Building & Leadership Management for Business	MDC	3	0	0	3	3
4	22BA7601	Creativity & Innovation in Entrepreneurship	MDC	3	0	0	3	3
5	22BA7602	Principles of Marketing Management for Business	MDC	3	0	0	3	3
6	22BA8601	Human Resource Management for Entrepreneurs	MDC	3	0	0	3	3
7	22BA8602	Financing New Business Ventures	MDC	3	0	0	3	3

Vertical IV
Environment and Sustainability

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22CEXXXX	Sustainable Infrastructure Development	MDC	3	0	0	3	3
2	22AG6233	Sustainable Agriculture and Environmental Management	MDC	3	0	0	3	3
3	22BM6233	Sustainable Bio Materials	MDC	3	0	0	3	3
4	22ME7233	Materials for Energy Sustainability	MDC	3	0	0	3	3
5	22CE7233	Green Technology	MDC	3	0	0	3	3
6	22CE8232	Environmental Quality Monitoring and Analysis	MDC	3	0	0	3	3

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COIMBATORE - 641 032.

Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC6201	EMBEDDED SYSTEMS AND IOT	3	0	0	3

Course Objectives	1. To learn the internal architecture and interfaces of an embedded system. 2. To interpret the concepts of real-time operating systems. 3. To ffamiliarize the embedded system design methodologies. 4. To get an idea where the application areas are available for the Internet of Things. 5. To survey successful IoT products and solutions to analyze their architecture and technologies.
Course Prerequisite	22EC5203-Microprocessors and Microcontrollers

Unit	Description	Instructional Hours
I	**INTRODUCTION TO EMBEDDED SYSTEMS** Introduction – Classification – Major Applications – Embedded system design process - General purpose and Domain specific processors – Designing with computing platforms- Sensors and Actuators – Communication Interfaces.	9
II	**REAL TIME OPERATING SYSTEMS** Operating System Basics – Types – Tasks –Multirate systems- Process and Threads – Multiprocessor and Multitasking –Interprocess communication mechanisms – Evaluating operating system performance- VxWorks – MicroC/OS-II.	9
III	**SYSTEM DESIGN TECHNIQUES AND NETWORKS** Design methodologies- Design flows - Requirement Analysis – Specifications-System analysis and architecture design – Quality Assurance techniques- Distributed embedded systems – MPSoCs and shared memory multiprocessors	9
IV	**OVERVIEW OF IoT UNDERSTANDING** Introduction – Physical and Logical design of IoT – IoT Enabling Technologies – IoT levels and deployment templates.- IoT protocols: MQTT and AMQP- IoT Security: AES and TLS1.2, FOTA	9
V	**APPLICATION DEVELOPMENT** Introduction to Embedded C Programming -Consumer Electronics IoT, -Automotive IoT -Health Care IoT and Industrial IoT. -Weather monitoring system – Forest Fire detection – Agriculture – Productivity Applications- Cloud based Data Analysis.	9
	Total Instructional Hours	45

Course Outcomes	Upon successful completion of the course, the students will have the ability to: CO1: Explore the knowledge about embedded systems. CO2: Analyze program design and scheduling of the process. CO3: Summarize the embedded system design techniques. CO4: Familiarize the concept of IoT system design. CO5: Develop a small portable IoT application.

TEXT BOOKS:

T1-Introduction to Embedded System, Shibu.K.V, McGraw and Hill Education, 13th Edition, 2014.
T2-Internet of Things: An hands on approach, Arshdeep Bahga, Vijay Madisetti, University Press, 2014.

REFERENCE BOOKS:

R1 - Raspberry Pi cookbook: Software and hardware problems and solutions, Monk, Simon. O'Reilly Media, Inc., 2016.

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R2- The Internet of Things: Applications to the Smart Grid and Building Automation by – Olivier Hersent, Omar Elloumi and David Boswarthick – Wiley Publications -2012.
R3- Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for theInternet of Things", CISCO Press, 2017.
R4- IOT (Internet of Things) Programming: A Simple and Fast Way of Learning,IoT Kindle Edition.

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1	2	3	3	3	2	3	-	-	-	2	-	3	3	3
CO2	3	3	2	2	3	3	-	-	-	2	-	3	3	3
CO3	3	2	3	3	3	2	-	-	-	1	-	3	3	3
CO4	3	3	3	2	2	2	-	-	2	1	2	3	3	3
CO5	3	3	3	3	3	3	3	-	2	2	2	3	3	3
AVG	3	3	3	3	3	3	3	-	2	2	2	3	3	3

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Programme	Course code	Name of the course	L	T	P	C
BE	22EC6253	DIGITAL SIGNAL PROCESSING	2	0	2	3

Course Objectives	1. To familiarize with discrete Fourier transform and its properties. 2. To recall the characteristics of IIR filters. 3. To summarize the design of Finite Impulse Response filters. 4. To interpret finite word length effects. 5. To learn the concepts and its application of DSP Processors.	
Course Prerequisite	22EC3202-Signals and Systems	
Unit	**Description**	**Instructional Hours**
I	**DISCRETE FOURIER TRANSFORM** Introduction to DFT–FFT Algorithms –Radix 2 FFT algorithms, Decimation in time Algorithms, Decimation in frequency Algorithms, Inverse DFT using FFT	6
II	**IIR FILTER DESIGN** IIR filter design: Butterworth approximation using Impulse Invariance Transform and Bilinear transformation, Chebyshev approximation using Impulse Invariance Transform and Bilinear transformation. (LPF)	6
III	**FIR FILTER DESIGN** Linear phase realization of FIR filters-Design of linear phase FIR filters using Windows (Rectangular Window, Hamming Window, Hanning Window)- FIR filter Design using Frequency sampling method.	6
IV	**FINITE WORDLENGTH EFFECTS** Quantization by Truncation and Rounding – Quantization of filter coefficients – Product quantization error - Limit cycle oscillations in recursive systems: Zero input limit cycle oscillation, Overflow limit cycle oscillation – Scaling to prevent Overflow.	6
V	**INTRODUCTION TO DSP PROCESSOR** DSP functionalities - circular buffering – TMS320C67X DSP Processor DSP architecture – Fixed- and Floating-point architecture principles – Programming – Application examples.	6
List of Experiments 1. Spectral analysis using FFT algorithms. 2. Filtering very long sequence using sectioned convolution. 3. Design of FIR filters using Rectangular, Hamming and Hanning windows. 4. Design of Digital IIR filters using Bilinear and Impulse Invariant Transforms. 5. Analysis of limit cycle oscillations in recursive digital filters due to quantization.		15
	Total Instructional Hours	45
Course Outcome	Upon successful completion of the course, the students will have the ability to: CO1: Apply DFT for the analysis of digital signals & systems CO2: Design IIR Butterworth and Chebyshev filters CO3: Design FIR filters using windowing techniques. CO4: Illustrate Finite word length effect on filters. CO5: Recognize the applications of DSP Processor.	
TEXT BOOKS		

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T1- John G. Proakis& Dimitris G.Manolakis, "Digital Signal Processing – Principles, Algorithms & Applications", Fourth Edition, Pearson Education / Prentice Hall, 2007.
T2- B. Venkataramani & M. Baskar, "Digital Signal Processing - Principles, Algorithms & Applications"- Mc Graw Hill, 2017

REFERENCE BOOK

R1- A.V.Oppenheim, R.W. Schafer and J.R. Buck, "Discrete-Time Signal Processing", 8th Indian Reprint, Pearson,2004
R2- Emmanuel C..Ifeachor, &Barrie.W.Jervis, "Digital Signal Processing", Second Edition, Pearson Education, Prentice Hall, 2002
R3- A.NagoorKani, "Digital Signal Processing", 2010 Edition,Mc Graw Hill Education (India) Pvt. Ltd
R4- P.Ramesh Babu, "Digital Signal Processing "- Fourth Edition,2011

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	3	-	-	-	-	-	-	3	2	3
CO2	3	2	2	3	3	-	-	-	-	-	-	3	3	3
CO3	2	3	3	2	3	-	-	-	-	-	-	3	3	3
CO4	3	3	3	2	2	-	-	-	-	-	-	3	3	3
CO5	3	3	3	3	2	-	-	-	-	-	-	3	2	3
AVG	2.8	2.8	2.8	2.4	2.6	-	-	-	-	-	-	3	2.6	3

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Programme	Course Code	Name of the Course	L	T	P	C
BE	**22EC6254**	**VLSI DESIGN**	**2**	**0**	**2**	**3**

Course Objective	1.To recall the fundamentals of CMOS and MOS design 2.To interpret silicon processing and resistance, capacitance Estimation 3.To develop the CMOS circuits and logic design 4.To construct the ultrafast systems and high-speed adders 5.To build CMOS testing and arithmetic building blocks
Course Prerequisite	22EC3203-Digital Electronics 22EC5203-Microprocessors and Microcontrollers

Unit	Description	Instructional Hours
I	**INTRODUCTION TO CMOS CIRCUITS AND MOS TRANSISTOR THEORY** MOS transistors – CMOS logic – Introduction to nMOS, pMOS enhancement transistor – MOS device design equation – Basic DC equation, second order effects – Complementary CMOS inverter – DC characteristics. Introduction to FinFET. **Experimental study: Characteristics of CMOS Invertor using SPICE**	6+3
II	**CMOS PROCESSING, CIRCUIT CHARACTERIZATION AND PERFORMANCE ESTIMATION** Silicon semiconductor technology: An overview – Basic CMOS technology —Resistance estimation – Capacitance estimation – Switching characteristics -- Analytical delay models, Gate delays – Power dissipation. **Experimental study: Simulation of Basic logical gates, Half and full adders**	6+3
III	**CMOS CIRCUITS AND LOGIC DESIGN** CMOS logic gate design –physical design of simple logic gates – INVERTER, NAND and NOR gates, Complex logic gateslayout, CMOS standard cell design – CMOS logic structures – Pseudo nMOS logic, Dynamic CMOS logic, Clocked CMOS logic, Introduction to Clocking strategies **Experimental study: Simulation of Multiplexer and Demultiplexer.**	6+3
IV	**INTRODUCTION TO GaAs TECHNOLOGY &ARITHMETIC BUILDING BLOCKS** Ultra-fast systems – Gallium arsenide crystal structure, Architectures for ripple carry adders, carry look ahead adders, High speed adders. **Experimental study: Simulation of Flip flop - RS, D and JK.**	6+3
V	**INTRODUCTION TO PLD'S AND FPGA** Introduction Simple PLD's- Read only memories- Programmable Array Logic-Programmable Logic Array -FPGA program technology-Programmable logic blocks-Programmable Interconnects-Programmable I/O blocks in FPGA-Xilinx XC 2000 **Experimental study: Synthesis of full adder using FPGA**	6+3
	Total Instructional Hours	**30+15**

Course Outcome	Upon successful completion of the course, the students will have the ability to: CO1: Summarize the CMOS and MOS transistors. CO2: Analyze the CMOS passive components estimation. CO3: Compare the performance of various CMOS logic techniques CO4: Interpret the ultra-fast systems and arithmetic building blocks CO5: Elaborate the various CMOS testing techniques.

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TEXT BOOKS:
T1-Neil H E Weste and Kamran Eshranghian, "Principles of CMOS VLSI Design: A system Perspective", Second edition, Pearson education Asia. T2- Douglas A Pucknell and Kamran Eshranghian, "Basic VLSI Design", Third edition, Prentice Hall of India. T3-Field Programmable Gate Array Technology-Stephen M. Trimberger, Spinger International
REFERENCE BOOKS:
R1- -Samir Palnitkar, "Verilog HDL – A guide top Digital Design and Synthesis", Second edition, Pearson education. R2 - Neil H E Weste and David money Haris, "CMOS VLSI Design: A circuits and systems Perspective",Addison Wesley, New Delhi, 2010. R3 - Sung-Mo Kanga and Yusuf Leblebici, "CMOS Digital Integrated Circuits- Analysis and Design", Tata McGraw Hill, New Delhi, 2004.

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1	3	3	2	3	2	-	-	-	-	3	-	2	3	2
CO2	3	3	2	3	2	-	-	-	-	2	-	2	3	2
CO3	3	2	3	3	2	-	-	-	-	2	-	2	3	2
CO4	3	2	3	2	2	-	-	-	-	2	-	2	3	2
CO5	3	2	3	3	2	-	-	-	-	2	-	2	3	3
AVG	3	2.4	2.6	2.8	2	-	-	-	-	2.2	-	2	3	2.2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC6307	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	3	0	0	3
Course Objectives	1. To understand the basics of Artificial Intelligence and problem-solving agents. 2. To apply the appropriate Heuristic search techniques in problem solving. 3. To understand the basics of Machine learning and compare supervised, unsupervised learning. 4. To implement linear regression, classification models like logistic regression and SVMs, and decision trees for the necessary application. 5. To investigate back propagation in neural network.					
Prerequisite	22EC3202 -Signals and systems					

Unit	Description	Instructional Hours
I	**INTRODUCTION TO ARTIFICIAL INTELLIGENCE** Introduction to AI – Agents and Environments – concept of rationality – nature of environments – structure of agents. Problem solving agents – search algorithms – uninformed search strategies.	9
II	**PROBLEM SOLVING** Heuristic search strategies – heuristic functions. Local search and optimization problems – local search in continuous space – search with non-deterministic actions – search in partially observable environments – online search agents and unknown environments	9
III	**INTRODUCTION TO MACHINE LEARNING** Introduction to Machine Learning-Supervised Learning Algorithms - Unsupervised Learning Algorithms – Reinforcement Learning, Deep Learning-Dimensionality reduction.	9
IV	**SUPERVISED LEARNING AND UNSUPERVISED LEARNING ALGORITHMS** Regression models-Linear regression, logistic regression -Classification Models-Decision trees, Naïve Bayes, K-nearest neighbor algorithm-Support Vector Machines-Self Organizing Map.	9
V	**NEURAL NETWORKS** Perceptron - Multilayer perceptron, activation functions, network training – gradient descent optimization – stochastic gradient descent, error backpropagation- Building a Machine Learning Algorithm	9
	Total Instructional Hours	45
Course Outcomes	Upon successful completion of the course, the students will have the ability to: CO1: Interpret Intelligent agent frameworks. CO2: Design heuristic-based algorithms and evaluate their effectiveness for problem-solving in uncertain or partially observable environments. CO3: Compare supervised, unsupervised, and reinforcement learning algorithms to solve complex data-driven problems in machine learning. CO4: Implement and evaluate regression, classification and decision tree models to achieve accurate predictions using supervised and unsupervised learning. CO5: Develop and train neural network architectures, including perceptions and multilayer networks, using techniques like gradient descent and error backpropagation.	

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TEXT BOOKS:
T1- Stuart Russell and Peter Norvig, "Artificial Intelligence – A Modern Approach", Fourth Edition, Pearson Education, 2021. T2: Stephen Marsland, "Machine Learning – An Algorithmic Perspective", Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
REFERENCE BOOKS:
R1: Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Fourth Edition, 2020. R2: Patrick H. Winston, "Artificial Intelligence", Third Edition, Pearson Education, 2006 R3: Tom Mitchell, "Machine Learning", McGraw Hill, 3rd Edition, 2017 R4: Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006. R5: Kevin Night, Elaine Rich, and Nair B., "Artificial Intelligence", McGraw Hill, 2008

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	3	-	2	-	-	-	-	-	3	3	3
CO2	3	3	3	3	2	2	-	-	-	-	-	3	3	3
CO3	3	1	1	3	-	2	-	-	-	-	-	3	3	3
CO4	3	3	3	3	2	2	-	-	-	-	-	3	3	3
CO5	3	3	3	3	2	2	-	-	-	-	-	3	3	3
AVG	3	2.2	2.2	3	2	2	-	-	-	-	-	3	3	3

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC6302	ASIC DESIGN	3	0	0	3

Course Objectives	1. To Recall the fundamentals of ASIC and CMOS logic design 2. To familiarize with the various principles of programmable ASIC design 3. To impart knowledge on ASIC architecture and various logic synthesis techniques 4. To Summarize the concepts of delay models and logic simulation. 5. To Interpret with the concepts of floor planning and system partitioning
Course Prerequisit	22EC6254-VLSI DESIGN

Unit	Description	Instructional Hours
I	**ASIC AND CMOS LOGIC DESIGN** Types of ASICs - Design flow - CMOS transistors - Combinational Logic Cell – Sequential logic cell - Data path logic cell - Transistors as Resistors - Transistor Parasitic Capacitance.	9
II	**PROGRAMMABLE ASIC** Anti-fuse - static RAM - EPROM and EEPROM technology - Actel ACT - Xilinx LCA –Altera FLEX - Altera MAX DC & AC inputs and outputs - Clock & Power inputs - Xilinx I/O blocks.	9
III	**ASIC ARCHITECUTRE AND LOGIC SYNTHESIS** Architecture and configuration of Spartan and Virtex FPGAs- Logic Synthesis with an example-Finite State Machine Synthesis - Memory Synthesis.	9
IV	**LOGIC SIMULATION** Simulation-Logic Systems - Cell Models - Delay Models – Static Timing Analysis - Formal verification - Switch level and Transistor level simulation.	9
V	**ASIC CONSTRUCTION** System Partitioning – FPGA Partitioning, Partitioning Methods- Kernighan-Lin algorithm. Floor Planning - Placement-min cut & Eigen value algorithm - Routing-Global & Detailed routing.	9
	Total Instructional Hours	**45**

Course Outcomes	Upon successful completion of the course, the students will have the ability to: CO1: Understand the concepts of basic ASIC and CMOS logic design. CO2: Compare and analyze the various types of Programmable ASICs. CO3: Develop the ASIC architecture and logic synthesis. CO4: Analyze the various techniques used in the logic simulation and delay models. CO5: Construct the various methods system floor planning and partitioning.

TEXT BOOKS:

T1- M.J.S.Smith, “Application - Specific Integrated Circuits", Pearson, 2003.

REFERENCE BOOKS:

R1. Steve Kilts, “Advanced FPGA Design,” Wiley Inter-Science.

R2. Roger Woods, John McAllister, Dr. Ying Yi, Gaye Lightbod, “FPGA-based Implementation of Signal Processing Systems”, Wiley, 2008.

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R3. Mohammed Ismail and Terri Fiez, "Analog VLSI Signal and Information Processing ", McGraw Hill, 1994

R4. Douglas J. Smith, HDL Chip Design, Madison, AL, USA: Do one Publications, 1996.

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3	2	2	-	-	-	-	-	3	3	3
CO2	3	3	3	3	2	2	-	-	-	-	-	3	3	3
CO3	3	2	2	3	2	2	-	-	-	-	-	3	3	3
CO4	3	3	3	2	2	2	-	-	-	-	-	3	3	3
CO5	3	2	2	2	3	2	-	-	-	-	-	3	3	3
AVG	3	2.4	2.4	2.6	2.2	2	-	-	-	-	-	3	3	3

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC6305	CLOUD COMPUTING	3	0	0	3

Course Objectives	1. To impart the concepts of cloud computing along with definition of organizational roles. 2. To review the evolution of cloud from the enabling technologies. 3. To gain knowledge on various cloud computing specialized mechanism. 4. To explore cloud computing design principles in architectural models. 5. To be familiar with the security threats and security mechanism in cloud.	
Course Prerequisite	22IT1151-Python and Java Programming 22EC4253- Data Communication and Networks	
Unit	**Description**	**Instructional Hours**
I	**INTRODUCTION TO CLOUD COMPUTING** Understanding Cloud Computing- Cloud concepts and Terminology-Goals and Benefits –Risks and Challenges- Cloud Characteristics-Cloud Delivery Models – Cloud deployment Models.	9
II	**CLOUD ENALBLING TECHNOLOGY** Broadband Networks and Internet Architecture-ISPs-Technical and Business consideration Data Centre Technology-Virtualization Technology - Operating System Based Virtualization-Hardware Based Virtualization -Virtualization Management- Web and Service Technology-Web Services-REST Services-Service Agents and Middle ware.	9
III	**CLOUD COMPUTING AND SPECIALIZED MECHANISM** Logical Network Perimeter-Virtual Server –cloud storage Device-Cloud Usage Monitor –Automated scaling Listener-Load balancer-SLA Monitor-Hypervisor-Resource cluster-Multi Device Broker	9
IV	**CLOUD COMPUTING ARCHITECTURE** Fundamental cloud Architecture-Elastic Resource Capacity Architecture-Service load Balancing Architecture-Cloud Bursting Architecture –Advanced Cloud Architecture-Hypervisor clustering Architecture –Cloud Balancing Architecture-Specialized cloud Architecture- Direct I/O Access Architecture-Elastic Network Capacity Architecture.	9
V	**CLOUD MANAGEMENT AND SECURITY MECHANISM** Resource Management system-SLA Management System-Billing management system-Identity and Access Management (IAM) –Single Sign-On (SSO)-Cloud Based Security Groups	9
	Total Instructional Hours	45
Course Outcomes	Upon successful completion of the course, the students will have the ability to: CO1: Infer the concepts and Terminology of Cloud Computing CO2: Compare and Contrast the cloud technology with existing technology CO3: Interpret and outline the various Cloud Computing Mechanism CO4: Identify and comprehend the essential components and infrastructure in Cloud environment CO5: Demonstrate strategies and technologies to mitigate the management and security mechanism.	

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TEXT BOOKS
T1-Cloud Computing Concepts, Technology and Architecture
T2-Distributed and Cloud Computing. Kal Hwang. GeoffeiyC.Fox. Jack J.Dongarra. Elsevier. 2012.

REFERENCE BOOKS:
R1-Cloud Computing: A Practical Approach. Anthony T.Velte. Toby J.VeFte, Robert Elsenpeter. Tata McGraw Hill. rp20ll.
R2-Enterprise Cloud Computing GautamShroif, Cambridge University Press. 2010.
R3-Cloud Computing: Implementation, Management and Security, John W. Rittinouse, James F Ransome. CRC Press, rp2012

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	-	-	-	-	2	-	2	3	2
CO2	3	3	3	3	-	-	-	-	-	3	-	1	3	2
CO3	3	2	2	2	-	-	-	-	-	2	-	1	2	2
CO4	3	3	3	2	-	-	-	-	-	2	-	2	2	3
CO5	3	3	2	3	-	-	-	-	-	2	-	2	2	2
AVG	3	2.8	2.4	2.4	-	-	-	-	-	2.2	-	1.6	2.4	2.2

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Programme	Course code	Name of the Course	L	T	P	C
BE	22HE6101	PROFESSIONAL ETHICS	3	0	0	3

Course Objective	1. To foster ethical behavior and life skills for holistic development. 2. To educate the value of Engineering Ethics 3. To inculcate the social responsibility of an engineer. 4. To impart knowledge on issues related to safety, responsibility and rights 5. To educate on professional practice on global issues

Unit	Description	Instructional Hours
I	**VALUE EDUCATION** Moral values and Right understanding- Holistic development and the Role of Value Education- Understanding Value Education- Self-exploration as the process for value Education- Integrity -Work Ethics- Empathy- Spirituality	9
II	**ENGINEERING ETHICS** Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.	9
III	**ENGINEERING AS SOCIAL EXPERIMENTATION:** Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.	9
IV	**SAFETY, RESPONSIBILITIES AND RIGHTS** Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.	9
V	**GLOBAL ISSUES** Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility	9
	Total Instructional Hours	45

Course Outcomes	CO1: Understand the importance of various components of human values CO2: Apply ethics in society CO3: Discuss the ethical issues related to engineering and CO4: Realize the responsibilities and rights in the society CO5: Apply professional ethics in solving global issues

TEXT BOOKS:

T1-Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata Mc Graw Hill, New Delhi, 2003.

T2-Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2009.

REFERENCES BOOKS:

R1-Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.

R2-John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003

R3-Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC6301	PCB DESIGN	3	0	0	3

Course Objective	To provide an overview of PCB components, classifications, and basic manufacturing processes. To outline general and special circuit design rules for analog, digital, high-frequency, and power electronic circuits. To acquire knowledge about techniques used to transfer images, plating, and etching. To summarize the PCB Technology trends. To discuss emerging trends like fine-line conductors, multilayer boards, flexible PCBs, metal core boards, and mechanical milling techniques.

Unit	Description	Instructional Hours
I	**BASICS OF PRINTER CIRCUIT BOARDS :** Component of a PCB – Classification of PCB - Manufacturing of Basic PCB – Layout planning General PCB considerations – Layout Approaches – Standards : Mechanical Design Considerations - Electrical Design Considerations –Layout Design : Grid Systems - Layout Scale – Layout Sketch / Design – Layout considerations.	9
II	**DESIGN CONSIDERATIONS FOR SPECIAL CIRCUITS** Design Rules for Analog Circuits : Components and Placement – Signal Conductors – Supply and Ground Connectors – General Rules for design of Analog PCBs. Design Rules for Digital Circuits : Transmission Lines - Problems in Design of PCBs for digital circuits. Design rules for PCBs for High frequency circuits, Fast Pulse Circuits , Microwave Circuits and Power Electronic Circuits.	9
III	**IMAGE TRANSFER, PLATING AND ETCHING TECHNIQUES** Image Transfer Techniques: Laminates Surface Preparation – Screen Printing – Pattern Transferring Techniques – Printing Links – Printing Process - Photo Painting - Laser Diode Imaging(LDI) - Plating Process : need for Plating – Plating Techniques – General Problems in Plating - Special plating Techniques - Etching Techniques : Etching Arrangements - Etching Parameters – Equipment and Techniques - Optimizing Etchant Economy	9
IV	**TECHNOLOGY OF PRINTED CIRCUIT BOARDS** Film Master Production : Emulsion Parameters – Film Emulsions – Dimensional Stability of Film Masters – Reprographic Cameras– - – Film Processing - Film Registration - Photo printing : Basic processes for Double sided PCBs – Wet Film resists and Dry Film resists.	9
V	**PCB TECHNOLOGY TRENDS** Fine–line Conductors with Ultra–Thin copper Foil - Multilayer Boards - Multiwire Boards – Subtractive-Additive processes - Semi-Additive Processes – Additive Processes – Flexible Printed Circuit Boards – Metal Core Circuit Boards – Mechnaical Milling of PCBs.	9
	Total Instructional Hours	45

Course Outcome	Upon successful completion of the course, the students will have the ability to : CO1: Explain the basic components, classifications, and layout planning considerations for PCBs.. CO2: Enumerate PCB Design considerations in Special circuits. CO3: Gain practical knowledge of various image transfer methods used in PCB manufacturing. CO4: Recognize the diverse technologies involved in creating PCBs, ranging from film mastering to advanced PCB varieties. CO5: Summarize current trends and innovations in PCB technology, enabling students to stay informed about industry developments.

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TEXT BOOKS:
T1:Walter C Bosshart , "Printed Circuits Boards Design and Technology" - Tata McGraw- Hill , 2008 T2:R.S.Khandpur, "Printed Circuit Boards Design, Fabrication, Assemble and Testing", TMH, 2005.
REFERENCE BOOKS:
R1:ChristoperT.Robertson, " PCB Designers Referennce : Basics" - Prentice Hall, First edition , 2003. R2:C.F.Coombs, "Printed Circuits Handbook", McGraw-Hill, 2001.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	2	-	-	-	2	2	2	2	2
CO2	3	3	3	3	2	2	-	-	-	2	2	2	2	2
CO3	3	3	3	3	2	1	-	-	-	2	2	2	2	2
CO4	3	2	2	4	2	2	-	-	-	2	0	2	2	1
CO5	3	2	2	3	2	1	-	-	-	2	2	2	2	1
AVG	3	2.6	2.6	3.2	2	1.6	-	-	-	2	1.6	2	2	1.6

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC6303	RF SYSTEM DESIGN	3	0	0	3

Course Objective	To evaluate and integrate advanced passive and active components into radio frequency circuits. To gain knowledge on microstrip line filters To understand the working principle of active RFcomponents for various applications. To design biasing circuits for RF amplifiers To analyze advanced RF oscillator, mixer, power divider, and coupler technologies for diverse applications.	
Unit	**Description**	**Instructional Hours**
I	**INTRODUCTION TO RF DESIGN** Importance of RF design, Electromagnetic Spectrum, RF behavior of passive Components, Chip components and Circuit Board considerations, Scattering Parameters, Smith Chart and applications.	9
II	**RF FILTER DESIGN** Overview, Basic resonator and filter configuration, Special Filter Realizations, Filter Implementations, Unit element, Kurodas Identity , Coupled Filters.	9
III	**ACTIVE RF COMPONENTS & APPLICATIONS** RF Diodes, BJT, RF FETs, High electron mobility transistors; Matching and Biasing Networks – Impedance matching using discrete components, Microstrip line matching networks, Amplifier classes of operation and biasing networks.	9
IV	**RF AMPLIFIER DESIGN** Characteristics, Amplifier Power relations, Stability Considerations, Constant gain circles, Constant VSWR circles, Broadband, Low power, High power and multistage amplifiers.	9
V	**OSCILLATORS, MIXERS & APPLICATIONS** Basic oscillator Model - high frequency oscillator configuration - Basic characteristics of mixers - RF couplers - Wilkinson divider - Detector and demodulator circuits.	9
	Total Instructional Hours	**45**
Course Outcome	Upon successful completion of the course, the students will have the ability to: CO1: Analyze RF design principles and the electromagnetic spectrum's importance. CO2: Implement RF filter design with resonator configurations and special realizations. CO3: Evaluate active RF components like diodes, BJTs, FETs, and HEMTs in applications. CO4:Design RF amplifiers, oscillators, and mixers considering stability and performance characteristics. CO5: Analyze the characteristics and applications of mixers in RF systems.	

TEXT BOOKS:

T1 - Reinhold Ludwig and Powel Bretchko, —RF Circuit Design – Theory and Applications‖, Pearson Education Asia, First Edition, 2011

T2- Joseph. J.Carr, —Secrets of RF Circuit Design‖, McGraw Hill Publishers, Third Edition, 2000

REFERENCE BOOKS:

R1 -Matthew M.Radmanesh, — Radio frequency and Microwave Electronics‖, Pearson Education Asia, 2nd Edition ,2002.

R2- Ulrich L. Rohde and David P. NewKirk, —RF/ microwave Circuit Design‖, John Wiley & Sons USA, 2000

R3-Roland E. Best, —Phase –Locked loops: Design, simulation and Applications‖, McGraw Hill Publishers , 5th Edition,2003

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CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	3	2	2	-	2	1	-	1	3	2
CO2	3	3	3	2	3	2	2	-	2	1	-	1	3	2
CO3	3	3	2	2	3	2	2	-	2	1	-	1	3	2
CO4	3	3	2	2	3	2	2	-	2	1	-	1	3	2
CO5	3	3	1	2	3	2	2	-	2	1	-	1	3	2
AVG	3	3	2	2	3	2	2	-	2	1	-	1	3	2

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Programme	Course code	Name of the course	L	T	P	C
BE	22EC6304	SOFTWARE DEFINED RADIO	3	0	0	3

Course Objective	To Analyze the foundational concepts and benefits of Software Defined Radios To Evaluate the functional architecture of SDR systems, focusing on hardware and software integration To Investigate Cognitive Radio principles To Examine the capabilities and architectural components of Cognitive Radio systems To Explore future trends in Smart Radios

Unit	Description	Instructional Hours
I	**INTRODUCTION TO SOFTWARE DEFINED RADIO** The Need for Software Defined Radios (SDR) - Definition, Characteristics and Benefits of a SDR- Architecture evolution of SDR – Foundations, technology tradeoffs and architecture implications - Antenna for Cognitive Radio - Design Principles of a Software Radio.	9
II	**FUNCTIONAL ARCHITECTURE OF SDR** Basics of SDR - Essential functions of SDR– Goals of architecture of SDR - Hardware and Software architecture of SDR - Computational properties of processing resources- Top level component topology- Interface topologies among plug and play modules - SDR as platform for cognitive radio.	9
III	**COGNITIVE RADIO** Introduction to Cognitive Radio - Motivation and Purpose - Marking radio self aware and cognitive techniques – Organization of Cognitive tasks -Enabling location and environment awareness in cognitive radios- Design Challenges associated with CR. - IEEE 802 Cognitive Radio related activities.	9
IV	**FUNCTIONAL ARCHITECTURE OF COGNITIVE RADIO** Cognitive Radio Capabilities-Cognitive Transceiver architecture - Radio Resource Allocation for Cognitive Radio - Spectrum Allocation in Cognitive Radio Networks - Spectrum Sensing – Spectrum Sharing – Spectrum Mobility – Spectrum Management – Regulatory issues – Emerging Cognitive Radio Applications in Cellular Networks.	9
V	**SMART RADIO FOR FUTURE** Dynamic Spectrum Access- Cognitive Cycle concept- Technologies supporting the Cognitive Radio concept-Spectrum Awareness- Radio Spectrum models- Spectrum measurement techniques – Concept and architecture of TV White Spaces.	9
	TOTAL INSTRUCTIONAL HOURS	**45**

Course Outcome	Upon successful completion of the course, the students will have the ability to: CO1: Understand the need, characteristics, and benefits of Software Defined Radio. CO2: Analyze the functional and architectural evolution of SDR. CO3: Evaluate Cognitive Radioconcepts, tasks, and design challenges. CO4: Examine the capabilities and architecture of Cognitive Transceivers. CO5: Explore Dynamic Spectrum Access and emerging applications in Smart Radios.

TEXT BOOKS:

T1- Andreas F. Molisch, "Wireless Communications", 2nd Edition, John Wiley & Sons Ltd, 2011.

T2- H. Venkataraman, G. Muntean (editores). Cognitive Radio and its Application for Next Generation Cellular and Wireless Networks. 2013. Spriger, ISBN 978-94-007-1826-5.

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REFERENCE BOOKS:

R1- Markus Dillinger, "Software Defined Radio: Architectures, Systems and Functions", 2003.
R2- HuseyinArslan , "Cognitive Radio, Software Defined Radio and Adaptive wireless system,Springer, 1 edition ,September 24, 2007.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	3	-	-	-	-	-	-	-	3	3	2
CO2	3	3	3	3	-	-	-	-	-	-	-	3	3	2
CO3	3	3	3	3	-	-	-	-	-	-	-	3	3	2
CO4	3	3	3	2	-	-	-	-	-	-	-	3	3	2
CO5	3	3	3	2	-	-	-	-	-	-	-	3	3	2
AVG	3	2.8	3	2.8	-	-	-	-	-	-	-	3	3	2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC6306	WIRELESS BROADBAND NETWORKS	3	0	0	3
Course Objective	To acquire knowledge about various network layer and transport layer protocols for wireless networks To study the architecture and interference mitigation techniques in 3G standards To learn about 4G technologies and LTE-A in mobile cellular network. To familiarize about layer level functionalities in interconnecting networks. To gain knowledge on emerging techniques in 5G network.					

Unit	Description	Instructional Hours
I	**WIRELESS PROTOCOLS** Mobile network layer- Fundamentals of Mobile IP, data forwarding procedures in mobile IP, IPv4,IPv6, IP mobility management, IP addressing - DHCP, Mobile transport layer-Traditional TCP, congestion control, slow start, fast recovery/fast retransmission, classical TCP improvements-Indirect TCP, snooping TCP, Mobile TCP.	9
II	**3G EVOLUTION** IMT-2000 - W-CDMA, CDMA 2000 - radio & network components, network structure, packet-data transport process flow, Channel Allocation, core network, interference-mitigation techniques, UMTS-services, air interface, network architecture of 3GPP, UTRAN – architecture, High Speed Packet Data-HSDPA,HSUPA.	9
III	**4G EVOLUTION** Introduction to LTE-A – Requirements and Challenges, network architectures – EPC, E-UTRAN architecture - mobility management, resource management, services, channel - logical and transport channel mapping, downlink/uplink data transfer, MAC control element, PDU packet formats, scheduling services, random access procedure	9
IV	**LAYER-LEVEL FUNCTIONS** Characteristics of wireless channels - downlink physical layer, uplink physical layer, MAC scheme -frame structure, resource structure, mapping, synchronization, reference signals and channel estimation, SC-FDMA, interference cancellation – CoMP, Carrier aggregation, Services – multimedia broadcast/multicast, location-based services.	9
V	**5G EVOLUTION** 5G Roadmap - Pillars of 5G - 5G Architecture, The 5G internet - IoT and context awareness -Networking reconfiguration and virtualization support - Mobility QoS control - emerging approach for resource over provisioning, Small cells for 5G mobile networks-capacity limits and achievable gains with densification - Mobile data demand, Demand Vs Capacity, Small cell challenges, conclusion and future directions.	9
	Total Instructional Hours	45

Course Outcome	Upon successful completion of the course, the students will have the ability to: CO1: Design and implement the various protocols in wireless networks. CO2: Analyze the architecture of 3G network standards. CO3: Analyze the difference of LTE-A network design from 4G standard. CO4: Design the interconnecting network functionalities by layer level functions. CO5: Explore the current generation (5G) network architecture

TEXT BOOKS:

T1- Kaveh Pahlavan. "Principles of wireless networks", Prentice-Hall of India. 2008.

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R1- Vijay K.Garg, "Wireless Network Evolution - 2G & 3G". Prentice Hall, 2008.
R2 - Clint Smith,P.E, Dannel Collins, "3G Wireless Networks" Tata McGraw- Hill, 2nd Edition,2011.
R3- Sassan Ahmadi, "LTE-Advanced – A practical systems approach to understanding the GPP LTE Releases 10 and 11 radio access technologies", Elsevier, 2014.
R4- Jonathan Rodriguez, "Fundamentals of 5G Mobile networks", John Wiley, 2015.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	3	-	-	-	-	-	-	2	3	3
CO2	3	3	3	3	3	-	-	-	-	-	-	2	2	3
CO3	3	2	2	2	3	-	-	-	-	-	-	2	3	3
CO4	3	3	3	3	3	-	-	-	-	-	-	2	2	3
CO5	3	2	2	2	3	-	-	-	-	-	-	2	3	3
AVG	3	2.6	2	2.3	3	-	-	-	-	-	-	2	2.3	3

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Programme	Course code	Name of the course	L	T	P	C
BE	22EC6308	NEURAL NETWORKS AND DEEP LEARNING	3	0	0	3
Course Objective	1.To explore models of neurons and distinguish between feed-forward and feedback network architectures. 2.To demonstrate proficiency in supervised and unsupervised learning algorithms and tasks. 3.To apply the Perceptron learning algorithm and understand convergence theorems in separable and non-separable sets. 4.To apply Cover's theorem and hybrid learning procedures to solve interpolation problems with RBF networks. 5.To investigate associative learning, content addressable memory, and deep learning architectures like CNNs					

Unit	Description	Instructional Hours
I	**BASIC LEARNING ALGORITHMS** Biological Neuron – Models of a Neuron – Network Architectures : Feed Forward and Feedback – Learning Process – Supervised and Unsupervised Learning - Learning Tasks - Pattern Recognition and Classification .	9
II	**PERCEPTRONS AND MULTILAYER PERCEPTRONS** Learning Algorithms - Perceptron Learning Algorithm–Perceptron Convergence Theorem – Perceptron learning and non separable sets – Multilayer Network Architectures.	9
III	**RADIAL BASIS FUNCTION NETWORKS** Cover's Theorem on the Separability of Patterns – The Interpolation problem –Generalized Radial Basis Function Networks –Hybrid Learning procedure for Radial Basis Function Networks – Computer Experiment:Pattern Classification	9
IV	**ATTRACTOR NEURAL NETWORKS** Associative Learning – Attractor Neural Network Associative Memory – Linear Associative Memory – Hopfield Network – Content Addressable Memory – Boltzmann Machine – Bidirectional Associative Memory – BAM Stability Analysis – Error Correction in BAMs.	9
V	**DEEP NETWORKS** Convolutional Neural Networks – Basic Structure: Padding, Strides, ReLU, Pooling, Fully Connected Layers, Interleaving, Local Response Normalization. Case studies :Alexnet, ZFNet, VGG, GoogleNet, ResNet.	9
	Total Instructional Hours	**45**
Course Outcome	Upon successful completion of the course, the students will have the ability to: CO1: Describe biological neuron models and differentiate between feed-forward and feedback network structures. CO2: Implement supervised and unsupervised learning algorithms effectively for pattern recognition and classification tasks. CO3: Implement Perceptron learning algorithms and assess convergence properties on separable and non-separable datasets. CO4: Develop generalized RBF networks using hybrid learning approaches to solve pattern classification problems. CO5: Analyze convolutional neural networks (CNNs) structures and their applications through case studies like AlexNet, VGG, and ResNet.	

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TEXT BOOKS:

T1:SimonHaykin, "Neural Networks and Learning machines". Pearson Education/PHI, 3rd Edition. 2009.

T2:Satish Kumar, "Neural Networks: A classroom approach". TMH education, 2nd Edition, 2013.

T3:Charu C Aggarwal, Neural Networks and Deep Learning, Springer, 2015.

REFERENCES BOOKS:

R1 –James A. Freeman and David M. Skapura, "Neural Networks Algorithms, Applications and Programming Techniques", Pearson Education, 2003.

R2 - Martin T.Hagan, Howard B. Demuth and Mark Beale, "Neural Network Design", Thomson Learning, 2003.

R3 - Michael Nielsen, Neural Networks and Deep Learning, Determination Press, 2015.

R4 - Ian Goodfellow, YoshuaBengio, Aaron Courville, "Deep Learning", MIT Press, 2016.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	3		-	-	3	-	-	2	3	1
CO2	3	2	3	3	3		-	-		-	-	3	3	3
CO3	3	3	3	3	2		-	-	3	2	-	2	3	3
CO4	3	2	2	3	3		-	-			-	3	3	2
CO5	3	3	3	3	2		-	-	3	2	-	2	3	2
AVG	3	3	3	3	3				3	2		2	3	2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC6309	BIOMETRIC SYSTEMS	3	0	0	3

Course Objective	1.To Gain knowledge about Biometric Technologies 2.To Learn Fingerprint Technology 3.To Explore Face Recognition and Hand Geometry 4.To Examine Iris Recognition 5.To Study Voice Scan and Multimodal Biometrics	
Unit	**Description**	**Instructional Hours**
I	**INTRODUCTION TOBIOMETRICS** Introduction and back ground – biometric technologies – passive biometrics – active biometrics –Biometric characteristics, Biometric applications – Biometric Authentication systems-Taxonomy of Application Environment, Accuracy in Biometric Systems- False match rate- False non match rate-Failure to enroll rate-Derived metrics-Biometrics and Privacy.	9
II	**FINGERPRINTTECHNOLOGY** History of fingerprint pattern recognition - General description of fingerprints- fingerprint sensors, fingerprint enhancement, Feature Extraction-Ridge orientation, ridge frequency, finger print matching techniques- correlation based, Minutiae based, Ridge feature based, finger print classification, Applications of fingerprints, Finger scan- strengths and weaknesses, Evaluation of fingerprint verification algorithms.	9
III	**FACE RECOGNITIONAND HAND GEOMETRY** Introduction to face recognition, face recognition using PCA, LDA, face recognition using shape and texture, face detection in color images, 3D model-based face recognition in video images, Neural networks for face recognition, Hand geometry–scanning–Feature Extraction–classification	9
IV	**IRIS RECOGNITION** Introduction, Anatomical and Physiological underpinnings, Iris sensor, Iris representation and localization- Daugman and Wilde's approach, Iris matching, Iris scan strengths and Weaknesses. System performance, future directions.	9
V	**VOICE SCAN AND MULTI MODAL BIOMETRICS** Voice scan, speaker features, short term spectral feature extraction, Midfrequency cepstral coefficients, speaker matching, Gaussian mixture model, NIST speaker Recognition Evaluation Program, Introduction to multimodal biometric system – Integration strategies – Architecture – level of fusion – combination strategy, examples of multimodal biometric systems, Securing and trusting a biometric transaction – matching location – local host - authentication server – match on card(MOC).	9
	Total Instructional Hours	**45**

Course Outcome	Upon successful completion of the course, the students will have the ability to: CO1: Expertise in Biometric Technologies. CO2: Application of Fingerprint Technology. CO3: Skill in Face Recognition and Hand Geometry. CO4: Competence in Iris Recognition. CO5: Integration of Multimodal Biometrics.

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TEXT BOOKS:
T1. James Wayman & Anil Jain, "Biometric Systems- Technology Design and performance Evaluation", SPRINGER(SIE), 1st Edition,2011 T2:PaulReid,"BiometricsforNetworkSecurity",PearsonEducation,2004 T3:S.Y. Kung, S.H. Lin, M.W., "Biometric Authentication: A Machine Learning Approach", Prentice Hall, 2004
REFERENCE BOOKS:
R1: NaliniKRatha,RuudBolle,"Automaticfingerprintrecognitionsystem'',Springer,2003. R2;L C Jain, I Hayashi, S B Lee, U Halici, "Intelligent Biometric Techniques in Fingerprint And Face Recognition", CRC Press,1st Edition,1999. R3:JohnChirillo,ScottBlaul,"ImplementingBiometricSecurity",JohnWiley&Sons,2003.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	2	-	-	1	-	-	-	-	1	1
CO2	3	2	1	1	2	-	-	1	-	-	-	-	1	1
CO3	3	2	1	1	2	-	-	1	-	-	-	-	1	1
CO4	3	2	1	1	2	-	-	1	-	-	-	-	1	1
CO5	3	2	1	1	2	-	-	1	-	-	-	-	1	1
AVG	3	2	1	1	2	-	-	1	-	-	-	-	1	1

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC6310	MEDICAL ROBOTICS	3	0	0	3

Course Objective	1.To Understand Medical Robots and Their Applications 2.To Learn Localization and Tracking Techniques 3.To Design Medical Robots 4.To Examine Surgical Robotics 5.To Explore Rehabilitation and Medical Care Robots	
Unit	**Description**	**Instructional Hours**
I	**INTRODUCTION** Types of medical robots - Navigation - Motion Replication - Imaging - Rehabilitation and Prosthetics – Stateof art of robotics in the field of healthcare-DICOM	9
II	**LOCALIZATION AND TRACKING** Position sensors requirements - Tracking - Mechanical linkages - Optical – Sound based - Electromagnetic - Impedance-based - In-bore MRI tracking-Video matching - Fiber optic tracking systems - Hybrid systems	9
III	**DESIGN OF MEDICAL ROBOTS** Characterization of gestures to the design of robots - Design methodologies - Technological choices - Security.	9
IV	**SURGICAL ROBOTICS** Minimally invasive surgery and robotic integration - surgical robotic sub systems - synergistic control - Control Modes - Radiosurgery - Orthopedic Surgery - Urologic Surgery and Robotic Imaging -Cardiac Surgery – Neurosurgery - case studies	9
V	**ROBOTS IN REHABILITATION AND MEDICAL CARE** Rehabilitation for Limbs - Brain-Machine Interfaces - Steerable Needles - Assistive robots - Robots in Physiotherapy - case studies	9
	Total Instructional Hours	**45**
Course Outcome	Upon successful completion of the course, the students will have the ability to: CO1: Knowledge in Medical Robotics CO 2: Application of Localization and Tracking. CO 3: Skill in Designing Medical Robots CO 4: Competence in Surgical Robotics. CO 5: Integration of Rehabilitation and Assistive Robotics	

TEXT BOOKS:

T1 S.B.Niku,IntroductiontoRobotics,Analysis,Control,Applications,PearsonEducation,2020
T2 RobertSchilling,FundamentalsofRobotics-Analysisandcontrol,PrenticeHallofIndia,2003.
T3 FuGonzalesandLee,Robotics,McGrawHill, 1987.
T4 JCraig,IntroductiontoRobotics,PearsonEducation,2005.

REFERENCE BOOKS:

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R1 Grover,Wiess, NagelandOderey,IndustrialRobotics,McGrawHill,2012.
R2 Klafter,ChmielewskiandNegin,RobotEngineering,PrenticeHallOfIndia,1989.
R3 Mittal, Nagrath,RoboticsandControl,TataMcGrawHillpublications,2003.
R4 BijayK.Ghosh,NingXi,T.J.Tarn,ControlinRoboticsandAutomationSensor–Basedintegration,AcademicPress,1999.
R5 MikellP.Groover,MitchellWeiss,Industrialrobotics,technology,ProgrammingandApplications, McGrawHill InternationalEditions,1986.
R6 RichardD.Klafter,ThomasA.ChmielewskiandMichaelNegin,Roboticengineering-AnIntegratedApproach,PrenticeHallInc,EnglewoodsCliffs,NJ,USA,1989.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	-	-	-	-	1	3	3
CO2	3	2	1	1	-	-	-	-	-	-	-	1	3	3
CO3	3	2	1	1	-	-	-	-	-	-	-	1	3	3
CO4	3	2	1	1	-	-	-	-	-	-	-	1	3	3
CO5	3	2	1	1	-	-	-	-	-	-	-	1	3	3
AVG	3	2	1	1	-	-	-	-	-	-	-	1	3	3

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SYLLABUS REVISION DETAILS FOR THE REGULATION 22 – ACADEMIC YEAR 2024-25 EVEN SEMESTER

S. No	Year	Semester	Course Code and Course Name	Existing content (in academic Year 2023-24)	Revised Content (for 2024-25)	Percentage of Revision
1	III	VI	22EC6301- PCB Design	**PCB TECHNOLOGY TRENDS** Fine–line Conductors with Ultra–Thin copper Foil - Multilayer Boards - Multiwire Boards – Subtractive-Additive processes - Semi-Additive Processes – Additive Processes – Flexible Printed Circuit Boards – Metal Core Circuit Boards – Mechnaical Milling of PCBs.	**PCB TECHNOLOGY TRENDS** Fine–line Conductors with Ultra–Thin copper Foil - Multilayer Boards - Multiwire Boards – Subtractive-Additive processes - Semi-Additive Processes – Additive Processes – Flexible Printed Circuit Boards – Metal Core Circuit Boards – Mechnaical Milling of PCBs. Introduction to KiCad EDATool	10
2	III	VI	22EC6254- VLSI Design	**INTRODUCTION TO CMOS CIRCUITS AND MOS TRANSISTOR THEORY** MOS transistors – CMOS logic – Circuits and System Representation – An example – Introduction to nMOS, pMOS enhancement transistor – MOS device design equation – Basic DC equation, second order effects – Complementary CMOS inverter – DC characteristics **VERILOG PROGRAMMING INTRODUCTION** Hierarchical modelling concepts – Basic concepts – Modules and ports – Gate level modelling – Behavioural modelling – Data flow modelling: An introduction.	**INTRODUCTION TO CMOS CIRCUITS AND MOS TRANSISTOR THEORY** MOS transistors – CMOS logic – Introduction to nMOS, pMOS enhancement transistor – MOS device design equation – Basic DC equation, second order effects – Complementary CMOS inverter – DC characteristics. Introduction to FinFET. **Experimental study: Characteristics of CMOS Invertor using SPICE** **INTRODUCTION TO PLD'S AND FPGA** Introduction Simple PLD's- Read only memories-Programmable Array Logic- Programmable Logic Array -FPGA program technology-Programmable logic blocks-Programmable Interconnects-Programmable I/O blocks in FPGA-Xilinx XC 2000 **Experimental study: Synthesis of full adder using FPGA**	20

3	III	VI	22EC6253- Digital Signal Processing	**MULTI RATE DIGITAL SIGNAL PROCESSING** Decimation, Interpolation, Sampling rate conversion by a rational factor, Applications of Multirate Signal Processing:Subband Coding of Speech signals.	**INTRODUCTION TO DSP PROCESSOR** DSP functionalities - circular buffering – TMS320C67X DSP Processor DSP architecture – Fixed- and Floating-point architecture principles – Programming – Application examples.	20

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Coimbatore – 641032

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Curriculum and Syllabus for the Batch 2021-2025

2019 REGULATIONS with Amendments

DETAILS OF CHANGES CARRIED OUT IN CURRICULUM & SYLLABUS

CBCS PATTERN

UNDERGRADUATE PROGRAMMES

B.E ELECTRONICS AND COMMUNICATION ENGINEERING (UG)

REGULATION-2019

(For the students admitted during the academic year 2021-2022 and onwards)

SEMESTER I

S. No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
		THEORY								
1	21HE1101	Technical English	HSC	2	1	0	3	40	60	100
2	21MA1103	Calculus and Differential Equations	BSC	3	1	0	4	40	60	100
		THEORY WITH LAB COMPONENT								
3	21PH1151	Applied Physics	BSC	2	0	2	3	50	50	100
4	21CY1151	Chemistry for Engineers	BSC	2	0	2	3	50	50	100
5	21CS1151/ 21CS1152	Python Programming and Practices/ Object Oriented Programming using Python (IBM)	ESC	2	0	2	3	50	50	100
6	21EC1153	Electron devices and Electric Circuits	ESC	2	0	2	3	50	50	100
		PRACTICAL								
7	21HE1001	Language Competency Enhancement Course-I	HSC	0	0	2	1	0	100	100
		MANDATORY COURSES								
8	21HE1072	**Career Guidance Level – I** Personality, Aptitude and Career Development	EEC	2	0	0	0	100	0	100
			Total	**15**	**2**	**10**	**20**	**350**	**450**	**800**

As Per AICTE Norms 3 Weeks Induction Programme is Added in The First Semester as an Audit Course

SEMESTER II

S. No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
		THEORY								
1	21HE2101	Business English for Engineers	HSC	2	1	0	3	40	60	100
2	21MA2103	Linear Algebra, Numerical Methods and Transform Calculus	BSC	3	1	0	4	40	60	100
		THEORY WITH LAB COMPONENT								
3	21PH2151	Material Science	BSC	2	0	2	3	50	50	100
4	21CY2151	Environmental Studies	BSC	2	0	2	3	50	50	100
5	212CS2152/ 21CS2153	Essentials of C&C++Programming/ Java Fundamentals (IBM)	ESC	2	0	2	3	50	50	100
6	21ME2154	Engineering Graphics	ESC	1	0	4	3	50	50	100
		PRACTICAL								
7	21ME2001	Engineering Practices	ESC	0	0	4	2	50	50	100
8	21HE2001	Language Competency Enhancement Course-II	HSC	0	0	2	1	0	100	100
		MANDATORY COURSES								
9	21HE2072	**Career Guidance Level – II** Personality, Aptitude and Career Development	EEC	2	0	0	0	100	0	100
10	21HE2073	Entrepreneurship & Innovation	EEC	1	0	0	0	100	0	100
			Total	**15**	**2**	**16**	**22**	**500**	**500**	**1000**

SEMESTER III

S. No	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	21MA3102	Fourier analysis and transforms	BSC	3	1	0	4	40	60	100
2	21EC3201	Digital Electronics	PCC	3	0	0	3	40	60	100
3	21EC3202	Signals and Systems	PCC	3	1	0	4	40	60	100
4	21EC3203	Electronic Circuits	PCC	3	0	0	3	40	60	100
THEORY WITH LAB COMPONENT										
5	21CS3252/21IT3252	Oops using Java/ Relational Database Management System (IBM)	PCC	2	0	2	3	50	50	100
PRACTICAL										
6	21EC3001	Electronic circuits lab	PCC	0	0	3	1.5	50	50	100
7	21EC3002	Digital Electronics Lab	PCC	0	0	3	1.5	50	50	100
MANDATORY COURSES										
8	21MC3191	Indian Constitution	MCC	2	0	0	0	100	0	100
9	21HE3072	**Career Guidance Level – III** Personality, Aptitude and Career Development	EEC	2	0	0	0	100	0	100
10	21HE3073	Leadership Management Skills	EEC	1	0	0	0	100	0	100
			Total	**19**	**2**	**8**	**20**	**550**	**450**	**1000**

SEMESTER IV

S. No	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	21MA4104	Probability and Random Processes	BSC	3	1	0	4	40	60	100
2	21EC4201	Electro Magnetic Fields and waves	PCC	3	1	0	4	40	60	100
3	21EC4202	Analog Communication	PCC	3	1	0	4	40	60	100
4	21EC4203	Linear Integrated Circuits	PCC	3	0	0	3	40	60	100
THEORY WITH LAB COMPONENT										
5	21EC4251/21EC4252	Control Systems/ Design Thinking-An Introduction (IBM)	PCC	2	0	2	3	50	50	100
PRACTICAL										
6	21EC4001	Linear Integrated Circuits Lab	PCC	0	0	3	1.5	50	50	100
7	21EC4002	Analog communication Lab	PCC	0	0	3	1.5	50	50	100
MANDATORY COURSES										
8	21MC4191	Essence of Indian tradition knowledge/Value Education	MCC	2	0	0	0	100	0	100
9	21HE4072	**Career Guidance Level – IV** Personality, Aptitude and Career Development	EEC	2	0	0	0	100	0	100
10	21HE4073	Ideation Skills	EEC	2	0	0	0	100	0	100
			Total	**20**	**3**	**8**	**21**	**550**	**450**	**1000**

SEMESTER V

S. No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	21EC5201	Microprocessor and Microcontroller	PCC	3	0	0	3	40	60	100
2	21EC5202	Transmission lines and Wave Guides	PCC	3	1	0	4	40	60	100
3	21EC5203	VLSI Design	PCC	3	0	0	3	40	60	100
4	21EC53XX	**Professional Elective –I**	PEC	3	0	0	3	40	60	100
THEORY WITH LAB COMPONENT										
5	21EC5251	Data Communication and Networks	PCC	2	0	2	3	50	50	100
6	21EC5252	Digital Signal Processing	PCC	2	0	2	3	50	50	100
7	21CS5331	Angular JS (for IBM students)	PCC	2	0	2	3	50	50	100
PRACTICALS										
8	21EC5001	VLSI Design Lab	PCC	0	0	3	1.5	50	50	100
9	21EC5002	Microprocessors and Microcontrollers Lab	PCC	0	0	3	1.5	50	50	100
MANDATORY COURSES										
10	21HE5071	Soft Skills - I	EEC	1	0	0	1	100	0	100
11	21HE5072	Design Thinking	EEC	1	0	0	1	100	0	100
			Total	**18**	**1**	**10**	**24**	**500**	**500**	**1000**

SEMESTER VI

S. No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	21EC6202	Antenna and Wave Propagation	PCC	3	1	0	4	40	60	100
2	21EC6181	Principles of Management	HSC	3	0	0	3	40	60	100
3	21EC63XX/ 21CS6351	**Professional Elective – II/Node JS and Microservices (IBM)**	PEC	3	0	0	3	40	60	100
4	21XX64XX	**Open Elective– I**	OEC	3	0	0	3	40	60	100
THEORY WITH LAB COMPONENTS										
5	21EC6251/ 21CS6255	**Embedded Systems and IOT/IOT and Spring Framework (IBM)**	PCC	2	0	2	3.	50	50	100
6	21EC6253	Digital Communication	PCC	2	0	2	3	50	50	100
PRACTICALS										
7	21EC6003	Project Based Learning	PCC	0	0	3	2	50	50	100
MANDATORY COURSES										
8	21EC6701	Internship	EEC	-	-	-	1	100	0	100
9	21HE6071	Soft Skills - II	EEC	1	0	0	1	100	0	100
10	21HE6072	Intellectual Property Rights (IPR)	EEC	1	0	0	1	100	0	100
			Total	**19**	**1**	**6**	**24**	**550**	**450**	**1000**

SEMESTER VII

S. No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
		THEORY								
1	21EC7201	Digital Image Processing	PCC	3	0	0	3	40	60	100
2	21EC7202	Optical and Microwave Engineering	PCC	3	0	0	3	40	60	100
3	21EC73XX/ 21EC7331	**Professional Elective-III/Block Chain (IBM)**	PEC	3	0	0	3	40	60	100
4	21XX74XX	**Open Elective – II**	OEC	3	0	0	3	40	60	100
		THEORY WITH LAB COMPONENTS								
5	21EC7251	Wireless Communication	PC	2	0	2	3	50	50	100
		PRACTICALS								
6	21EC7001	Digital Image processing Lab	PCC	0	0	3	1.5	50	50	100
7	21EC7002	Optical Communication and Microwave Lab	PCC	0	0	3	1.5	50	50	100
		PROJECT WORK								
8	21EC7901	Project Work -I	EEC	0	0	4	2	50	50	100
		Total		**14**	**0**	**12**	**20**	**300**	**500**	**800**

SEMESTER VIII

S. No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
		THEORY								
1	21EC83XX	**Professional Elective –IV**	PEC	3	0	0	3	40	60	100
2	21EC83XX	**Professional Elective- V**	PEC	3	0	0	3	40	60	100
		PROJECT WORK								
3	21CH8901	Project Work –II	EEC	0	0	16	8	100	100	200
			Total	**6**	**0**	**16**	**14**	**150**	**250**	**400**

TOTAL NO OF CREDITS: 165

CREDIT DISTRIBUTION

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	20	22	20	21	24	24	20	14	**165**

LIST OF PROFESSIONAL ELECTIVES

S. No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
PROFESSIONAL ELECTIVE I										
1	21EC5301	Measurements and Instrumentation	PEC	3	0	0	3	40	60	100
2	21EC5302	PCB Design	PEC	3	0	0	3	40	60	100
3	21EC5303	RF System Design	PEC	3	0	0	3	40	60	100
4	21EC5304	Network Security	PEC	3	0	0	3	40	60	100
5	21EC5181	Total Quality Management	PEC	3	0	0	3	40	60	100
PROFESSIONAL ELECTIVE II										
1	21EC6301	Medical Electronics	PEC	3	0	0	3	40	60	100
2	21EC6302	Industrial Automation	PEC	3	0	0	3	40	60	100
3	21EC6303	Mobile Communication	PEC	3	0	0	3	40	60	100
4	21EC6304	High Speed Networks	PEC	3	0	0	3	40	60	100
5	21EC6182	E-Commerce Technology	PEC	3	0	0	3	40	60	100
6	21EC6305	Virtual Reality and Augmented Reality	PEC	3	0	0	3	40	60	100
PROFESSIONAL ELECTIVE III										
1	21EC7301	Robotics	PEC	3	0	0	3	40	60	100
2	21EC7302	ASIC Design	PEC	3	0	0	3	40	60	100
3	21EC7303	Global Positioning Systems	PEC	3	0	0	3	40	60	100
4	21EC7181	Entrepreneurship Development	PEC	3	0	0	3	40	60	100
5	21EC7305	Cyber Forensics	PEC	3	0	0	3	40	60	100
6	21EC7306	Embedded Controllers	PEC	3	0	0	3	40	60	100
PROFESSIONAL ELECTIVE IV										
1	21EC8301	Neural networks and Deep learning	PEC	3	0	0	3	40	60	100
2	21EC8303	Satellite Communication	PEC	3	0	0	3	40	60	100
3	21EC8304	Wireless Sensors and Networks	PEC	3	0	0	3	40	60	100
4	21EC8181	Foundation Skills in Integrated Product Development	PEC	3	0	0	3	40	60	100
5	21EC8305	Medical Image Proeessing	PEC	3	0	0	3	40	60	100
6	21EC8311	Computer Communication and Internet Protocol	PEC	3	0	0	3	40	60	100
7	21EC8312	Cloud Computing	PEC	3	0	0	3	40	60	100
PROFESSIONAL ELECTIVE V										

1	21EC8306	Artificial Intelligence	PEC	3	0	0	3	40	60	100
2	21EC8307	Low Power VLSI	PEC	3	0	0	3	40	60	100
3	21EC8308	Software Defined Radio	PEC	3	0	0	3	40	60	100
4	21EC8309	Photonic Networks	PEC	3	0	0	3	40	60	100
5	21EC8182	Intellectual Property Rights and Innovations	PEC	3	0	0	3	40	60	100
6	21EC8310	Fundamentals of Nano Science	PEC	3	0	0	3	40	60	100

LIST OF INDUSTRIAL CORE COURSES

S. No.	CODE	Courses	CAT	L	T	P	C	CIA	ESE	TOTAL
1	21CS1152	Object Oriented Programming using Python	ICC	2	0	2	3	50	50	100
2	21CS2153	Java Fundamentals	ICC	2	0	2	3	50	50	100
3	21IT3252	Relational Database Management System	ICC	2	0	2	3	50	50	100
4	21EC4252	Design Thinking-An Introduction	ICC	2	0	2	3	50	50	100
5	21CS5331	Angular JS	ICC	2	0	2	3	50	50	100
6	21CS6351	Node JS and Micro services	ICC	2	0	2	3	50	50	100
7	21CS6255	IoT and Spring Framework	ICC	2	0	2	3	50	50	100
8	21EC7331	Blockchain	ICC	2	0	2	3	50	50	100

LIST OF OPEN ELECTIVES

ELECTRONICS AND COMMUNICATION ENGINEERING										
S. No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
1	21EC6401	Consumer Electronics	OEC	3	0	0	3	40	60	100
2	21EC7401	Introduction to IOT	OEC	3	0	0	3	40	60	100
LIFE SKILL COURSES										
3	21LSZ401	General Studies for Competitive Examinations	OEC	3	0	0	3	40	60	100
4	21LSZ402	Human Rights, Women's Rights and Gender Equality	OEC	3	0	0	3	40	60	100
5	21LSZ403	Indian Ethos and Human Values	OEC	3	0	0	3	40	60	100
6	21LSZ404	Indian Constitution and Political System	OEC	3	0	0	3	40	60	100
7	21LSZ405	Yoga for Human Excellence	OEC	3	0	0	3	40	60	100
NCC COURSES (Only forthe students' who have opted NCC subjects in Semester I, II, III & IV are eligible)										
8	21HEZ401	NCC course level 1	OEC	3	0	0	3	40	60	100
9	21HEZ402	NCC course level 2	OEC	3	0	0	3	40	60	100

MINOR DEGREE VERTICAL COURSES

Vertical I

Embedded and IoT

S No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
1	21EC5601	Electronics for Embedded Systems	MDC	3	0	0	3	40	60	100
2	21EC6601	Microcontroller and its Applications	MDC	3	0	0	3	40	60	100
3	21EC6602	Sensor and Embedded Systems	MDC	3	0	0	3	40	60	100
4	21EC7601	Fundamentals of IoT	MDC	3	0	0	3	40	60	100
5	21EC7602	Industrial IoT and Industry 4.0	MDC	3	0	0	3	40	60	100
6	21EC8601	IoT for Smart Systems	MDC	3	0	0	3	40	60	100

Vertical II

Fintech and Block Chain

S No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
1	21CS5602	Financial Management	MDC	3	0	0	3	40	60	100
2	21MB6231	Fundamentals of Investment	MDC	3	0	0	3	40	60	100
3	21MB6232	Banking, Financial Services and Insurance	MDC	3	0	0	3	40	60	100
4	21MB7231	Introduction to Blockchain and its Applications	MDC	3	0	0	3	40	60	100
5	21MB7232	Fintech Personal Finance and Payments	MDC	3	0	0	3	40	60	100
6	21MB8231	Introduction to Fintech	MDC	3	0	0	3	40	60	100

Vertical III

Entrepreneurship

S No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
1	21BA5601	Foundation of Entrepreneurship	MDC	3	0	0	3	40	60	100
2	21BA6601	Introduction to Business Venture	MDC	3	0	0	3	40	60	100
3	21BA6602	Team Building & Leadership Management for Business	MDC	3	0	0	3	40	60	100
4	21BA7601	Creativity & Innovation in Entrepreneurship	MDC	3	0	0	3	40	60	100
5	21BA7602	Principles of Marketing Management for Business	MDC	3	0	0	3	40	60	100
6	21BA8601	Human Resource Management for Entrepreneurs	MDC	3	0	0	3	40	60	100
7	21BA8602	Financing New Business Ventures	MDC	3	0	0	3	40	60	100

Vertical IV

Environment and Sustainability

S No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
1	21CEXXXX	Sustainable Infrastructure Development	MDC	3	0	0	3	40	60	100
2	21AG6233	Sustainable Agriculture and Environmental Management	MDC	3	0	0	3	40	60	100
3	21BM6233	Sustainable Bio Materials	MDC	3	0	0	3	40	60	100
4	21ME7233	Materials for Energy Sustainability	MDC	3	0	0	3	40	60	100
5	21CE7233	Green Technology	MDC	3	0	0	3	40	60	100
6	21CE8232	Environmental Quality Monitoring and Analysis	MDC	3	0	0	3	40	60	100

HONOUR DEGREE VERTICAL COURSES

S. No.	Vertical-I Sensor Technologies and IoT	Vertical II Advanced Communication Systems	Vertical III Semiconductor Chip Design and Testing
1	Realtime Embedded Systems	Cognitive Radio Networks	Wide Bandgap Devices
2	Sensor for IoT applications	Remote Sensing	Validation and Testing Technology
3	Advanced Processor Architectures	Rocketry and Space Mechanics	Low Power VLSI
4	IOT Processors	Underwater Navigation Systems	VLSI Testing and Design for Testability
5	Wearable Devices	Massive MIMO Networks	Mixed Signal IC Design Testing
6	Industrial IoT and Industry 4.0	Advanced Wireless Communication Techniques	Analog IC Design

Vertical-I
Sensor Technologies and IoT

S No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
1	22EC5305	Realtime Embedded Systems	HDC	3	0	0	3	40	60	100
2	22EC6305	Sensor for IoT applications	HDC	3	0	0	3	40	60	100
3	22EC6306	Advanced Processor Architectures	HDC	3	0	0	3	40	60	100
4	22EC7304	IOT Processors	HDC	3	0	0	3	40	60	100
5	22EC7305	Wearable Devices	HDC	3	0	0	3	40	60	100
6	22EC8301	Industrial IoT and Industry 4.0	HDC	3	0	0	3	40	60	100

Vertical-II
Advanced Communication Systems

S No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
1	22EC5306	Cognitive Radio Networks	HDC	3	0	0	3	40	60	100
2	22EC6307	Remote Sensing	HDC	3	0	0	3	40	60	100
3	22EC6308	Rocketry and Space Mechanics	HDC	3	0	0	3	40	60	100
4	22EC7306	Underwater Navigation Systems	HDC	3	0	0	3	40	60	100
5	22EC7307	Massive MIMO Networks	HDC	3	0	0	3	40	60	100
6	22EC8203	Advanced Wireless Communication Techniques	HDC	3	0	0	3	40	60	100

Vertical-III
Semiconductor Chip Design and Testing

S No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
1	22EC5307	Wide Bandgap Devices	HDC	3	0	0	3	40	60	100
2	22EC6309	Validation and Testing Technology	HDC	3	0	0	3	40	60	100
3	22EC6310	Low Power VLSI	HDC	3	0	0	3	40	60	100
4	22EC7308	VLSI Testing and Design for Testability	HDC	3	0	0	3	40	60	100
5	22EC7309	Mixed Signal IC Design Testing	HDC	3	0	0	3	40	60	100
6	22EC8202	Analog IC Design	HDC	3	0	0	3	40	60	100

P. Hayka

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COIMBATORE - 641 032.

Programme	Course Code	Name of the Course	L	T	P	C
BE	21EC8303	SATELLITE COMMUNICATION	3	0	0	3

Course Objective	To Understand the fundamental concepts, communication networks and services enabled by satellites. To Develop analytical skills to assess and mitigate the effects of propagation impairments on communication systems. To Examine the coordination between the space and earth segments to maintain efficient and uninterrupted communication. To Gain knowledge on various loss mechanisms. To Familiarize the principles, advantages and applications of various satellite mobile services.
Prerequisite	21EC7251Wireless Communication

Unit	Description	Instructional Hours
I	**BASICS OF SATELLITE COMMUNICATION** Historical background, Basic concepts of Satellite Communications, Communication Networks and Services, Comparison of Network Transmission technologies, Orbital and Spacecraft problems, Growth of Satellite communications. **Orbits and Launching Methods:** Introduction, Kepler's First Law, Kepler's Second Law, Kepler's Third Law, Definitions of Terms for Earth-Orbiting Satellites, Orbital Elements, Apogee and Perigee Heights, Orbit Perturbations, Effects of a non-spherical earth, Atmospheric drag.	9
II	**RADIO WAVE PROPAGATION AND POLARIZATON** **Radio wave Propagation:** Introduction, Atmospheric Losses, Ionospheric Effects, Rain Attenuation, Other Propagation Impairments. **Polarization:** Introduction, Antenna Polarization, Polarization of Satellite Signals, Cross Polarization, Discrimination, Ionospheric Depolarization, Rain Depolarization, Ice Depolarization.	9
III	**THE SPACE SEGMENT AND THE EARTH SEGMENT** **The space segment:** Introduction, The Power Supply, Attitude Control, Spinning satellite stabilization, Momentum wheel stabilization, Station Keeping, Thermal Control, TT&C Subsystem, Transponders, The wideband receiver, The input demultiplexer, The power amplifier, The Antenna Subsystem **The Earth Segment:** Introduction, Receive-Only Home TV Systems, The outdoor unit, The indoor unit for analog (FM) TV, Master Antenna TV System, Community Antenna TV System, Transmit-Receive Earth Stations.	9
IV	**THE SPACE LINK** Introduction, Equivalent Isotropic Radiated Power, Transmission Losses, Free-space transmission, Feeder losses, Antenna misalignment losses, Fixed atmospheric and ionospheric losses, The Link-Power Budget Equation, System Noise, Carrier-to-Noise Ratio, The Uplink, Saturation flux density, Input backoff, Downlink, Output back-off, Combined Uplink and Downlink C/N Ratio.	9
V	**SATELLITE ACCESS AND SPECIALIZED SERVICES** Introduction, Single Access, Preassigned FDMA, Demand-Assigned FDMA, Spade System, TDMA, Preassigned TDMA, Demand-assigned TDMA, Satellite-Switched TDMA, Code-Division Multiple Access **Satellite Mobile and Specialized Services:** Introduction, Satellite Mobile Services, VSATs, Radarsat, Global Positioning Satellite System (GPS), Orbcomm, Iridium.	9
	Total Instructional Hours	**45**

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Course Outcomes	Upon successful completion of the course, the students will have the ability to: CO1: Explore the historical evolution, basic concepts and growth of satellite communication systems. CO2: Evaluate the impact of losses on radio wave propagation. CO3: Describe the components and functions of the space segment and Earth segment. CO4: Assess the effects of fixed losses, antenna misalignment, and atmospheric conditions on the performance of the space link. CO5: Gain insight into the design principles and practical applications of specialized satellite services.

TEXT BOOKS:

T1- Satellite Communications, by Dennis Roddy(Fourth edition),McGraw Hill
T2 – Satellite Communication Systems Engineering, by Wilbur L. Pritchard, Henri G. Suyderhoud, Robert A. Nelson (Second Edition), Pearson Education.

REFERENCE BOOKS:

R1-Satellite Communication, by Timothy Pratt, Charles Bostian, Jeremy Allnutt(Second Edition), John Wiley & Sons.
R2-Satellite Technology, Principles and Applications, by Anil K. Maini, VarshaAgarwal(Third Edition), Wiley.

CO/ PO	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	3	3	3	3	2	3	1	1	-	1	-	3	3	3
CO2	3	2	3	3	2	2	3	-	-	-	-	3	3	3
CO3	3	2	2	3	2	3	-	-	-	-	-	3	3	3
CO4	3	3	3	2	1	3	-	-	-	-	-	3	3	3
CO5	3	3	2	3	2	3	3	-	3	3	-	3	3	3
AVG	3	2.6	2.6	2.8	1.8	2.8	2.3	1	3	2	-	3	3	3

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Programme	Course Code	Name of the Course	L	T	P	C
BE	19EC6304	HIGH SPEED NETWORKS	3	0	0	3

Course Objective	1. To impart knowledge on Frame relay networks and ATM networks 2. To understand the concepts of congestion and traffic management 3. To gain knowledge on Graph Theory and Internet Routing 4. To know more about Quality of Service in IP Networks 5. To study the importance of Compression in High Speed Networks
Prerequisite	22EC4253 Data Communication and Networks

Unit	Description	Instructional Hours
I	**HIGH SPEED NETWORKS** Protocols and TCP/IP Suite-TCP and IP-Frame Relay –Asynchronous Transfer Mode-High Speed LANs	9
II	**CONGESTION AND TRAFFIC MANAGEMENT** Congestion Control in Data Networks and Internets- Link-level Flow and Error Control-TCP Traffic Control-Traffic and Congestion Controls in ATM Networks	9
III	**INTERNET ROUTING** Overview of Graph Theory and Least-Cost Paths-Internet Routing Protocols-Exterior Routing Protocols and Multicast	9
IV	**QOS IN IP NETWORKS** Integrated and Differentiated Services-Protocols for QoS Support: Resource Reservation RSVP- Multiprotocol Label Switching - Real Time Transport Protocol	9
V	**COMPRESSION** Overview of Information Theory: Information and Entropy, Coding-Lossless Compression-Lossy Compression	9
	Total Instructional Hours	45

Course Outcome	Upon Completion of the course, the students will have the ability to: CO1: Interpret ATM and Frame relay networks CO2: Describe the concepts of congestion and traffic management CO3: Analyze the Quality of service in IP Networks. CO4: Infer the Principle of wireless network operation and compression CO5: Summarize the Network management and application

TEXT BOOKS:

T1- William Stallings, "High-Speed Networks and Internets: Performance and Quality of Service", Pearson Education, Second Edition.

T2- Jean Warland and Pravin Varaiya, "High Performance Communication Networksl", Jean Harcourt Asia Pvt. Ltd., Second Edition.

REFERENCE BOOKS:

R1-Behrouz A. Forouzan, "Data Communication and Computer Networking", Fourth Edition,

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CO/ PO	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	3	3	3	3	2	3	1	1	-	1	-	3	3	3
CO2	3	2	3	3	2	2	3	-	-	-	-	3	3	3
CO3	3	2	2	3	2	3	-	-	-	-	-	3	3	3
CO4	3	3	3	2	1	3	-	-	-	-	-	3	3	3
CO5	3	3	2	3	2	3	3	-	3	3	-	3	3	3
AVG	3	2.6	2.6	2.8	1.8	2.8	2.3	1	3	2	-	3	3	3

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Programme	Course Code	Name of the Course	L	T	P	C
BE	**21EC8306**	**ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING**	**3**	**0**	**0**	**3**

Course Objectives	1. To understand the basics of Artificial Intelligence and problem-solving agents. 2. To apply the appropriate Heuristic search techniques in problem solving. 3. To understand the basics of Machine learning and compare supervised, unsupervised learning. 4. To implement linear regression, classification models like logistic regression and SVMs, and decision trees for the necessary application. 5. To investigate back propagation in neural network.
Prerequisite	21EC3202 Signals and systems 21EC7201 Digital Image Processing

Unit	Description	Instructional Hours
I	**INTRODUCTION TO ARTIFICIAL INTELLIGENCE** Introduction to AI – Agents and Environments – concept of rationality – nature of environments – structure of agents. Problem solving agents – search algorithms – uninformed search strategies.	9
II	**PROBLEM SOLVING** Heuristic search strategies – heuristic functions. Local search and optimization problems – local search in continuous space – search with non-deterministic actions – search in partially observable environments – online search agents and unknown environments	9
III	**INTRODUCTION TO MACHINE LEARNING** Introduction to Machine learning-Supervised Learning Algorithms - Unsupervised Learning Algorithms – Reinforcement Learning, Deep Learning-Dimensionality reduction.	9
IV	**SUPERVISED LEARNING AND UNSUPERVISED LEARNING ALGORITHMS** Regression models-Linear regression, logistic regression -Classification Models-Decision trees, Naïve Bayes, K-nearest neighbor algorithm-Support Vector Machines-Self Organizing Map.	9
V	**NEURAL NETWORKS** Perceptron - Multilayer perceptron, activation functions, network training – gradient descent optimization – stochastic gradient descent, error backpropagation- Building a Machine Learning Algorithm	9
	Total Instructional Hours	**45**

Course Outcomes	Upon Completion of the course, the students will have the ability to: CO1: Interpret Intelligent agent frameworks. CO2: Design heuristic-based algorithms and evaluate their effectiveness for problem-solving in uncertain or partially observable environments. CO3: Compare supervised, unsupervised, and reinforcement learning algorithms to solve complex data-driven problems in machine learning. CO4: Implement and evaluate regression, classification and decision tree models to achieve accurate predictions using supervised and unsupervised learning. CO5: Develop and train neural network architectures, including perceptrons and multilayer networks, using techniques like gradient descent and error backpropagation.
TEXT BOOKS:	

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T1- Stuart Russell and Peter Norvig, “Artificial Intelligence – A Modern Approach”, Fourth Edition, Pearson Education, 2021. T2: Stephen Marsland, "Machine Learning – An Algorithmic Perspective", Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
REFERENCE BOOKS:
R1: Ethem Alpaydin, “Introduction to Machine Learning”, MIT Press, Fourth Edition, 2020. R2: Patrick H. Winston, "Artificial Intelligence", Third Edition, Pearson Education, 2006 R3: Tom Mitchell, “Machine Learning”, McGraw Hill, 3rd Edition, 2017 R4: Christopher M. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006. R5: Kevin Night, Elaine Rich, and Nair B., “Artificial Intelligence”, McGraw Hill, 2008

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	3	-	2	-	-	-	-	-	3	3	3
CO2	3	3	3	3	2	2	-	-	-	-	-	3	3	3
CO3	3	1	1	3	-	2	-	-	-	-	-	3	3	3
CO4	3	3	3	3	2	2	-	-	-	-	-	3	3	3
CO5	3	3	3	3	2	2	-	-	-	-	-	3	3	3
AVG	3	2.2	2.2	3	2	2	-	-	-	-	-	3	3	3

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC6401	IOT CONCEPTS AND APPLICATIONS	3	0	0	3

Course Objectives	1. To impart basic knowledge on physical and logical design of Internet of Things (IoT) 2. To familiarize IoT Physical Devices and its controlling hardware 3. To provide foundational understanding of various sensors and their interfacing techniques 4. To teach programming skills for IoT applications using Arduino or Raspberry Pi 5. To acquire knowledge on various applications of IoT in real world scenario

Unit	Description	Instructional Hours
I	**INTRODUCTION TO INTERNET OF THINGS** Evolution of Internet of Things – Enabling Technologies – IoT Architectures: one M2M, IoT World Forum (IoTWF) and Alternative IoT Models – Simplified IoT Architecture and Core IoT Functional Stack – Fog, Edge and Cloud in IoT	9
II	**COMPONENTS IN INTERNET OF THINGS** **IoT Physical Devices and Endpoints**- Introduction to Arduino and Raspberry Pi- Installation, Interfaces (serial, SPI, I2C) **Controlling Hardware**- Connecting LED, Buzzer, Switching High Power devices with transistors, Controlling AC Power devices with Relays, Controlling servo motor, speed control of DC Motor, unipolar and bipolar Stepper motors	9
III	**SENSORS AND INTERFACING TECHNIQUES** Light sensor, temperature sensor with thermistor, voltage sensor, ADC and DAC, Temperature and Humidity Sensor DHT11, Motion Detection Sensors, Wireless Bluetooth Sensors, Level Sensors, USB Sensors, Embedded Sensors, Distance Measurement with ultrasound sensor	9
IV	**OPEN PLATFORMS AND PROGRAMMING** IOT deployment for Raspberry Pi/Arduino/ESP IDE platform-Architecture – Programming – Interfacing – Accessing GPIO Pins – Sending and Receiving Signals Using GPIO Pins – Connecting to the Cloud.	9
V	**IOT APPLICATIONS** Business models for the internet of things, Smart city, Smart mobility and transport, Industrial IoT, Smart health, Environment monitoring and surveillance – Home Automation – Smart Agriculture.	9
	Total Instructional Hours	**45**

Course Outcomes	After completion of the course the learner will be able to CO1: Explain the fundamental concepts and principles of physical and logical design in IoT systems CO2: Design portable IoT using Arduino and Raspberry Pi CO3: Implement basic IoT systems that collect sensor data and process effectively CO4: Design IoT projects using Raspberry Pi, Arduino, or ESP IDE platforms CO5: Develop solutions for real time applications using IoT concepts.

TEXT BOOKS:

T1-- Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017.

T2- Samuel Greengard, The Internet of Things, The MIT Press, 2015

REFERENCE BOOKS:

R1- Perry Lea, "Internet of things for architects", Packt, 2018

R2. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applications and Protocols", Wiley, 2012

R3. IOT (Internet of Things) Programming: A Simple and Fast Way of Learning, IOT Kindle Edition.

R4. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.

R5. ArshdeepBahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015

R6. https://www.arduino.cc/ https://www.ibm.com/smarterplanet/us/en/?ca=v_smarterplanet

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CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1	2	3	3	3	2	3	-	-	-	2	-	3	3	3
CO2	3	3	2	2	3	3	-	-	-	2	-	3	3	3
CO3	3	2	3	3	3	2	-	-	-	1	-	3	3	3
CO4	3	3	3	2	2	2	-	-	2	1	2	3	3	3
CO5	3	3	3	3	3	3	3	-	2	2	2	3	3	3
AVG	3	3	3	3	3	3	3	-	2	2	2	3	3	3

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MINOR DEGREE
Vertical I
Embedded and IoT

S No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22EC5471	Electronics for Embedded Systems	MDC	3	0	0	3	3
2	22EC6471	Microcontroller and its Applications	MDC	3	0	0	3	3
3	22EC6472	Sensor and Embedded Systems	MDC	3	0	0	3	3
4	22EC7471	Fundamentals of IoT	MDC	3	0	0	3	3
5	22EC7472	Industrial IoT	MDC	3	0	0	3	3
6	22EC8471	IoT for Smart Systems	MDC	3	0	0	3	3

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC5471	**ELECTRONICS FOR EMBEDDED SYSTEMS**	3	0	0	3

Course Objective	1. To understand the fundamentals of Electronics and Boolean logic and functions. 2. To design and realize digital systems 3. To study the instruction sets and operations of a processor. 4. To study the different ways of communication with I/O devices and standard I/O Interfaces 5. To study the Embedded system design.

Unit	Description	Instructional Hours
I	**ELECTRONICS FUNDAMENTALS** Theory of PN junction diode- Zener diode and its characteristics. TRANSISTORS Basic principle of operation of NPN and PNP configuration JFET – Construction and working principle –E-MOSFET, D MOSFET - Comparison of JFET and MOSFET.	5
II	**DIGITAL FUNDAMENTALS** Digital Systems – Binary Numbers – Octal – Hexadecimal Conversions – Signed Binary Numbers – Complements – Llogic Gates – Boolean Algebra – K-Maps – Standard Forms neither – NAND – NOR Implementation.	5
III	**INTRODUCTION TO EMBEDDED SYSTEMS** Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.	6
IV	**EMBEDDED C PROGRAMMING** Memory and I/O Devices Interfacing – Programming Embedded Systems in C – Need for RTOS – Multiple Tasks and Processes – Context Switching – Priority Based Scheduling Policies	7
V	**EMBEDDED FIRMWARE:** Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches and Development Languages.	7
	Total Instructional Hours	**45**

Course Outcome	Upon successful completion of the course, the students will have the ability to: CO1: Understand the concepts of smart system design and its present developments. CO2: Illustrate different embedded open-source and cost-effective techniques for developing solution for real time applications. CO3: Acquire knowledge on different platforms and Infrastructure for Smart system design. CO4: Infer about smart appliances and energy management concepts. CO5: Apply and improve Employability and entrepreneurship capacity due to knowledge up gradation on embedded system technologies.

TEXT BOOKS:

T1-Thomas Bräunl, Embedded Robotics, Springer, 2003.
T2 - Grimm, Christoph, Neumann, Peter, Mahlknech and Stefan, Embedded Systems for Smart Appliances and Energy Management, Springer 2013.

REFERENCE BOOKS:

R1- Raj Kamal, Embedded Systems - Architecture, Programming and Design, McGraw- Hill, 2008

R2- NilanjanDey, Amartya Mukherjee, Embedded Systems and Robotics with Open-Source Tools, CRC press, 2016.

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CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	-	-	-	-	-	-	-	3	2
CO2	3	3	3	2	2	-	-	-	-	-	-	-	3	2
CO3	3	3	2	2	2	-	-	-	-	-	-	-	2	1
CO4	3	3	2	2	2	-	-	-	-	-	-	-	3	3
CO5	3	3	3	3	3	-	-	-	-	-	-	-	3	3
AVG	**3**	**3**	**2.6**	**2.2**	**2.2**	-	-	-	-	-	-	-	**2.8**	**2.2**

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC6471	MICROCONTROLLER AND ITS APPLICATIONS	3	0	0	3

Course Objective	To explore the Architecture of 8085 and 8086 microprocessor. To acquire the design aspects of I/O and Memory Interfacing circuits. To assess about communication and bus interfacing. To interpret the Architecture of 8051 microcontroller To identify the concepts of microcontroller interfacing	
Unit	**Description**	**Instructional Hours**
I	**THE 8085 AND 8086 MICROPROCESSOR** Introduction to 8085 – Microprocessor architecture – Addressing modes - Instruction set - Introduction to 8086 – Microprocessor architecture – Addressing modes - Instruction set- Assembly language programming – Modular Programming - Interrupts and interrupt service routines.	9
II	**8086 SYSTEM BUS STRUCTURE** 8086 signals – Basic configurations – System bus timing –System design using 8086 – Introduction to Multiprogramming – Multiprocessor configurations – Coprocessor, Closely coupled and loosely Coupled configurations – Introduction to advanced processor	9
III	**I/O INTERFACING** Parallel communication interface – Serial communication interface – D/A and A/D Interface – Timer Interface – Keyboard /display controller – Interrupt controller – DMA controller – Programming and applications Case studies: Traffic Light control, LED display, LCD display.	9
IV	**MICROCONTROLLER AND INTERFACING MICROCONTROLLER** Architecture of 8051 – Special Function Registers (SFRs) - I/O Pins Ports and Circuits – Instruction set - Addressing modes - Assembly language programming. Programming 8051 Timers - Serial Port Programming - Interrupts Programming – LCD & Keyboard Interfacing - ADC, DAC & Sensor Interfacing - Stepper Motor	9
V	**ARM PROCESSOR 9** Arcon RISC Machine – Architectural Inheritance – Core & Architectures - Registers – Pipeline - Interrupts – ARM organization - ARM processor family – Co-processors - ARM instruction set- Thumb Instruction set - Instruction cycle timings - The ARM Programmer"s model- ARM Assembly Language Programming	9
Course Outcome	Upon successful completion of the course, the students will have the ability to CO1: Design and implement programs on 8086 microprocessor. CO2: Design I/O circuits. CO3: Design Memory Interfacing circuits. CO4: Design and implement 8051 microcontroller-based systems. CO5: Design various interfacing and its programming methodologies	
	Total Instructional Hours	**45**

TEXT BOOKS:

T1-Ramesh S. Goankar, "Microprocessor Architecture, Programming and Applications with 8085". 5th Edition, Prentice Hall

T2- Yu-Cheng Liu, Glenn A.Gibson, "Microcomputer Systems: The 8086 / 8088 Family - Architecture. Programming and Design", Prentice Hall of India. 2011.

T3- Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", Second Edition, Pearson education, 2011.

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REFERENCE BOOKS:
R1 - Doughlas V.Hall, "Microprocessors and Interfacing, Programming and Hardware",TMH,2012 R2- Krishna Kant , "Microprocessors and microcontrollers architecture programming and system design 8085 8086 8051 8096 PHI Learning Private Limited", 2014

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	2	2	-	-	-	-	-	2	3	2
CO2	3	3	3	2	2	1	-	-	-	-	-	1	3	2
CO3	3	3	3	2	2	1	-	-	-	-	-	1	2	2
CO4	3	3	3	3	3	2	-	-	-	-	2	2	2	3
CO5	2	1	2	1	3	-	2	-	1	-	-	2	2	2
AVG	2.8	2.4	2.6	2	2.4	1.5	2	-	1	-	2	1.6	2.4	2.2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC6472	SENSOR AND EMBEDDED SYSTEMS	3	0	0	3

Course Objective	1. To provide insight about the embedded processor and sensors required for IoT. 2. To familiarize the design and development of embedded system-based system design. 3. To provide an insight into smart appliances and energy management concepts. 4. To identify the architecture and requirements of UAV. 5. To expose students to different open-source platforms and attributes.

Unit	Description	Instructional Hours
I	**INTRODUCTION** Classification of Sensors and Actuators - Input and Output Characteristics - Sensors and Actuators- working principle of Electric and Magnetic, Mechanical, Acoustic, Chemical, Radiation and Temperature- Smart Sensors and Actuators.	9
II	**SENSORS AND ACTUATORS FOR AUTOMOTIVES** Review of sensors- sensors interface to the ECU, conventional sensors and actuators, Modern sensor and actuators - LIDAR sensor- smart sensors- MEMS/NEMS sensors and actuators for automotive Applications.	9
III	**SENSORS AND UAVS** Real time Embedded processors for UAVs - sensors-servos-accelerometer –gyros-actuators- power supply- integration, installation, configuration, and testing – MEMS/NEMS sensors and actuators for UAVs- Autopilot – AGL.	9
IV	**EMBEDDED SYSTEM ARCHITECTURE DESIGN** Overview of Design Requirements - Hardware and software selection & co-design - Smart sensors and Actuators –Communication protocols used in smart systems – Data Analytics: Need & Types – Open-source Analytics Platform for embedded systems (IFTTT &ThingSpeak) – Smart Microcontrollers - Embedded system for Smart card design and development – Recent trends.	9
V	**EMBEDDED HARDWARE DEVICES** Application of Smart Embedded Sensor Wearable's in Healthcare & Activity Monitoring Functional requirements - Selection of body sensors, Hardware platform, OS and Softwar platform – Selection of suitable communication protocol. Case Study: Design of a wearable collecting heart-beat, temperature and monitoring health status using a Smartphon application.	9
	Total Instructional Hours	45

Course Outcome	Upon successful completion of the course, the students will have the ability to CO1: Insight into the significance of the role of embedded system for automotive applications. CO2: Illustrate the need, selection of sensors and actuators and interfacing with UAV CO3: Develop the Embedded concepts for vehicle management and control systems. CO4: Demonstrate the need of Electrical vehicle and able to apply the embedded system technology for various aspects of EVs CO5: Demonstrate criteria of choice of sensors, components to build meters.

TEXT BOOKS:

T1-Thomas Bräunl, Embedded Robotics, Springer, 2003.
T2- Grimm, Christoph, Neumann, Peter, Mahlknech and Stefan. Embedded Systems for Smart Appliances and Energy Management, Springer 2013.

REFERENCE BOOKS:

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R1. Raj Kamal, Embedded Systems - Architecture, Programming and Design, McGraw- Hill, 2008
R2. NilanjanDey, Amartya Mukherjee, Embedded Systems and Robotics with Open-Source Tools, CRC press, 2016.
R3. Karim Yaghmour, Embedded Android, O'Reilly, 2013.
R4. Steven Goodwin, Smart Home Automation with Linux and Raspberry Pi, Apress, 2013
R5. C.K.Toh, AdHoc mobile wireless networks, Prentice Hall, Inc, 2002.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	-	3	3	2	2	-	-	-	-	-	-	-	3
CO2	3	-	3	3	2	2	-	-	-	-	-	-	-	3
CO3	3	-	3	2	2	2	-	-	-	-	-	-	-	2
CO4	3	-	3	2	2	2	-	-	-	-	-	-	-	3
CO5	3	3	3	3	3	-	-	-	-	-	-	-	3	3
AVG	3	3	3	2.2	2.2	2	-	-	-	-	-	-	3	2.2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	**22EC7471**	**FUNDAMENTALS OF IOT**	**2**	**0**	**2**	**3**

Course Objective

The student should be able to

1. To apprise students with basic knowledge of IoT that paves a platform to understand physical and logical design of IOT
2. To analyses requirements of various communication models and Protocols for cost-effective design of IoT applications on different IoT platforms.
3. To introduce the technologies behind Internet of Things (IoT).
4. To explain the students how to code for an IoT application using Arduino/Raspberry Pi open platform.
5. To apply the concept of Internet of Things in real world scenario

Unit	Description	Instructional Hours
I	**INTRODUCTION TO INTERNET OF THINGS** Evolution of Internet of Things – Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT Models – Simplified IoT Architecture and Core IoT Functional Stack – Fog, Edge and Cloud in IoT	9
II	**COMPONENTS IN INTERNET OF THINGS** Functional Blocks of an IoT Ecosystem – Sensors, Actuators, and Smart Objects – Control Units - Communication modules (Bluetooth, Zigbee, Wifi, GPS, GSM Modules)	9
III	**PROTOCOLS AND TECHNOLOGIES BEHIND IOT** IOT Protocols - IPv6, 6LoWPAN, MQTT, CoAP - RFID, Wireless Sensor Networks, BigData Analytics, Cloud Computing, Embedded Systems.	9
IV	**OPEN PLATFORMS AND PROGRAMMING** IOT deployment for Raspberry Pi /Arduino platform-Architecture –Programming – Interfacing – Accessing GPIO Pins – Sending and Receiving Signals Using GPIO Pins – Connecting to the Cloud.	9
V	**IOT APPLICATIONS** Business models for the internet of things, Smart city, Smart mobility and transport, Industrial IoT, Smart health, Environment monitoring and surveillance – Home Automation – Smart Agriculture	9
	Total Instructional Hours	45

Course Outcome

Upon successful completion of the course, the students will have the ability to
CO1: Explain the concept of IoT.
CO 2: Understand the communication models and various protocols for IoT.
CO 3: Design portable IoT using Arduino/Raspberry Pi /open platform
CO 4: Apply data analytics and use cloud offerings related to IoT.
CO 5: Analyze applications of IoT in real time scenario.

TEXT BOOKS:

T1- Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017
T2- Samuel Greengard, The Internet of Things, The MIT Press, 2015

REFERENCE BOOKS:

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R1-Perry Lea, "Internet of things for architects", Packt, 2018
R2- Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applications and Protocols", Wiley, 2012
R3-IOT (Internet of Things) Programming: A Simple and Fast Way of Learning, IOT Kindle Edition.
R4-Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things". Springer, 2011.
R5-ArshdeepBahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press,2015
R6-. https://www.arduino.cc/https://www.ibm.com/smarterplanet/us/en/?ca=v_smarterplanet

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	2	2	-	-	-	-	-	2	3	2
CO2	3	3	3	2	2	1	-	-	-	-	-	1	3	2
CO3	3	3	3	2	2	1	-	-	-	-	-	1	2	2
CO4	3	3	3	3	3	2	-	-	-	-	-	2	2	3
CO5	2	1	2	1	3	-	2	-	-	-	-	2	2	2
AVG	2.8	2.4	2.6	2	2.4	1.5	2	-	-	-	-	1.6	2.4	2.2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC7472	INDUSTRIAL IOT	3	0	0	3

Course Objective	1. To understand the fundamentals of Internet of Things 2. To learn about the basics of IoT protocols 3. To build a small low-cost embedded system using IoT 4. To learn the IoT Security Protocols 5. To apply the concept of IoT in the real-world scenario

Unit	Description	Instructional Hours
I	**INTRODUCTION AND ARCHITECTURE OF IoT** Introduction – Definition and characteristics of IoT – Physical and Logical Design of IoT - Communication models and APIs – Challenges in IoT - Evolution of IoT-Components of IoT - A Simplified IoT Architecture – Core IoT Functional Stack.	9
II	**INDUSTRIAL IoT** Introduction, Industrial IoT: Business Model and Reference Architecture: IIoT-Models, Industrial IoT- Layers: IIoT Sensing, IIoT Processing, Communication, IIoT Networking.	9
III	**IIOT ANALYTICS** Big Data Analytics and Software Defined Networks, Machine Learning and Data Science, Julia Programming, Data Management with Hadoop	9
IV	**IOT SECURITY** Industrial IoT: Security and Fog Computing - Cloud Computing in IIoT, Fog Computing in IIoT. Security in IIoT.	9
V	**CASE STUDIES** Industrial IOT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies: Milk Processing and Packaging Industries, Manufacturing Industries	9
	Total Instructional Hours	**45**

Course Outcome	Upon successful completion of the course, the students will have the ability to CO1. Understand the basic concepts and Architectures of Internet of Things. CO2. Understand various IoT Layers and their relative importance. CO3. Realize the importance of Data Analytics in IoT. CO4. Study various IoT platforms and Security. CO5. Understand the Model real-time applications using IoT concepts

TEXT BOOKS:

T1. Industry 4.0: The Industrial Internet of Things", by Alasdair Gilchrist (Apress), 2017.
T2. Hands-On Industrial Internet of Things: Create a powerful Industrial IoT by Giacomo Veneri, Antonio Capasso, Packt, 2018.

REFERENCE BOOKS:

R1- "Industrial Internet of Things: Cybermanufacturing Systems"by Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer), 2017.
R2- Industrial IoT Challenges, Design Principles, Applications, and Security by Ismail Butun

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CO/PO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	3	3	2	2	2	-	-	-	-	-	3	3	3
CO 2	3	3	3	3	2	2	-	-	-	-	-	2	3	3
CO 3	3	3	3	3	2	2	-	-	-	-	-	2	2	2
CO 4	3	3	2	2	2	2	-	-	-	-	-	2	2	2
CO 5	3	3	2	2	2	1	-	-	-	-	-	3	3	2
Avg.	3	3	2.6	2.4	2	1.8	-	-	-	-	-	2.4	2.6	2.4

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC8471	IOT FOR SMART SYSTEMS	3	0	0	3

Course Objective	1. To study about Internet of Things technologies and its role in real time applications. 2. To introduce the infrastructure required for IoT 3. To familiarize the accessories and communication techniques for IoT. 4. To provide insight about the embedded processor and sensors required for IoT 5. To familiarize the different platforms and Attributes for IoT	
Unit	**Description**	**Instructional Hours**
I	**INTRODUCTION TO INTERNET OF THINGS** Overview, Hardware and software requirements for IOT, Sensor and actuators, Technology drivers, Business drivers, Typical IoT applications, Trends and implications.	9
II	**IOT ARCHITECTURE** IoT reference model and architecture -Node Structure - Sensing, Processing, Communication, Powering, Networking - Topologies, Layer/Stack architecture, IoT standards, Cloud computing for IoT, Bluetooth, Bluetooth Low Energy beacons	9
III	**PROTOCOLS AND WIRELESS TECHNOLOGIES FOR IOT 9 PROTOCOLS** NFC, SCADA and RFID, Zigbee MIPI, M-PHY, UniPro, SPMI, SPI, M-PCIe GSM, CDMA, LTE, GPRS, small cell. Wireless technologies for IoT: WiFi (IEEE 802.11), Bluetooth/Bluetooth Smart, ZigBee/ZigBee Smart, UWB (IEEE 802.15.4), 6LoWPAN, Proprietary Systems-Recent trends	9
IV	**IOT PROCESSORS** Services/Attributes: Big-Data Analytics for IOT, Dependability, Interoperability, Security, Maintainability. Embedded processors for IOT: Introduction to Python programming - Building IOT with RASPERRY PI and Arduino.	9
V	**CASE STUDIES** Industrial IoT, Home Automation, smart cities, Smart Grid, connected vehicles, electric vehicle charging, Environment, Agriculture, Productivity Applications, IOT Defense	9
	Total Instructional Hours	**45**
Course Outcome	Upon successful completion of the course, the students will have the ability to CO1: Analyze the concepts of IoT and its present developments. CO2: Compare and contrast different platforms and infrastructures available for IoT CO3: Explain different protocols and communication technologies used in IoT CO4: Analyze the big data analytic and programming of IoT CO5: Implement IoT solutions for smart applications	

TEXT BOOKS:

T1. ArshdeepBahga and VijaiMadisetti : A Hands-on Approach "Internet of Things",Universities Press 2015.
T2. Oliver Hersent , David Boswarthick and Omar Elloumi " The Internet of Things", Wiley,2016.
T3. Samuel Greengard, " The Internet of Things", The MIT press, 2015.
T4. Adrian McEwen and Hakim Cassimally "Designing the Internet of Things "Wiley,2014.

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REFERENCE BOOKS:
R1- Jean- Philippe Vasseur, Adam Dunkels, "Interconnecting Smart Objects with IP: The Next Internet" Morgan Kuffmann Publishers, 2010. .
R2- Adrian McEwen and Hakim Cassimally, "Designing the Internet of Things", John Wiley and sons, 2014.
R3- Lingyang Song/DusitNiyato/ Zhu Han/ Ekram Hossain," Wireless Device-to-Device Communications and Networks, CAMBRIDGE UNIVERSITY PRESS,2015. R4- OvidiuVermesan and Peter Friess (Editors), "Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems", River Publishers Series in Communication, 2013.
R5- Vijay Madisetti , ArshdeepBahga, "Internet of Things (A Hands on-Approach)", 2014.
R6- Zach Shelby, Carsten Bormann, "6LoWPAN: The Wireless Embedded Internet", John Wiley and sons, 2009.
R7- Lars T.Berger and Krzysztof Iniewski, "Smart Grid applications, communications and security", Wiley, 2015.
R8- JanakaEkanayake, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama and Nick Jenkins, " Smart Grid Technology and Applications", Wiley, 2015
R9- UpenaDalal,"Wireless Communications & Networks,Oxford,2015

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1	3	-	-	-	-	2	3	3	3
CO2	3	3	2	2	1	-	-	-	-	-	1	2	3	3
CO3	3	3	3	2	1	2	-	-	-	-	3	2	3	2
CO4	3	3	2	2	3	-	-	-	-	-	-	1	3	3
CO5	3	2	3	3	2	1	-	-	-	-	2	1	3	2
Avg	3	2.8	2.4	2.2	1.6	2	-	-	-	-	2	1.8	3	2.6

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Honor Degree

Vertical-I
Sensor Technologies and IoT

S No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
1	22EC5371	Realtime Embedded Systems	HDC	3	0	0	3	40	60	100
2	22EC6371	Sensor for IoT applications	HDC	3	0	0	3	40	60	100
3	22EC6372	Advanced Processor Architectures	HDC	3	0	0	3	40	60	100
4	22EC7371	IOT Processors	HDC	3	0	0	3	40	60	100
5	22EC7372	Wearable Devices	HDC	3	0	0	3	40	60	100
6	22EC8371	Industrial IoT and Industry 4.0	HDC	3	0	0	3	40	60	100

Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC5371	REALTIME EMBEDDED SYSTEMS	3	0	0	3

Course Objective	**The student should be able to** 1. To familiarize the architecture and programming of ARM processors 2. To assess the basic concepts of hard real time multiprocessing. 3. To interpret the analytical concepts for effective programming 4. To acquire knowledge about operating systems 5. To familiarize with networks for embedded

Unit	Description	Instructional Hours
I	**INTRODUCTION TO EMBEDDED COMPUTING AND ARM PROCESSORS** Complex systems and microprocessors – Embedded system design process – Formalism for system design– Design example: Model train controller- ARM Processor Fundamental Instruction Set and Programming using ARM Processor	9
II	**COMPUTING PLATFORM** CPU: Programming input and output – Supervisor mode, exception and traps – Coprocessor – Memory system mechanism – CPU performance – CPU power consumption- CPU buses – Memory devices – I/O devices – Component interfacing-System Level Performance Analysis Parallelism. Design Example: Data Compressor	9
III	**PROGRAM DESIGN AND ANALYSIS** Program design – Model of programs – Assembly and Linking – Basic compilation techniques – Program Optimization- Analysis and optimization of execution time, power, energy, program size – Program validation and testing- Example: Software Modem	9
IV	**PROCESS AND OPERATING SYSTEMS** Multiple tasks and Multi processes – Processes – Context Switching – Operating Systems Priority based Scheduling- RMS and EDF - Inter Process Communication mechanisms – Evaluating operating system performance – Power optimization strategies for processes.	9
V	**HARDWARE ACCELERATORS & NETWORKS** Multiprocessors- CPUs and Accelerators – Performance Analysis- Distributed Embedded Architecture – Networks for Embedded Systems: - I2C, CAN Bus, Ethernet, Myrinet – Network based design – Internet enabled systems. Design Example: Elevator Controller.	9
	Total Instructional Hours	**45**

Course Outcome	Upon successful completion of the course, the students will have the ability to: CO1: Design and develop ARM processor based systems CO2: Explain role of microcontrollers in embedded systems. CO3: Apply program design and optimization and proper scheduling of the process. CO4: Analyse the concept of process, multiprocesses and operating systems in embedded system design. CO5: Build various communication protocols in distributed embedded computing platform.

TEXT BOOKS:

T1 - Wayne Wolf, "Computers as Components - Principles of Embedded Computing System Design", Morgan Kaufmann Publisher (An imprint of Elsevier), 3rd Edition, 2008.

T2. Andrew N Sloss, Dominic Symes, Chris Wright, "ARM System Developer's Guide- Designing and Optimizing System Software", Elsevier/Morgan Kaufmann Publisher, 2008

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REFERENCE BOOKS:
R1 – David E-Simon," An Embedded Software Prime",Pearson Education,2010. R2. Tammy Noergaard,"Embedded Systems Architecture", Elsevier, 2006. R3. Jane.W.S.Liu,"Real-TimeSystems",PearsonEducationAsia,2011
List of Open Source Software/ Learning website: 1 https://nptel.ac.in/courses/117106111 2 https://onlinecourses.nptel.ac.in/noc20_cs16/preview 3 https://archive.nptel.ac.in/courses/108/105/108105057/ 4 https://mrcet.com/downloads/digital_notes/ECE/IV%20Year/EMBEDDED%20SYSTEMS%20 DESIGN.pdf 5 https://nptel.ac.in/courses/117106112

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	-	-	-	-	-	-	-	3	2
CO2	3	3	3	2	2	-	-	-	-	-	-	-	3	2
CO3	3	3	2	2	2	-	-	-	-	-	-	-	2	1
CO4	3	3	2	2	2	-	-	-	-	-	-	-	3	3
CO5	3	3	3	3	3	-	-	-	-	-	-	-	3	3
AVG	3	3	2.6	2.2	2.2	-	-	-	-	-	-	-	2.8	2.2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC6371	SENSOR FOR IOT APPLICATIONS	3	0	0	3

Course Objective	**The student should be able to** 1. To introduce the basics of technology and its applications. 2. To understand the concept of M2M (machine to machine) interfacing with necessary protocols 3. To develop the Python Scripting Language for IoT devices 4. To familiarize with the Raspberry PI platform based IoT applications. 5. To provide the knowledge on web-based services using IoT devices.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO INTERNET OF THINGS** Definition and Characteristics of IoT, Sensors, Actuators, Physical Design of IoT – IoT Protocols, Logical design of IoT – IoT communication models, IoT Communication APIs, IoT enabled Technologies – Wireless Sensor Networks, Cloud Computing, Embedded Systems, IoT Levels and Templates, Domain Specific IoTs – Home Automation, City, Environment, Energy, Agriculture, Industry and Health & Life style	9
II	**IoTAND M2M** Introduction, M2M, Software defined networks, network function virtualization, difference between SDN and NFV for IoT, IoT System Management with NETCONF - YANG –Need for IoT System Management, SNMP, NETCONF, YANG,NETOPEER.	9
III	**IOT SYSTEMS AND IOT PHYSICAL DEVICES & ENDPOINTS** Introduction to python, Introduction to Arduino and Raspberry Pi- Installation, Interfaces (serial, SPI, I2C), Programming – Python program with Raspberry PI with focus on interfacing external gadgets, controlling output, and reading input from pins.	9
IV	**PREPARING OUR IoT PROJECTS AND HARDWARE DESIGN** Creating the sensor project, Creating the actuator project, Connecting LED, Buzzer, Switching High Power devices with transistors. Light sensor, temperature sensor with thermistor, voltage sensor, ADC and DAC, Temperature and Humidity Sensor DHT11, Motion Detection Sensors, Wireless Bluetooth Sensors, Level Sensors, USB Sensors, Embedded Sensors, Distance Measurement with ultrasound sensor.	9
V	**IOT PHYSICAL SERVERS AND CLOUD OFFERINGS** Introduction to Cloud Storage models and communication APIs Webserver – Web server for IoT, Cloud for IoT, Python web application framework Designing a RESTful web API, Amazon Web service for IoT	9
	Total Instructional Hours	45

Course Outcome	Upon successful completion of the course, the students will have the ability to:: CO1: Relate IoT application areas and technologies involved. CO2: Explain IoT sensors and technological challenges. CO3: Apply Python program with Rasberry PI on IoT devices CO4: Analyze Market forecast for IoT devices CO5: Design Internet of Things based projects using Raspberry Pi.

TEXT BOOKS:

T1 - Peter Waher, 'Learning Internet of Things', Packt Publishing. 2015.

T2 - Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015.

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REFERENCE BOOKS:

R1 - Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014.

R2 - Raspberry Pi Cookbook, Software and Hardware Problems and solutions, Simon Monk, O'Reilly (SPD), 2016

1. https://www.edx.org/course/iot-sensors-and-devices
2. https://www.coursera.org/learn/internet-of-things-sensing-actuation
3. https://onlinecourses.nptel.ac.in/noc20_cs66/preview
4. Open source software: Arduino, Devicehub.net, IoT Toolkit, OpenWSN, Particle, SiteWhere, ThingSpeak, Webinos etc

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	2	2	-	-	-	-	-	2	3	2
CO2	3	3	3	2	2	1	-	-	-	-	-	1	3	2
CO3	3	3	3	2	2	1	-	-	-	-	-	1	2	2
CO4	3	3	3	3	3	2	-	-	-	-	2	2	2	3
CO5	2	1	2	1	3	-	2	-	1	-	-	2	2	2
AVG	2.8	2.4	2.6	2	2.4	1.5	2	-	1	-	2	1.6	2.4	2.2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC6372	**ADVANCED PROCESSOR ARCHITECTURE**	3	0	0	3

Course Objective	**The student should be able to** 1. To understand the basics of parallel processing, memory and input-output sub systems 2. To understand the principles of pipelining and vector processing. 3. To get knowledge about the structures and algorithms for array processors. 4. To know the multiprocessor architecture, programming, control and algorithms 5. To familiarize themselves with MSP430 microcontroller and TMS320C6713 DSP processor

Unit	Description	Instructional Hours
I	**PARALLEL PROCESSING, MEMORY AND INPUT-OUTPUT SUB SYSTEMS :** Trends towards Parallel Processing - Parallel Computer Structures - Architectural Classification Schemes - Parallel Processing Applications. Hierarchical Memory Structure - Virtual Memory System - Cache Memories - Input-Output Subsystems	9
II	**PRINCIPLES OF PIPELINING AND VECTOR PROCESSING :** Principles of Linear Pipelining- Classification of Pipeline Processors-General Pipelines and Reservation Tables- Interleaved Memory Organizations- Principles of Designing Pipelined Processors- Characteristics of Vector Processing-Pipelined Vector Processing Methods - Architecture of Cray-I Vector Processor.	9
III	**STRUCTURES AND ALGORITHMS FOR ARRAY PROCESSORS :** SIMD Array Processors: SIMD Computer Organization - Making the data routing mechanism. SIMD Interconnection Networks: Static Vs Dynamic Networks – Mesh Connected Illiac Network - Cube Interconnection Networks - Barrel Shifter and Data Manipulator- Parallel Algorithms for Array Processors: SIMD Matrix Multiplication - Parallel Storing on Array Processors and SIMD Fast Fourier Transform	9
IV	**MULTIPROCESSOR ARCHITECTURE, PROGRAMMING, CONTROL AND ALGORITHMS**: Loosely Coupled Multiprocessors-Tightly Coupled Multiprocessors-Processor Characteristics for Multiprocessing. Interconnection Networks: Time shared or Common Buses- Crossbar Switch and Multiport Memories-Inter-process Communication Mechanisms: Process Synchronization Mechanisms - Synchronization with Semaphores - Conditional Critical Sections and Monitors. System Deadlocks and Protection: System Deadlocks and Protection - Deadlock Prevention and Avoidance- Deadlock Detection and Recovery and Protection Schemes.	9
V	**MSP430 MICROCONTROLLER AND TMS320C6713 DSP PROCESSOR :** Introduction- - MSP 430 Architecture - Features - Digital I/O : Input Registers - Output Registers - Direction Registers - Pull Up and Pull down Enable Registers Function Select Registers - Configuring Unused Port Pins Digital I/O Registers -TMS320C6000 family overview- Typical Applications - TMS320C67x DSP features and Options - Architecture - CPU-CPU Data Paths - Functional Units - On-chip Peripherals: DMA - EDMA - HPI - McBSP and Timers	9
	Total Instructional Hours	**45**

Course Outcome	Upon successful completion of the course, the students will have the ability to: CO1: Understand the basics of parallel processing, memory and input-output sub systems CO2: Understand the principles of pipelining and vector processing. CO3: Get knowledge about the structures and algorithms for array processors. CO4: Know the multiprocessor architecture, programming, control and algorithms CO5: Familiarize themselves with msp430 microcontroller and tms320c6713 dsp processor

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T1.Venkataramani B, Bhaskar M , "Digital Signal Processors: Architecture, Programming & Applications", Tata McGraw Hill Publishing Company Ltd., 2010. T2.TI Team , "MSP430X2xx Family User's Guide", Texas Instruments, .
REFERENCE BOOKS:
R1. Kai Hwang , Faye A Briggs , "Computer Architecture and Parallel Processing", New York, 1985.

CO/PO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	3	3	2	2	2	-	-	-	-	-	3	3	3
CO 2	3	3	3	3	2	2	-	-	-	-	-	2	3	3
CO 3	3	3	3	3	2	2	-	-	-	-	-	2	2	2
CO 4	3	3	2	2	2	2	-	-	-	-	-	2	2	2
CO 5	3	3	2	2	2	1	-	-	-	-	-	3	3	2
AVg.	3	3	2.6	2.4	2	1.8	-	-	-	-	-	2.4	2.6	2.4

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC7371	IOT PROCESSORS	3	0	0	3

Course Objective	**The student should be able to** CO1: Learn the architecture and features of ARM. CO2: Study the exception handling and interrupts in CORTEX M3 CO3: Program the CORTEX M3 CO4: Learn the architecture of STM 32L15XXX ARM CORTEX M3/M4 microcontroller. CO5: Understand the concepts of System – On – Chip(SoC)	
Unit	**Description**	**Instructional Hours**
I	**CORTEX-PROCESSOR** Introduction to Cortex Processor: Registers, Stack Pointer, Link Register, Program Counter, Special Registers, Operation Mode, Exceptions and Interrupts, Vector Tables, Stack Memory Operations, Reset Sequence , CORTEX M3 Instruction Sets: Assembly Basics, Instruction List, Instruction Descriptions, CORTEX M3 – Implementation Overview: Pipeline, Block Diagram. Bus Interfaces, I – Code Bus, D – Code Bus, System Bus- External PPB and DAP Bus.	9
II	**CORTEX EXCEPTION HANDLING AND INTERRUPTS** Exception Types, Priority, Vector Tables, Interrupt Inputs and Pending behaviour, Fault Exceptions, Supervisor Call and Pendable Service Call, NVIC: Nested Vector Interrupt Controller, Overview, Basic Interrupts, SYSTICK Time, Interrupt Behaviourm Interrupt/Exception Sequences, Exception Exits, Nested Interrupts, Tail – Chaining Interrupts, Late Arrivals and Interrupt Latency.	9
III	**CORTEX M3/M4 PROGRAMMING** 6 Cortex M3/M4 Programming: Overview, Typical Development Flow, Using C, CMSIS Using Assembly, Excepiton Programming Using Interrupts, Exception/Interrupt Handlers, Software Interrupts, Vector Table Relocation, Memory Protection Unit and other CORTEX M3 Features, MPU Registers, Setting up the MPU, Power Management, Multiprocessor Configuration.	9
IV	**STM32 MICROCONTROLLER AND DEBUGGING TOOLS** Memory and Bus Architecture, Power Control, Reset and Clock Control. STM32L15XXX Peripherals: GPIOs, System Configuration Controller, NVIC, ADC, Comparators, GP Timers, USART Development and Debugging Tools: Software and Hardware tools like Cross Assemblerm Compiler, Debugger, Simulator, In – Circuit Emulator (ICE), Logic Analyser.	9
V	**INTRODUCTION TO SYSTEM – ON – CHIP** System Architecture: An Overview, Components of the System Processors, Memories and Interconnects. Processor Architectures, Memory and Addressing, System Level Interconnection – An Approach for SOC Design Chip basics – Cycle Time Die Area – Power and Cost Area, Power and Time Trade – Offs in Processor Design – Reliability and Configurability – SOC Design Approach – Application Studies – AES, 3D Graphics Processor. Image Compression and Video Compression.	9
	Total Instructional Hours	**45**

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Course Outcome	Upon successful completion of the course, the students will have the ability to: CO1: Explain the architecture and features of ARM. CO2: List the concepts of exception handling. CO3: Write a program using ARM CORTEX M3/M4. CO4: Learn the architecture of STM32L15XXX ARM CORTEX M3/M4. CO5: Design an SoC for any application

TEXT BOOKS:

T1. Joseph Yiu, The Definitive Guide to the ARM CORTEX M3/M4, Second Edition, Elsevier, 2010

T2-Andrew N Sloss, Dominic Symes, Chris Wright, ARM System Developers Guide Designing and Optimising System Software, Elsevier, 2006

T3- Michael J Flynn and Wayne Luk, Computer System Design, System On Chip, Wiley India 2011

REFERENCE BOOKS:

R1-Steve Furber, ARM System – on – Chip Architecture, 2nd Edition, Pearson, 2015.

R2-CORTEX M Series ARM Reference Manual

R3-CORTEX M3 Technical Reference Manual

R4-STM32L152XX ARM CORTEX M3 Microcontroller Reference Manual 5/97

CO/PO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	3	3	2	2	2	-	-	-	-	-	3	3	3
CO 2	3	3	3	3	2	2	-	-	-	-	-	2	3	3
CO 3	3	3	3	3	2	2	-	-	-	-	-	2	2	2
CO 4	3	3	2	2	2	2	-	-	-	-	-	2	2	2
CO 5	3	3	2	2	2	1	-	-	-	-	-	3	3	2
AVG.	3	3	2.6	2.4	2	1.8	-	-	-	-	-	2.4	2.6	2.4

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC7372	WEARABLE DEVICES	3	0	0	3

Course Objective	**The student should be able to** 1. To know the hardware requirement of wearable systems 2. To understand the communication and security aspects in the wearable devices 3. To know the applications of wearable devices in the field of medicine 4. To illustrate the concept of smart textile 5. To Compare the various wearable devices in healthcare system	
Unit	**Description**	**Instructional Hours**
I	**INTRODUCTION TO WEARABLE SYSTEMS AND SENSORS** Wearable Systems- Introduction, Need for Wearable Systems, Drawbacks of Conventional Systems for Wearable Monitoring, Applications of Wearable Systems, Types of Wearable Systems, Components of wearable Systems. Sensors for wearable systems-Inertia movement sensors, Respiration activity sensor, Impedance plethysmography, Wearable ground reaction force sensor.	9
II	**SIGNAL PROCESSING AND ENERGY HARVESTING FOR WEARABLE DEVICES** Wearability issues -physical shape and placement of sensor, Technical challenges - sensor design, signal acquisition, sampling frequency for reduced energy consumption, Rejection of irrelevant information. .Power Requirements- Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles.	9
III	**WIRELESS HEALTH SYSTEMS** Need for wireless monitoring, Definition of Body area network, BAN and Healthcare, Technical Challenges- System security and reliability, BAN Architecture – Introduction, Wireless communication Techniques.	9
IV	**SMART TEXTILE** Introduction to smart textile- Passive smart textile, active smart textile. Fabrication TechniquesConductive Fibres, Treated Conductive Fibres, Conductive Fabrics, Conductive Inks.Case studysmart fabric for monitoring biological parameters - ECG, respiration.	9
V	**APPLICATIONS OF WEARABLE SYSTEMS** Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, neural recording, Gait analysis, Sports Medicine	9
	Total Instructional Hours	**45**
Course Outcome	Upon successful completion of the course, the students will have the ability to: CO1: Describe the concepts of wearable system. CO2: Explain the energy harvestings in wearable device. CO3: Use the concepts of BAN in health care. CO4: Illustrate the concept of smart textile CO5: Compare the various wearable devices in healthcare system	
TEXT BOOKS:		

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T1. Annalisa Bonfiglo and Danilo De Rossi, Wearable Monitoring Systems, Springer. 2011
T2. Zhang and Yuan-Ting, Wearable Medical Sensors and Systems,Springer, 2013
T3. Edward Sazonov and Micheal R Neuman, Wearable Sensors: Fundamentals, Implementation and Applications, Elsevier, 2014
T4. Mehmet R. Yuce and JamilY.Khan, Wireless Body Area Networks Technology, Implementation applications,Pan Stanford Publishing Pte.Ltd, Singapore, 2012

REFERENCE BOOKS:

R1- Sandeep K.S, Gupta, Tridib Mukherjee and Krishna Kumar Venkatasubramanian, Body Area Networks Safety, Security, and Sustainability, Cambridge University Press, 2013.

R2- . Guang-Zhong Yang, Body Sensor Networks, Springer, 2006.

CO/PO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	2	1	1	2	-	-	1	-	-	-	-	1	1
CO 2	3	2	1	1	2	-	-	1	-	-	-	-	1	1
CO 3	3	2	1	1	2	-	-	1	-	-	-	-	1	1
CO 4	3	2	1	1	2	-	-	1	-	-	-	-	1	1
CO 5	3	2	1	1	2	-	-	1	-	-	-	-	1	1
AVG	3	2	1	1	2	-	-	1	-	-	-	-	1	1

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC8371	INDUSTRIAL IOT AND INDUSTRY 4.0	3	0	0	3
Course Objective	**The student should be able to** 1. To understand IoT Nodes & Sensors 2. To understand IoT Gateways 3. To understand IoT Cloud Systems 4. To understand IoT Cloud Dashboards 5. To study Challenges in IoT system Design – Hardware & Software					

Unit	Description	Instructional Hours
I	**UNDERSTANDING IOT CONCEPT AND DEVELOPMENT PLATFORM** IOT Definition, Importance of IoT, Applications of IOT, IoT architecture, Understanding working ofSensors, Actuators, Sensor calibration, Study of Different sensors and their characteristics	9
II	**ANALYZING & DECODING OF COMMUNICATION PROTOCOL USED IN IOT DEVELOPMENT PLATFORM** UART Communication Protocol, I2C Protocol device interfacing and decoding of signal, SPI Protocol device interfacing and decoding of signal, WIFI and Router interfacing, Ethernet Configuration, Bluetooth study and analysis of data flow, Zigbee Interfacing and study of signal flow	9
III	**IOT PHYSICAL DEVICES AND ENDPOINTS AND CONTROLLING HARDWARE AND SENSORS** IoT Physical Devices and Endpoints- Introduction to Arduino and Raspberry Pi- Installation, Interfaces (serial, SPI, I2C), Programming – Python program with Raspberry PI with focus on interfacing external gadgets, controlling output, reading input from pins. Controlling Hardware- Connecting LED, Buzzer, Switching High Power devices with transistors, Controlling AC Power devices with Relays, Controlling servo motor, speed control of DC Motor, unipolar and bipolar Stepper motors; Sensors- Light sensor, temperature sensor with thermistor, voltage sensor, ADC and DAC, Temperature and Humidity Sensor DHT11, Motion Detection Sensors, Wireless Bluetooth Sensors, Level Sensors, USB Sensors, Embedded Sensors, Distance Measurement with ultrasound sensor.	9
IV	**CLOUD SERVICES USED IN IOT DEVELOPMENT PLATFORM** Configuration of the cloud platform, Sending data from the IOT nodes to the gateways using different communication options; Transferring data from gateway to the cloud; Exploring the web services like mail, Messaging (SMS) and Twitter etc.;Tracking of cloud data as per the requirement; Google Cloud service architect; AWS clod Services architect; Microsoft Azure cloud services Architect; OEN source Cloud Services; Initial State Iot Dashboard & Cloud Services	9

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V	**CHALLENGES IN IOT SYSTEM DESIGN – HARDWARE & SOFTWARE** Antenna design and placement, Chip-package system development, Power electronics, electromagnetic interference/compatibility (EMI/EMC), Electronics reliability; Battery simulation.	9
	Total Instructional Hours	**45**

Course Outcome	Upon successful completion of the course, the students will have the ability to: CO1: Understand the building blocks of IoT technology and explore the vast spectrum of IoT applications CO2: Use processors & peripherals to design & build IoT hardware CO3: Assess, select and customize technologies for IoT applications CO4: Connect numerous IOT applications with the physical world of humans and real-lifeproblem solving. CO5: Design and implement IOT applications that manage big data

TEXT BOOKS:

T1. Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti,Universities Press, 2015, ISBN: 9788173719547

T2:Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD),2014, ISBN: 9789350239759

REFERENCE BOOKS:

R1: Raspberry Pi Cookbook, Software and Hardware Problems and solutions, Simon Monk,O'Reilly (SPD), 2016, ISBN 7989352133895

R2:N. Ida, Sensors, Actuators and Their Interfaces, SciTech Publishers, 2014.

R3:Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015 3. Editors OvidiuVermesan

CO/PO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	2	2	2	1	2	-	-	-	-	-	2	3	2
CO 2	3	2	2	2	1	2	-	-	-	-	-	2	3	3
CO 3	3	2	2	2	2	2	-	-	-	-	-	2	3	3
CO 4	3	2	3	2	3	2	-	-	-	-	-	2	3	3
CO 5	3	3	3	3	3	3	-	-	-	-	-	1	3	2
AVG	**3**	**2.25**	**2.4**	**2.2**	**2**	**2.2**	-	-	-	-	-	**1.8**	**3**	**2.6**

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Honor Degree

Vertical-II

Advanced Communication Systems

S No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
1	22EC5372	Cognitive Radio Networks	HDC	3	0	0	3	40	60	100
2	22EC6373	Remote Sensing	HDC	3	0	0	3	40	60	100
3	22EC6374	Rocketry and Space Mechanics	HDC	3	0	0	3	40	60	100
4	22EC7373	Underwater Navigation Systems	HDC	3	0	0	3	40	60	100
5	22EC7374	Massive MIMO Networks	HDC	3	0	0	3	40	60	100
6	22EC8372	Advanced Wireless Communication Techniques	HDC	3	0	0	3	40	60	100

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC5372	COGNITIVE RADIO NETWORK	3	0	0	3

Course Objective	
Course Objective	**The student should be able to** 1. To understand the fundamentals of Software Defined radio and compare various SDR platforms. 2. To acquire the student to understand the evolving paradigm of cognitive radio communication and the enabling technologies for its implementation. 3. To assess the student to understand the essential functionalities and requirements in designing software defined radios and their usage for cognitive communication 4. To analyze the various methods of implementing the Cognitive Radio functions 5. To exemplify the research challenges in designing a Cognitive Radio Network and the applications

Unit	Description	Instructional Hours
I	**SOFTWARE DEFINED RADIO AND ITS ARCHITECTURE** Definitions and potential benefits, software radio architecture evolution, technology tradeoffs and architecture implications. Essential functions of the software radio, basic SDR, hardware architecture, Computational processing resources, software architecture, top level component interfaces, interface topologies among plug and play modules. different fusion rules, wideband spectrum	9
II	**COGNITIVE RADIOS AND ITS ARCHITECTURE** Marking radio self-aware, cognitive techniques – position awareness, environment awareness in cognitive radios, optimization of radio resources, Artificial Intelligence Techniques, Cognitive Radio – functions, components and design rules, Cognition cycle – orient, plan, decide and act phases, Inference Hierarchy, Architecture maps, Building the Cognitive Radio Architecture on Software defined Radio Architechture.	9
III	**SPECTRUM SENSING AND IDENTIFICATION** Overview-Classification-Matched Filter , waveform based sensing - cyclo stationary based sensing -Energy detector based sensing - Radio Identifier - Cooperative Sensing -Spectrum Opportunity Detection , Fundamental Trade-offs: Performance versus Constraint , MAC Layer Performance Measures, Global Interference Model, Local Interference Model, Fundamental Trade-offs: Sensing Accuracy versus Sensing Overhead.	9
IV	**USER COOPERATIVE COMMUNICATIONS** User Cooperation and Cognitive Systems , Relay Channels: General Three-Node Relay Channel, Wireless Relay Channel , User Cooperation in Wireless Networks: Two-User Cooperative Network, Cooperative Wireless Network , Multihop Relay Channel	9
V	**INFORMATION THEORETICAL LIMITS ON CR NETWORKS** Types of Cognitive Behavior, Interference-Avoiding Behavior: Spectrum Interweave, Interference-Controlled Behavior: Spectrum Underlay, Underlay in Small Networks: Achievable Rates, Underlay in Large Networks: Scaling Laws, Interference-Mitigating Behavior: Spectrum Overlay, Opportunistic Interference Cancellation, Asymmetrically Cooperating Cognitive Radio Channels.	9
	Total Instructional Hours	45

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Course Outcome	Upon successful completion of the course, the students will have the ability to: CO1: Appreciate the motivation and the necessity for cognitive radio communication strategies. CO2: Demonstrate understanding of the enabling technologies for its implementation CO3: Demonstrate understanding of the essential functionalities and requirements in designing software defined radios and their usage for cognitive communication. CO4: Evolve new techniques and demonstrate their feasibility using mathematical validations and simulation tools. CO5: Interpret the impact of the evolved solutions in future wireless network design.

TEXT BOOKS:

T1- Alexander M. Wyglinski, Maziar Nekovee, And Y. Thomas Hou, "Cognitive Radio Communications and Networks - Principles And Practice", Elsevier Inc. , 2010.
T2- Kwang-Cheng Chen and Ramjee Prasad, "Cognitive Radio Networks", John Wiley & Sons, Ltd, 2009

REFERENCE BOOKS:

R1: Khattab, Ahmed, Perkins, Dmitri, Bayoumi, Magdy, "Cognitive Radio Networks - From Theory to Practice", Springer Series, Analog Circuits and Signal Processing, 2009.
R2: J. Mitola, "Cognitive Radio: An Integrated Agent Architecture for software defined radio", Doctor of Technology thesis, Royal Inst. Technology, Sweden 2000.
R3: Simon Haykin, "Cognitive Radio: Brain –empowered wireless communications", IEEE Journal on selected areas in communications, Feb 2005.

CO/PO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	-	-	-	-	-	-	2	3	3
CO2	3	3	3	3	-	-	-	-	3	-	-	2	3	3
CO3	3	2	2	2	-	-	-	-	2	-	-	3	3	3
CO4	3	3	3	2	-	-	-	-	3	-	-	3	3	3
CO5	3	3	2	3	-	-	-	-	3	-	-	3	3	3
AVG	3	2.8	2.4	2.4	-	-	-	-	2.75	-	-	2.6	3	3

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC6373	REMOTE SENSING	3	0	0	3
Course Objective	**The student should be able to** 1. To assess about The components of RS &Radiation principles 2. To analyze atmospheric regions, windows & Spectral Signature concepts 3. To interpret about Newton 's law of gravitation & Kepler 's law of planetary motion. 4. To Explore Various Sensing Techniques, scanners and sensors. 5. To Enrich the Knowledge About open-source satellite data products					

Unit	Description	Instructional Hours
I	**REMOTE SENSING AND ELECTROMAGNETIC RADIATION** Definition – components of RS – History of Remote Sensing – Merits and demerits of Data Collation between conventional and remote sensing methods - Electromagnetic Spectrum – Radiation principles - Wave theory, Planck's law, Wien's Displacement Law, Stefan's Boltzmann law, Kirchoff's law – Radiation sources: active & passive – Radiation Quantities.	9
II	**EMR INTERACTION WITH ATMOSPHERE AND EARTH MATERIAL** Standard atmospheric profile – main atmospheric regions and its characteristics – interaction of radiation with atmosphere – Scattering, absorption and refraction – Atmospheric windows – Energy balance equation – Specular and diffuse reflectors – Spectral reflectance & emittance– Spectroradiometer – Spectral Signature concepts – Typical spectral reflectance curves for vegetation, soil and water – solid surface scattering in microwave region.	9
III	**ORBITS AND PLATFORMS** Motions of planets and satellites – Newton 's law of gravitation – Gravitational field and potential - Escape velocity - Kepler 's law of planetary motion - Orbit elements and types – Orbital perturbations and maneuvers – Types of remote sensing platforms - Ground based, Air borne platforms and Space borne platforms – Classification of satellites – Sun synchronous and Geosynchronous satellites – Legrange Orbit	9
IV	**SENSING TECHNIQUES** Classification of remote sensors – Resolution concept: spatial, spectral, radiometric and temporal resolutions - Scanners - Along and across track scanners – Optical-infrared sensors – Thermal sensors – microwave sensors – Calibration of sensors – High Resolution Sensors - LIDAR, UAV – Orbital and sensor characteristics of live Indian earth observation satellites.	9
V	**DATA PRODUCTS AND INTERPRETATION** Photographic and digital products – Types, levels and open-source satellite data products – selection and procurement of data – Visual interpretation: basic elements and interpretation keys - Digital interpretation – Concepts of Image rectification, Image enhancement and Image classification.	9
	Total Instructional Hours	45

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Course Outcome	Upon successful completion of the course, the students will have the ability to:: CO1: To understand the principles of electromagnetic radiation. CO2: To learn the atmospheric radiation interactions. CO3: To study the laws of planetary motion. CO4: To classify the different types of resolution. CO5: To know the concepts of digital interpretation

TEXT BOOKS:

T1. Thomas M. Lillesand, Ralph W. Kieferand Jonathan W. Chipman, Remote Sensing andImage interpretation, John Wiley and Sons, Inc., New York, 2015.

T2:George Joseph and C Jeganathan, Fundamentals of Remote Sensing, Third EditionUniversities Press (India) Private limited, Hyderabad, 2018.

REFERENCE BOOKS:

R1 Stanley A Morain; Amelia M Budge; Michael S Renslow. Manual of Remote Sensing. Vol. I, American Society for Photogrammetry and Remote Sensing, Virginia, USA,2019, 4th edition

R2: Verbyla, David, Satellite Remote Sensing of Natural Resources. CRC Press,2022 firstedition.

R3: Paul Curran P. J. Principles of Remote Sensing Longman, RLBS, 1996.

R4:Introduction to Physics and Techniques of Remote Sensing, Charles Elachi and Jacob VanZyl, 2021 Edition3, Wiley Publication.

R5:BasudebBhatta, Remote Sensing and GIS, Oxford University Press, 2020 third edition.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3	1	3	2	-	-	-	-	1	3	3
CO2	3	2	2	3	1	3	2	-	-	-	-	1	3	3
CO3	1	2	1	3	2	3	2	-	-	-	-	1	3	3
CO4	1	2	3	1	3	3	2	-	-	-	-	1	3	3
CO5	2	2	2	-	3	3	2	-	-	-	-	1	3	3
AVG	2	2	2	2	2	3	2	-	-	-	-	1	3	3

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC6374	ROCKETRY AND SPACE MECHANICS	3	0	0	3

Course Objective	**The student should be able to** 1. To assess the fundamental aspects of rocket motion along with detailedestimation of rocket trajectories. 2. To imparts knowledge on optimization of multistage rockets. 3. To acquire provides the basics of space mechanics required for an aeronautical student 4. To analyze students to provide with the basics of orbit transfer of satellites. 5. To gain knowledge on various control methods of rockets.	
Unit	**Description**	**Instructional Hours**
I	**ORBITAL MECHANICS** Description of solar system – Kepler's Laws of planetary motion – Newton's Law of Universal gravitation – Two body and Three-body problems – Jacobi's Integral, Librations points – Estimation of orbital and escape velocities.	9
II	**SATELLITE DYNAMICS** Geosynchronous and geostationary satellites- factors determining life time of satellites – satellite perturbations – orbit transfer and examples –Hohmann orbits – calculation of orbit parameters– Determination of satellite rectangular coordinates from orbital elements.	9
III	**ROCKET MOTION** Principle of operation of rocket motor – thrust equation – one dimensional and two dimensional rocket motions in free space and homogeneous gravitational fields – Description of vertical, inclined and gravity turn trajectories – determinations of range and altitude – simple approximations to burnout velocity.	9
IV	**ROCKET AERODYNAMICS** Description of various loads experienced by a rocket passing through atmosphere – drag estimation – wave drag, skin friction drag, form drag and base pressure drag – Boat-tailing in missiles – performance at various altitudes – rocket stability – rocket dispersion – launching problems.	9
V	**STAGING AND CONTROL OF ROCKET VEHICLES** Need for multi staging of rocket vehicles – multistage vehicle optimization – stage separation dynamics and separation techniques- aerodynamic and jet control methods of rocket vehicles – SITVC.	9
	Total Instructional Hours	**45**

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Course Outcome	Upon successful completion of the course, the students will have the ability to: CO1: To knowledge on the fundamental laws of orbital mechanics with particular emphasis on interplanetary trajectories. CO2: To calculate orbital parameters and perform conceptual trajectory designs for geocentric or interplanetary missions. CO3: To familiarize themselves with trajectory calculations for planar motion of rockets. CO4: To determine forces and moments acting on airframe of a missile. CO5: To acquire knowledge on the need for staging and stage separation dynamics of rocketvehicles.

TEXT BOOKS:

T1- Cornelisse,JW, "Rocket Propulsion and Space Dynamics", J.W. Freeman & Co., Ltd., London, 1982.
T2:Parker,ER, "Materials for Missiles and Spacecraft", McGraw-Hill Book Co., Inc., 1982.

REFERENCE BOOKS:

R1 Suresh. B N & Sivan. K, "Integrated Design for Space Transportation System", Springer India, 2015.
R2:Sutton,GP, "Rocket Propulsion Elements", John Wiley & Sons Inc., New York, 8th Edition, 2010.
R3:Van de Kamp, "Elements of Astromechanics", Pitman Publishing Co., Ltd., London, 1980.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	2	-	-	-	-	-	3	3	2
CO2	3	3	3	2	2	2	-	-	-	-	-	2	3	2
CO3	3	3	3	2	2	2	-	-	-	-	-	2	3	2
CO4	3	3	3	2	2	2	-	-	-	-	-	2	2	2
CO5	3	3	3	3	2	2	-	-	-	-	-	2	2	2
AVG	3	3	3	2	2	2	-	-	-	-	-	2	2	2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC7373	UNDERWATER NAVIGATION SYSTEMS	3	0	0	3

Course Objective	**The student should be able to** 1. To intepret the relationship between autonomy, sensing, navigation and control on an unmanned marine subsea vehicle. 2. To assess about various types of navigational equipment & sensors 3. To acquire the basic communication methods and signal losses, attenuation. 4. To explore the types of Acoustic transponders, Beacon and Responder 5. To understand the underwater positioning system

Unit	Description	Instructional Hours
I	**BASICS OF UNDERWATER COMMUNICATION** Introduction to underwater acoustics, Understanding Thermoclines in Ocean Waters, subsea communication sensors, Instruments and applications, Sound propagation in the ocean – Sound Velocity Profiles (SVP) in the deep water and shallow water; Sound attenuation in the sea – absorption, scattering, transmission loss, reverberation, Snell's law, target strength; Laser communication and limitations.	9
II	**UNDERWATER NAVIGATION & ITS AIDING SENSOR AND DEVICES** Different types of navigational sensors, Accelerometers, Fiber Optic Gyroscopes (FOGs), Ring Laser Gyroscope (RLG) types and Working principles, and their applications, Doppler Velocity Log, Error sources in subsea navigation, Calibration overview for subsea navigation. Attitude Heading and Reference Systems (AHRS) & IMU	9
III	**ACOUSTIC POSITIONING SYSTEMS** Subsea navigation possible solutions, Vehicle positioning, Acoustic Positioning systems, Short Base Line (SBL), Super Short Base Line (SSBL), Long Base line (LBL) Configurations and Positioning overview.	9
IV	**SUBSEA VEHICLE NAVIGATION** Subsea navigation, Uses of subsea navigation, challenges of subsea navigation. Basics of underwater navigation, Types of underwater Navigations. Aided navigational systems, Inertial Navigational systems. role of dead-reckoning navigation in subsea navigation, Kalman filters (XKF) and Invariant extended Kalman filters for navigation.	9
V	**CASE STUDY** • Tethered vehicle deployment guidelines and preparedness. • AUV /ROV based search operation requirements and planning. • Tethered crawling vehicle sensors, data acquisition and maneuvering. • Acoustic positioning system transponder deployment and recovery	9

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	• Aided and unaided navigation system study. • Understand the basic tools needed to effectively develop software for robotic platforms in agroup environment, and resolve conflicts and adhere to group goals in the software cycle.	
	Total Instructional Hours	**45**
Course Outcome	Upon successful completion of the course, the students will have the ability to: CO1: Understand about the Underwater Navigation System CO2: Know about the INS and its aiding sensor CO3: Expose about the challenges involved in underwater navigation CO4: Study about the navigation system is integrated with manned andunmanned underwater vehicles CO5: Examine underwater positioning system	

TEXT BOOKS:

T1. Fundamentals of ocean acoustics by L.M.Brekhovskikh and Yu. P. Lysanov
T2: An Underwater Vehicle Navigation System Using Acoustic and Inertial Sensors by Norvald Kjerstad
T3: Underwater Acoustic Positioning Systems by P. H. Milne

REFERENCE BOOKS:

R1. Electronic and Acoustic Navigation systems for Maritime Studies by Norvald Kjerstad
R2:Guidance & Control of Ocean Vehicles by TT Fossen
R3:Dynamic Positioning of Offshore Vessels. By Morgan, M.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	2	-	-	-	-	-	2	3	3
CO2	3	3	2	2	2	2	-	-	-	-	-	2	3	2
CO3	3	3	2	2	2	2	-	-	-	-	-	2	3	2
CO4	3	3	3	2	2	1	-	-	-	-	-	2	1	2
CO5	3	3	3	2	2	2	-	-	-	-	-	3	2	1
AVG	**3**	**3**	**3**	**2**	**2**	**2**	-	-	-	-	-	**2**	**3**	**2**

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC7374	MASSIVE MIMO NETWORKS	3	0	0	3
Course Objective	1.To gain knowledge about massive MIMO networks. 2.To assess the massive MIMO propagation channels. 3.To acquire about channel estimation in single cell and multicell massive MIMO systems. 4.To comprehend the concepts of massive MIMO deployment in the context of single cell and multicell deployment. 5.To learn concepts underlining the deployment of single and multicell massiveMIMO systems					

Unit	Description	Instructional Hours
I	**MASSIVE MIMO NETWORKS** Definition of Massive MIMO, Correlated Rayleigh Fading, System Model for Uplink and Downlink,Basic Impact of Spatial Channel Correlation, Channel Hardening and Favourable Propagation, Local Scattering Spatial Correlation Model	9
II	**THE MASSIVE MIMO PROPAGATION CHANNEL** Favorable Propagation and Deterministic Channels-Capacity Upper Bound-Distance from Favorable Propagation-Favorable Propagation and Linear Processing-Singular Values and Favorable Propagation, Favorable Propagation and Random Channels-Independent Rayleigh Fading-Uniformly Random Line-of-Sight (UR-LoS)-Independent Rayleigh Fading versus UR-LoS - Finite-Dimensional Channels	9
III	**SINGLE-CELL SYSTEMS** Uplink Pilots and Channel Estimation - Orthogonal Pilots- De-Spreading of the Received Pilot Signal-MMSE Channel Estimation, Uplink Data Transmission - Zero-Forcing - Maximum-Ratio. Downlink Data Transmission-Linear Precoding-Zero-Forcing-Maximum-Ratio, Discussion- Interpretation of the Effective SINR Expressions-Implications for Power Control-Scaling Laws and Upper Bounds on the SINR - Near-Optimality of Linear Processing when M >> K - Net Spectral Efficiency - Limiting Factors: Number of Antennas and Mobility	9
IV	**MULTI-CELL SYSTEMS** Uplink Pilots and Channel Estimation, Uplink Data Transmission - Zero-Forcing - Maximum-Ratio, Downlink Data Transmission -Zero-Forcing - Maximum-Ratio, Discussion -Asymptotic Limits with Infinite Numbers of Base Station Antennas - The Effects of Pilot Contamination - Non-SynchronousPilot Interference	9
V	**Case Studies** Single-Cell Deployment Example: Fixed Broadband Access in Rural Area, Multi-Cell Deployment: Preliminaries and Algorithms, Multi-Cell Deployment Examples: Mobile Access - Dense Urban Scenario - Suburban Scenario - Minimum Per-Terminal Throughput Performance -Additional Observations - Comparison of Power Control Policies	9
	Total Instructional Hours	**45**

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Course Outcome	Upon successful completion of the course, the students will have the ability to: CO1: Understand and explain massive MIMO networks. CO2: Analyze massive MIMO propagation channels and their capacity bounds CO3: Examine channel estimation techniques for single cell system. CO4: Analyze channel estimation techniques for multi cell system. CO5: Explain the concepts underlining the deployment of single and multicell massiveMIMO systems.

TEXT BOOKS:

T1:Thomas L. Marzetta, Erik G. Larsson, Hong Yang, Hien Quoc Ngo, "Fundamentals of Massive MIMO", Cambridge University Press 2016. (UNITS II-V)
T2:Emil Björnson, Jakob Hoydis and Luca Sanguinetti (2017), "Massive MIMO Networks:Spectral, Energy, and Hardware Efficiency", Foundations and Trends, Now, 2017. (UNIT I)

REFERENCE BOOKS:

R1:Long Zhao, Hui Zhao, Kan Zheng, "Wei Xiang Massive MIMO in 5G Networks: Selected Applications", Springer 2018.
R2:Leibo Liu, Guiqiang Peng, Shaojun Wei, "Massive MIMO Detection Algorithm and VLSI Architecture", Springer 2019.
R3:Shahid Mumtaz, Jonathan Rodriguez, Linglong Dai, "mmWave Massive MIMO A Paradigm for 5G", Elsevier, 2017

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	2	2	-	-	-	-	-	2	3	1
CO2	3	3	2	2	2	2	-	-	-	-	-	1	2	2
CO3	3	2	2	2	2	2	-	-	-	-	-	1	3	3
CO4	3	3	2	2	2	2	-	-	-	-	-	1	3	1
CO5	3	2	2	2	2	2	-	-	-	-	-	2	3	3
AVG	3	2.4	1.8	1.8	2	2	-	-	-	-	-	1.4	3	2

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BE	22EC8372	ADVANCED WIRELESS COMMUNICATION TECHNIQUES	3	0	0	3
Course Objective	1. To assess the evolving paradigm of cooperative communication 2. To interpret concepts related to green wireless communication 3. To enable the student to understand the different power saving strategies and energyefficient signal, system and network design 4. To acquire the student to the energy saving techniques adopted in existing wireless components 5. To explore the UMOC network concepts.					

Unit	Description	Instructional Hours
I	**COOPERATIVE COMMUNICATIONS AND GREEN CONCEPTS** Network architectures and research issues in cooperative cellular wireless networks ; Cooperative communications in OFDM and MIMO cellular relay networks: issues and approaches; Fundamental trade-offs on the design of green radio networks, Green modulation and coding schemes.	9
II	**COOPERATIVE TECHNIQUES** Cooperative techniques for energy efficiency, Cooperative base station techniques for cellular wireless networks; Turbo base stations; Antenna architectures for cooperation; Cooperative communications in 3GPP LTE-Advanced, Partial information relaying and Coordinated multi-point transmission in LTE-Advanced.	9
III	**RELAY-BASED COOPERATIVE CELLULAR NETWORKS** Distributed space-time block codes ; Collaborative relaying in downlink cellular systems ; Radio resource optimization; Adaptive resource allocation ; Cross-layer scheduling design for cooperative wireless two-way relay networks ; Network coding in relay-based networks.	9
IV	**GREEN RADIO NETWORKS** Base Station Power-Management Techniques- Opportunistic spectrum and load management. Energy-saving techniques in cellular wireless base stations, Power-management for base stations in smart grid environment, Cooperative multi cell processing techniques for energy-efficient cellular wireless communications.	9
V	**ACCESS TECHNIQUES FOR GREEN RADIO NETWORKS** Cross-layer design of adaptive packet scheduling for green radio networks; Energy-efficient relaying for cooperative cellular wireless networks ; Energy performance in TDD-CDMA multihop cellular networks ; Resource allocation for green communication in relay-based cellular networks ; Green Radio Test-Beds and Standardization Activities.	9
	Total Instructional Hours	45

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Course Outcome	Upon successful completion of the course, the students will have the ability to: CO1: The student would be able to appreciate the necessity and the design aspects of cooperativecommunication CO2: The student would be able to appreciate the necessity and the design aspects of greenwireless communication. CO3: The student would be able to evolve new techniques in wireless communication CO4: The students would be able to demonstrate the feasibility of using mathematical models usingsimulation tools. CO5: The student would be able to demonstrate the impact of the green engineering solutions in aglobal, economic, environmental and societal context.

TEXT BOOKS:

T1- Ekram Hossain, Dong In Kim, Vijay K. Bhargava , "Cooperative Cellular Wireless Networks",Cambridge University Press, 2011.
T2:Ekram Hossain, Vijay K. Bhargava(Editor), Gerhard P. Fettweis (Editor), "Green Radio Communication Networks", Cambridge University Press, 2012.

REFERENCE BOOKS:

R1- F. Richard Yu, Yu, Zhang and Victor C. M. Leung "Green Communications andNetworking", CRC press, 2012.
R2:Ramjee Prasad and Shingo Ohmori, Dina Simunic, "Towards Green ICT", River Publishers,2010.
R3:Jinsong Wu, Sundeep Rangan and Honggang Zhang, "Green Communications: Theoretical Fundamentals, Algorithms and Applications", CRC Press, 2012.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	1	1	-	-	-	-	-	2	3	3
CO2	3	3	3	2	2	1	-	-	-	-	-	2	3	2
CO3	3	2	2	1	2	1	-	-	-	-	-	2	2	1
CO4	3	3	3	3	2	1	-	-	-	-	-	2	3	1
CO5	3	3	3	2	1	2	-	-	-	-	-	2	2	3
AVG	3	2.8	2.8	2	1.6	1.2	-	-	-	-	-	2	3	2

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Honour Degree

Vertical-III

Semiconductor Chip Design and Testing

S No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
1	22EC5373	Wide Bandgap Devices	HDC	3	0	0	3	40	60	100
2	22EC6375	Validation and Testing Technology	HDC	3	0	0	3	40	60	100
3	22EC6376	Low Power VLSI	HDC	3	0	0	3	40	60	100
4	22EC7375	VLSI Testing and Design for Testability	HDC	3	0	0	3	40	60	100
5	22EC7376	Mixed Signal IC Design Testing	HDC	3	0	0	3	40	60	100
6	22EC8373	Analog IC Design	HDC	3	0	0	3	40	60	100

Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC5373	WIDE BANDGAP DEVICES	3	0	0	3
Course Objective	1. To Introduce the concept of wide band gap (WBG) devices and its application in real world 2. To identify Advantages and disadvantages of WBG devices 3. To assess about an introduction to basic operation of WBG power devices 4. To Learn Design principles of modern power devices 5. To explore the applications of wide bandgap devices in consumer electronic					

Unit	Description	Instructional Hours
I	**WBG DEVICES AND THEIR APPLICATION IN REAL WORLD** Review of semiconductor basics, Operation and characteristics of the SiC Schottky Barrier Diode, SiC DMOSFET and GaN HEMT, Review of Wide bandgap semiconductor technology -Advantages and disadvantages	9
II	**SWITCHING CHARACTERIZATION OF WBG** Turn-on and Turn-off characteristics of the device, Hard switching loss analysis, Double pulse test set-up	9
III	**DRIVERS FOR WIDE BAND GAP DEVICES** Gate driver, Impact of gate resistance, Gate drivers for wide bandgap power devices, Transient immunity integrated gate drivers	9
IV	**HIGH FREQUENCY DESIGN COMPLEXITY AND PCB DESIGNING** Effects of parasitic inductance, Effects of parasitic capacitance, EMI filter design for high frequency power converters High frequency PCB design, Conventional power loop design, High frequency power loop optimization, Separation of power from signal PCB	9
V	**APPLICATIONS OF WIDE BANDGAP DEVICES** Consumer electronics applications, Wireless power transfer applications, Electric vehicle applications, Renewable energy sources applications	9
	Total Instructional Hours	**45**

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Course Outcome	Upon successful completion of the course, the students will have the ability to: CO1: Understand the operation and characteristics of Wide Bandgap semiconductor devices CO2: Analyze the switching characteristics of Wide Bandgap devices and evaluate their performance in power applications CO3: Design and implement gate drivers for Wide Bandgap power devices to optimize their efficiency and reliability CO4: Evaluate the complexities of high frequency design in PCBs and implement techniques to minimize parasitic effects CO5: Identify and apply Wide Bandgap devices in various real-world applications such as consumer electronics, electric vehicles, and renewable energy sources

TEXT BOOKS:

T1- A. Lidow, J. Strydom, M. D. Rooij, D. Reusch, GaN Transistors for Efficient Power Convertion, Wiley, 2014, ISBN-13: 978-1118844762.

T2- G. Meneghesso, M. Meneghini, E. Zanoni, "Gallium Nitride-enabled High Frequency and High Efficiency Power Conversion," Springer International Publishing, 2018, ISBN: 978-3-319-77993-5.

REFERENCE BOOKS:

R1- F. Wang, Z. Zhang and E. A. Jones, Characterization of Wide Bandgap Power Semiconductor Devices, IET, ISBN-13: 978-1785614910 (2018).

R2- B.J.Baliga, "Gallium Nitride and Silicon Carbide Power Devices," World Scientific Publishing Company (3 Feb. 2017).

R3- L. Corradini, D. Maksimovic, P. Mattavelli, R. Zane, "Digital Control of HighFrequency Switched-Mode Power Converters", Wiley, ISBN-13: 978-1118935101 (9th June, 2015).

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	2	-	-	-	-	-	-	-	1	1
CO2	3	3	3	2	2	-	-	-	-	-	-	-	1	1
CO3	3	3	2	2	2	-	-	-	-	-	-		2	2
CO4	3	3	3	3	2	-	-	-	-	-	-	-	3	2
CO5	3	2	3	3	2	-	-	-	-	-	-	-	2	2
AVG	3	3	2.6	2.6	2	-	-	-	-	-	-	-	2	2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC6375	VALIDATION AND TESTING TECHNOLOGY	3	0	0	3

Course Objective	**The student should be able to** 1. To familiar with various IC technology. 2. To assess about MOS theory and testing 3. To Interpret CMOS circuit theory and testing 4. To expertise on CMOS characterization 5. To Explore circuit and device level testing methods	
Unit	**Description**	**Instructional Hours**
I	**TECHNOLOGY INTRODUCTION** Introduction to IC Technology – MOS, PMOS, NMOS, CMOS & BiCMOS Technologies. VLSI Fabrication, Oxidation, Lithography, Diffusion, Ion Implantation, Metallization, Integrated Resistors and Capacitors.	9
II	**MOS THEORY ANALYSIS-I** Basic Electrical Properties of MOS Circuits: Ids-Vds Relationships, MOS Transistor Threshold Voltage Vth, gm, gds, Figure of Merit ωo, Short Channel and Narrow Channel Width Effects.	9
III	**MOS THEORY ANALYSIS- II** Pass Transistor, Transmission Gate, NMOS Inverter, Various Pull-ups, CMOS Inverter Analysis andDesign, Bi-CMOS Inverters, Latch up in CMOS Circuits.	9
IV	**CMOS CIRCUIT CHARACTERISATION AND PERFORMANCE ESTIMATION** Sheet Resistance RS, conductivity and its Concept to MOS, Area Capacitance Units, Calculations - Delays, Driving Large Capacitive Loads, Delay Estimation, Logical Effort and Transistor Sizing, Power Dissipation, Reliability.	9
V	**BASIC OF SILICON VALIDATION** Need for Testing, Testing at Various Levels, Objectives of Testing - VLSI Test process and Test Equipment - Types of Testing: Functionality Tests, Silicon Debug, Manufacturing Tests, Defect during manufacturing - Fault Modelling, Observability and Controllability, Fault Coverage, Fault Sampling - ATE, Test economics.	9
	Total Instructional Hours	**45**

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Course Outcome	Upon successful completion of the course, the students will have the ability to: CO1: Understand the basics of IC technology including MOS, PMOS, NMOS, CMOS, and BiCMOS technologies. CO2: Analyze and design MOS circuits, including NMOS inverters and CMOS inverters. CO3: Characterize CMOS circuits and estimate their performance. CO4: Gain knowledge of Silicon validation, testing processes, equipment, and economics. CO5: Demonstrate proficiency in testing at various levels and identifying faults during manufacturing.

TEXT BOOKS:

T1- Kamran Ehraghian, Dauglas A. Pucknell and Sholeh Eshraghiam, "Essentials of VLSICircuits and Systems" – PHI, EEE, 2005 Edition.

T2- Neil H. E. Weste and David. Harris Ayan Banerjee,, "CMOS VLSI Design" - PearsonEducation, 1999.

REFERENCE BOOKS:

R1- M.L. Bushnell and V.D. Agrawal, "Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits", Kluwer Academic Publishers, 2004

R2- N.K. Jha and S.G. Gupta, "Testing of Digital Systems", Cambridge University Press, 2003

R3- Etienne Sicard, Sonia Delmas Bendhia, "Basics of CMOS Cell Design", TMH, EEE, 2005

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	2	1	-	-	-	2	2	3	2
CO2	2	3	3	3	2	1	1	-	-	-	2	2	3	3
CO3	3	2	2	3	2	3	3	-	-	-	3	2	2	2
CO4	3	3	2	3	2	3	3	-	-	-	2	2	1	2
CO5	3	2	3	3	3	3	2	-	-	-	2	2	1	2
AVG	2.8	2.6	2.6	3	2.2	2.4	2	-	-	-	2	2	2	2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC6376	LOW POWER VLSI	3	0	0	3

Course Objective	**The student should be able to** 1. To assess knowledge about sources of power. 2. To interpret about throw light on the power optimization techniques. 3. To learn about the design of low power CMOS circuits. 4. To identify suitable techniques to estimate the power dissipation. 5. To explore memory circuits with low power dissipation.

Unit	Description	Instructional Hours
I	**POWER DISSIPATION IN CMOS** Hierarchy of limits of power – Sources of power consumption – Physics of power dissipation in CMOS FET devices – Basic principle of low power design.	9
II	**POWER OPTIMIZATION** Logic level power optimization – Circuit level low power design – circuit techniques for reducing power consumption in adders and multipliers.	9
III	**DESIGN OF LOW POWER CMOS CIRCUITS** Computer arithmetic techniques for low power system – reducing power consumption in memories – low power clock, Inter connect and layout design – Advanced techniques – Special techniques.	9
IV	**POWER ESTIMATION** Power Estimation techniques – logic power estimation – Simulation power analysis – Probabilistic power analysis.	9
V	**SYNTHESIS AND SOFTWARE DESIGN FOR LOW POWER** Synthesis for low power – Behavioral level transform – software design for low power.	9
	Total Instructional Hours	45

Course Outcome	Upon successful completion of the course, the students will have the ability to: CO1: Understand the sources of power consumption in CMOS circuits and the physics of power dissipation in FET devices. CO2: Develop techniques for low power design at the logic and circuit levels, including reducing power consumption in adders and multipliers. CO3: Design low power CMOS circuits using computer arithmetic techniques and advanced power optimization techniques. CO4: Estimate power consumption in CMOS circuits using various techniques such as logic power estimation and simulation power analysis. CO5: Implement synthesis and software design strategies for low power, including behavioral level transformations and software design considerations.

TEXT BOOKS:

T1.Kaushik Roy and S.C.Prasad, "Low power CMOS VLSI circuit design", Wiley, 2000.
T2.Dimitrios Soudris, ChirstianPignet, Costas Goutis, "Designing CMOS Circuits for Low Power", Kluwer, 2002.

REFERENCE BOOKS:

R1.J.B.Kulo and J.H Lou, "Low voltage CMOS VLSI Circuits", Wiley 1999.
R2. A.P.Chandrasekaran and R.W.Broadersen, "Low power digital CMOS design", Kluwer, 1995.
R3.Gary Yeap, "Practical low power digital VLSI design", Kluwer, 1998.
R4. AbdelatifBelaouar, Mohamed.I.Elmasry, "Low power digital VLSI design", Kluwer, 1995.

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CO1	3	3	2	3	2	-	-	-	-	-	-	2	2	2
CO2	3	2	1	2	3	-	-	-	-	-		1	2	2
CO3	3	3	3	2	2	-	-	-	-	-	-	1	2	2
CO4	2	3	3	3	3	-	-	-	-	-	-	1	2	3
CO5	3	3	3	2	2	-	-	-	-	-	-	2	2	2
AVG	2.8	2.8	2.4	2.4	2.4	-	-	-	-	-	-	1.8	2	2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC7375	VLSI TESTING AND DESIGN FOR TESTABILITY	3	0	0	3

Course Objective	**The student should be able to** 1. To introduce logic and fault simulation and testability measures. 2. To intepret the design for testability. 3. To know about interfacing and testing of memory 4. To introduce power management techniques in testing 5. To assess about testability in analog circuits

Unit	Description	Instructional Hours
I	**TEST REQUIREMENTS AND METRICS** Validation platforms- SOC design methodology, IP components, Integration, Clocking, I/Os and interfaces, Device modes, Logic, memories, analog, I/Os, power management; Test requirements- Test handoffs, Testers Where DUT and DFT fit into design / framework; Test- ATPG, DFT, BIST, COF, TTR; Test cost metrics and test economics; Logic fault models- SAF, TDF, PDF, Iddq, St- BDG, Dy-BDG, SDD; Basics of test generation and fault simulation- Combinational circuits, Sequential; Specific algorithmic approaches, CAD framework, Optimisations.	9
II	**SCAN DESIGN AND BIST** Scan Design- Scan design requirements, Types of scan and control mechanisms, Test pattern construction for scan, Managing scan in IPs and SOCs, Scan design optimisations, Partitioning, Clocking requirements for scan and delay fault testing, Speed of operation; BIST – Framework, Controller configurations, FSMs, LFSRs, STUMPS architecture, Scan compression and bounds, Test per cycle, Test per scan, Self-testing and self-checking circuits, Online test.	9
III	**MEMORY TEST AND TEST INTERFACES** Memory Test -Memory fault models, Functional architecture as applicable to test, Test of memories, Test of logic around memories, BIST controller configuration, Test of logic around memories, DFT and architecture enhancements, Algorithmic optimisations; Test Interfaces-Test control requirements, Test interfaces - 1500, JTAG, Hierarchical, serial control, Module / IP test, SOC test, Board test, System test, Boundary scan.	9
IV	**DESIGN CONSIDERATIONS AND POWER MANAGEMENT DURING TEST** Design Considerations- Design considerations, Physical design congestion, Partitioning, Clocks, Test modes, Pins, Test scheduling, Embedded test, Architecture improvements, Test in the presence of security; Power management during test- Methods for low power test, ATPG methods, DFT methods, Scan methods, Low power compression, Test of power management, Implications of power excursions, Optimisations.	9
V	**ANALOG TEST** Test requirements. DFT methods. BIST methods. Test versus measurement. Defect tests versus performance tests. Tests for specific modules - PLL, I/Os, ADC, DAC, SerDes, etc. RF test requirements.	9
Total Instructional Hours		45

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Course Outcomes	Upon successful completion of the course, the students will have the ability to: CO1: Ability to validate and test complex SOC designs using various methodologies and tools. CO2: Proficiency in scan design and Built-In Self-Test (BIST) techniques for efficient testing. CO3: Understanding of memory test procedures and test interfaces for different testing scenarios. CO4: Consideration of design aspects and power management strategies during testing. CO5: Familiarity with analog test requirements and methods for testing specific modules.

TEXT BOOKS:

T1- Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits,Vishwani Agrawal and Michael Bushnell, Springer, 2002.
T2- VLSI Test principles and Architectures, L. Wang

REFERENCE BOOKS:

R1- Testing of digital systems, Niraj K Jha and Sandeep Gupta
R2-Digital VLSI Chip Design AWITH Emphasis on Testing and Verification, John PUyemura

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	2	1	-	-	-	2	2	3	2
CO2	3	3	3	3	2	2	1	-	-	-	2	2	3	3
CO3	3	2	2	3	2	3	3	-	-	-	3	2	2	2
CO4	3	3	2	3	2	3	3	-	-	-	2	2	1	2
CO5	3	2	3	3	3	3	2	-	-	-	2	2	1	2
AVG	3	2.6	2.6	3	2.2	2.6	2	-	-	-	2	2	2	2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC7376	MIXED SIGNAL IC DESIGN TESTING	3	0	0	3

Course Objective	**The student should be able to** 1. To assess about mixed-signal devices and the need for testing these devices. 2. To study the various techniques for testing. 3. To learn about ADC and DAC based testing. 4. To interpret about the Clock and Serial Data Communications Channels 5. To study the general-purpose measuring devices.	
Unit	**Description**	**Instructional Hours**
I	**MIXED – SIGNAL TESTING** Common Types of Analog and Mixed- Signal Circuits – Applications of Mixed-Signal Circuits - Post- Silicon Production Flow - Test and Packing – Characterization versus Production Testing - Test and Diagnostic Equipment - Automated Test Equipments – Wafer Probers – Handlers – E-Beam Probers – Focused Ion Beam Equipments – Forced –Temperature	9
II	**YIELD, MEASUREMENT ACCURACY, AND TEST TIME** Yield - Measurement Terminology - Repeatability, Bias, and Accuracy - Calibrations and Checkers - Tester Specifications - Reducing Measurement Error with Greater Measurement Time – Guardbands - Effects of Measurement Variability on Test Yield - Effects of Reproducibilty and Process Variation on Yield - Statistical Process Control	9
III	**DAC TESTING** Basics of Data Converters -Principles of DAC and ADC Conversion, Data Formats, Comparison of DACs and ADCs, DAC Failure Mechanisms - Basic DC Tests - Transfer Curve Tests - Dynamic DAC Tests - Tests for Common DAC Applications	9
IV	**ADC TESTING** ADC Testing Versus DAC Testing - ADC Code Edge Measurements - Edge Code Testing Versus Center Code Testing, Step Search and Binary Search Methods, Servo Method, Linear RampHistogram Method, Histograms to Code Edge Transfer Curves, Rising Ramps Versus Falling Ramps, Sinusoidal Histogram Method - DC Tests and Transfer Curve Tests - Dynamic ADC Tests - Tests for Common ADC Applications	9
V	**CLOCK AND SERIAL DATA COMMUNICATIONS CHANNEL MEASUREME** Synchronous and Asynchronous Communications - Time-Domain Attributes of a Clock Signal - Frequency-Domain Attributes of a Clock Signal -	9

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	Communicating Serially Over a Channel - Bit Error Rate Measurement - Methods to Speed Up BER Tests in Production - Deterministic Jitter Decomposition - Jitter Transmission Tests.	
	Total Instructional Hours	**45**
Course Outcome	Upon successful completion of the course, the students will have the ability to: **CO1**: Learn the fundamentals of mixed signal circuits. **CO2**: Define the various measurement terminologies. **CO3**: Acquire knowledge of Analog to Digital Converters. **CO4**: Learn testing of Analog to Digital Converters. **CO5**: Comprehend the attributes of a clock signal..	

TEXT BOOKS:

T1- Gordon W.Roberts, Friedrich Taenzler, Mark Burns, "An Introduction to Mixed-signal IC Test and Measurement" Oxford University Press, Inc.2012 (Unit I - V)

T2- M.L.Bushnell and V.D.Agrawal, "Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits", Kluwer Academic Publishers, 2002. (Unit - III)

REFERENCE BOOKS:

R1- BapirajuVinnakota, "Analog and mixed-signal test", Prentice Hall, 1998.(Unit - II)

R2- Digital and Analogue Instrumentation: Testing and Measurement by NihalKularatna

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	2	-	-	-	-	-	2	3	3
CO2	3	3	2	2	1	2	-	-	-	-	-	2	3	2
CO3	3	3	2	2	2	2	-	-	-	-	-	2	3	2
CO4	3	3	3	2	2	1	-	-	-	-	-	2	1	2
CO5	3	3	3	2	2	2	-	-	-	-	-	3	2	1
AVG	3	3	2.8	2.2	1.8	1.8	-	-	-	-	-	2.2	3	2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EC8373	ANALOG IC DESIGN	3	0	0	3

Course Objective	**The student should be able to** 1. To acquire the basics of MOS Circuits. 2. To analyse the noise characteristics of amplifiers. 3. To assess the performance parameters of amplifiers. 4. To comprehend the compensation techniques 5. To identify the detection and testing of faults.	
Unit	**Description**	**Instructional Hours**
I	**SINGLE STAGE AMPLIFIERS** Basic MOS physics and equivalent circuits and models, CS, CG and Source Follower, differential amplifier with active load, Cascode and Folded Cascode configurations with active load, design of Differential and Cascode Amplifiers – to meet specified SR, noise, gain, BW, ICMR and power dissipation, voltage swing, high gain amplifier structures.	9
II	**HIGH FREQUENCY AND NOISE CHARACTERISTICS OF AMPLIFIERS** Miller effect, association of poles with nodes, frequency response of CS, CG and Source Follower, Cascode and Differential Amplifier stages, statistical characteristics of noise, noise in Single Stage amplifiers, noise in Differential Amplifiers.	9
III	**FEEDBACK AND SINGLE STAGE OPERATIONAL AMPLIFIERS** Properties and types of negative feedback circuits, effect of loading in feedback networks, operational amplifier performance parameters, single stage Op Amps, two-stage Op Amps, input range limitations, gain boosting, slew rate, power supply rejection, noise in Op Amps.	9
IV	**STABILITY , FREQUENCY COMPENSATION** Multipole Systems, Phase Margin, Frequency Compensation, Compensation of Two Stage Op Amps, Slewing In Two Stage Op Amps, Other Compensation Techniques.	9
V	**LOGIC CIRCUIT TESTING** Faults in Logic Circuits- Basic Concepts of Fault Detection- Design for Testability- Ad Hoc Techniques, Level-Sensitive Scan Design, Partial Scan, Built-in Self-Test.	9
	Total Instructional Hours	45

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Course Outcome	Upon successful completion of the course, the students will have the ability to: CO1: Ability to design and analyze single stage amplifiers to meet specified performance requirements. CO2: Understanding of high frequency and noise characteristics of amplifiers. CO3: Knowledge of feedback circuits and operational amplifier performance parameters. CO4: Understanding of stability and frequency compensation techniques in amplifier design. CO5: Familiarity with logic circuit testing techniques and fault detection methods.

TEXT BOOKS:

T1- Behzad Razavi, "Design Of Analog Cmos Integrated Circuits", Tata Mcgraw Hill, 2001.(Unit –I,II,III,IV)

T2- Parag K.Lala, "An Introduction to Logic Circuit Testing",Morgan & ClaypoolPublishers,2009.(Unit V)

REFERENCE BOOKS:

R1- Willey M.C. Sansen, "Analog Design Essentials", Springer, 2006.

R2- Grebene, "Bipolar And Mos Analog Integrated Circuit Design", John Wiley & Sons,Inc.,2003. Phillip E.Allen, Douglas R .Holberg, "Cmos Analog Circuit Design", Oxford University Press, 2nd Edition, 2002.

R3-Recorded Lecture Available at http://www.ee.iitm.ac.in/vlsi/courses/ee5320_2021/start

R4-Jacob Baker "CMOS: Circuit Design, Layout, And Simulation, Wiley IEEE Press, 3rd Edition,2010.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	2	-	-	-	-	-	2	3	3
CO2	3	3	2	2	1	2	-	-	-	-	-	2	3	2
CO3	3	3	2	2	2	2	-	-	-	-	-	2	3	2
CO4	3	3	3	2	2	1	-	-	-	-	-	2	1	2
CO5	3	3	3	2	2	2	-	-	-	-	-	3	2	1
AVG	3	3	2.6	2.2	1.8	1.8	-	-	-	-	-	2.2	2.4	2

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HINDUSTHAN ACADEMIC COUNCIL Chairman COLLEGE OF ENGG & TECH.

Syllabus for Value Added Courses

Programme	Course Code	Name of the Course	C
B.E-ECE	22VAEC01	VERILOG PROGRAMMING FOR DIGITAL CIRCUIT DESIGN	0
Course Objective	1. To impart the knowledge on basic concepts of Verilog HDL 2. To understand concepts data flow modeling with combinational logic circuits 3. To familiarize with Behavioral level modeling with sequential logic circuits 4. To acquire knowledge on Gate level modeling and hardware. 5. To develop mini project using Xilinx software with different levels of modeling concepts		
Module	**Titles**	**Description**	**Hours**
I	Introduction to VERILOG	Verilog as HDL, Levels of Design Description, Simulation and Synthesis, Test Benches, Keywords, Identifiers, , Comments, Numbers, Strings, Logic Values **Simulation by using Xilinx software tool** Basic programming with top-down and bottom up approach models (Hands on Session)	7
II	Data flow level Modeling	Introduction, Continuous Assignment Structures, Delays and Continuous Assignments, Assignment to Vectors, Operators with combinational circuit programs **Simulation by using Xilinx software tool** Hands on for Half and full adder,multiplexer,encoder,decoder.	7
III	Behavioral Modeling	Introduction, Operations and Assignments, Initial Construct, Always Construct, Assignments with Delays, wait construct, Designs at Behavioral Level, Blocking and Non-blocking Assignments with sequential circuit programs **Simulation by using Xilinx software tool** Hands on for flip flops, shift register, counter	7
IV	Gate level Modeling	Introduction, AND Gate Primitive, Module Structure, Other Gate Primitives, Tri-State Gates, Array of Instances of Primitives with example programs and FPGA **Simulation by using Xilinx software tool** Hands on Gate level modeling programs and FPGA trainer implementation	7
V	Looping concepts with example programs and **Mini Project Submission**		7
		Total Instructional Hours	35
Course Outcome	**After successful completion of the course the students will be able to** CO1: Analyze the Basic programming concepts using verilog HDL CO2: Design and simulate the Data flow modeling programming with combination logic circuit concepts CO3: Design and the behavioral flow modeling programming with sequential logic circuit concepts CO4: Analyze the gate level modeling with Xilinx software and implement in FGPA trainer CO5: Design the mini projects using Xilinx software		

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TEXTBOOKS:
T1- Samir Palnitkar, "Verilog HDL", Pearson Education, 2nd Edition,2003
T2- J. Bhaskar, "A Verilog Primer", BSP, 2nd edition 2003.

REFERENCEBOOKS:
R1 - T.R. Padmanabhan and B. Bala Tripura Sundari, "Design through Verilog HDL", WSE, IEEE Press 2008

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	2	-	-	3	-	-	3	3	3
CO2	3	3	3	3	3	2	-	-	3	-		3	3	3
CO3	3	3	3	3	3	2	-	-	3	-	-	3	3	3
CO4	3	3	3	3	3	2	-	-	3	-	-	3	3	3
CO5	3	3	3	3	3	2	-	-	3	-	-	3	3	3
AVG	3	3	3	3	3	2	-	-	3	-	-	3	3	3

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Programme	Course Code	Name of the Course	C
BE	22VAEC02	**Embedded Systems Design with ARM Cortex and STM32 Microcontrollers**	0

Course Objective	1. To Understand microcontroller architectures and peripheral interfacing. 2. To Develop embedded C programs for STM32 microcontrollers. 3. To Analyze GPIO, ADC, and DAC interfacing techniques using APIs. 4. To Implement timer functions and their applications in embedded systems. 5. To Create projects using STM32 and Arduino platforms, incorporating various peripherals.

Unit	Description	Instructional Hours
I	Microcontrollers, peripherals, buses- Bus architecture, types of buses, ARM architecture, ARM Cortex M Processor, STM32 controllers Architecture. Embedded C programming for STM32C103	9
II	GPIOs- embedded C programming and usage of datasheet for designing, types, interfacing GPIOS-- referring to the datasheet, selection of GPIOs, interfacing GPIO using APIs, Hands-on interfacing GPIOS. Hands-on training on interfacing GPIOS- – referring to the datasheet, selection of GPIOs, interfacing GPIO using APIs.	9
III	ADC- Embedded C Programming, usage of datasheet for designing, Hands-on Session- interfacing ADC using APIs with potentiometer. DAC- Embedded C Programming, usage of datasheet for designing, Hands-on Session - interfacing DAC using APIs.	9
IV	Timers- types of timers – specification and selection of timers, interfacing timers – using APIs. Hands-on training on interfacing timers – referring to the datasheet, selection of timers, interfacing timers using APIs.	9
V	Hands-on interfacing of peripherals in Arduino-GPIO, ADC using Arduino IDE. Interfacing GPIO, ADC in STM32. Hands-on Session: Interfacing of peripherals with Arduino-timers using Arduino IDE. Interfacing timers in STM32. Mini Project using STM32, Arduino and add-on cards	9
	Total Instructional Hours	45

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Course Outcome	**After completion of the course the learner will be able to,** CO1: Articulate the principles and applications of ARM, ARM Cortex M, and STM32 controllers. CO2: Design and implement GPIO interfaces using embedded C programming. CO3: Interface ADC and DAC with STM32 through embedded C programming CO4: Select and interface timers, applying specifications and APIs for embedded applications. CO5: Develop and integrate peripheral interfaces in mini-projects using STM32 and Arduino platforms.

TEXT BOOKS:

1. Joseph Yiu , "The Definitive Guide to ARM Cortex M3 and Cortex M4 Processors", Third, Newnes, 2014.
2. Brown, Geoffrey. "Discovering the STM32 Microcontroller." Indiana University (2016).

REFERENCE BOOKS:

1. Steve Furber , "ARM System-on – Chip Architecture", Second Edition, Addison Wesley, Pearson Education Limited, 2000.
2. Arnold s Berger , "Embedded systems Design: An introduction to Processes, tools and Techniques", CMP books, 2002.
3. Bahga A, Madisetti V , "Internet of things : A Hands - on approach", University Press, Hyderabad, 2017.
4. Bai Y , "Practical Micro Controller Engineering with ARM technology", John Wiley and Sons, 2015.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	2	-	-	3	-	-	3	3	3
CO2	3	3	3	3	3	2	-	-	3	-		3	3	3
CO3	3	3	3	3	3	2	-	-	3	-	-	3	3	3
CO4	3	3	3	3	3	2	-	-	3	-	-	3	3	3
CO5	3	3	3	3	3	2	-	-	3	-	-	3	3	3
AVG	3	3	3	3	3	2	-	-	3	-	-	3	3	3

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Percentage Revision & New Courses Introduced in the Fifteenth BoS

% revision in the syllabus (BE ECE)

S.No	Course code	Course name	% revision
		Regulation 2022	
1	22EC6301	PCB Design	10
2	22EC6254	VLSI Design	20
3	22EC6253	Digital Signal Processing	20
4	22EC4251	Control System	15

% Revision in the Curriculum

Total number of courses passed in this BOS	19(regular)+(6*3=18 Honors)+(1*6=6 Minor)+ 12 PE = 55
No. of courses revised	4
% revision in courses	20%

New course introduced

S.No	Course code	Course name	% revision
		Regulation 2022	
1	22EC2201	Electron Devices	100
2	22EC6201	Embedded Systems and IoT	100